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# **KEYNOTE LECTURE** abstracts

#### 0138

#### Minimum Intervention Oral Care - Preventing Dentistry "MI" Way!

#### Avijit Banerjee

#### King's College, London, United Kingdom

In his presentation, Prof Banerjee from King's College London, will outline the contemporary personfocused, prevention-based, team-delivered and susceptibility/needs-related minimum intervention oral care framework.

This can be used to deliver better oral health to patients and populations, across all disciplines of Restorative Dentistry, including caries management.

He will focus on outlining the preventive approaches to managing early demineralisation to reverse tissue damage caused by biofilm-mediated conditions.

He will highlight scientific and clinical evidence base for primary and secondary prevention, including remineralisation.

#### 0330

#### One Adhesive, one Shade, one Cement - Is This Possible?

#### Jose Ignacio Zorzin

Operative Dentistry and Periodontology, University Hospital of Erlangen, Erlangen, Germany

A central aim in everyday clinical practice is to optimize treatment processes. This optimization not only simplifies and makes the processes more reliable but also significantly enhances their cost-effectiveness



for both practitioners and patients.

In restorative dentistry, this can be achieved by reducing the number of individual, material components, e.g., through single-bottle adhesive systems that can be used in total or self-etch mode, composites with a reduced color palette or even just one color, or luting composites that can be used with a multi-step adhesive as well as self-adhesive. Due to their versatility, they are referred to as universal materials. This lecture will delve into the practical application of these universal materials using real-life clinical examples. These examples will be discussed in light of the available literature, aiming to answer the question: 'One adhesive, one colour, one cement: Is that possible?'

#### 0363

#### Periodontal Regeneration: From Biology to Clinical Application

Anton Sculean

#### Periodontology, University of Bern, Bern, Switzerland

The ultimate goal of reconstructive/regenerative periodontal therapy is the complete restoration of tissues lost due to periodontitis or trauma with tissues that are structurally and functionally identical to the original. Translational research, as the name suggests, "translates" research findings from laboratory experiments into clinical applications to improve the outcomes of various treatment procedures. The transfer of basic research to clinical application requires in vitro laboratory experiments, followed by studies in animal models to determine the safety and early-stage effectiveness of new technologies. Ultimately, the findings must be validated in clinical settings, including case series and randomized controlled clinical studies.

Using a cross-linked formulation of hyaluronic acid (xHyA) as an example, the lecture will illustrate how findings from in vitro and animal studies can contribute to a better understanding of the biological processes involved in periodontal wound healing/regeneration and how these findings can be translated into clinical applications to improve the outcomes of reconstructive/regenerative periodontal procedures. This comprehensive approach should serve as a model for the development of novel, substantive biological concepts aimed at enhancing the outcomes of periodontal and peri-implant nonsurgical and surgical therapies, ultimately leading to an improvement in the quality of life for our patients.

# **ORAL PRESENTATIONS** abstracts

0098

# Implant Surface Characteristics Affect Macrophage Polarization, Modulating Osteoblast Mineralization

<u>BENEDETTA GHEZZI<sup>1, 2</sup></u>, Ludovica Parisi<sup>3</sup>, Ottavia Cannatella<sup>1</sup>, Gerardo Nigro<sup>1</sup>, Francesca Rossi<sup>2</sup>, Edoardo Manfredi<sup>1</sup>, Simone Lumetti<sup>1, 2</sup>

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**Objectives** Successful osseointegration of dental implants relies on an intimate crosstalk between immune cells and osteoprogenitors. We hypothesized that the characteristics of the implant surface might be important to modulate the polarization of macrophages, thus contributing to the creation of a micro-environment favorable to osseointegration. The aim of this study was to investigate how various implant surfaces modulate the activation of human macrophages, and how the released cytokines affect osteoblast differentiation.

**Methods** Human monocytes (THP1) were seeded on four different dental implant surfaces: hydrophobic or hydrophilic sandblasted acid-etched titanium (SLA and SLA+), and hydrophobic or hydrophilic sandblasted acid-etched mixed titanium(85%)/zirconia(15%) (R and R+) surfaces. The release of proinflammatory interleukins (IL) 6 and 8, as well as of the anti-inflammatory IL4 and IL10 was studied by qRT-PCR and cytokine arrays. Subsequently, MG63 osteoblast-like cells were culture under osteogenic condition with THP1 conditioned medium. MG63 mineralization was assessed after 21 days by Alizarin Red staining.

**Results** R-like surfaces showed to promote the release of pro-inflammatory cytokines compared to the SLA counterparts. *Vice versa*, the SLA-like surfaces supported the release of the anti-inflammatory cytokines. The increased hydrophilicity for both SLA and R surfaces reduced the release of pro-inflammatory cytokines compared to the hydrophobic surfaces, while it did not show any effect with regard of the anti-inflammatory cues. Overall, the SLA+ surface markedly reduced the release of IL6 compared to SLA, R and R+ surfaces. IL6 is a potent pro-inflammatory cytokine, which is known to inhibit osteogenesis. Accordingly, mineralization of MG63 was stronger when THP1 cells were cultured on the SLA+.

**Conclusions** Taken together, these data prove that the type of implant surface affects the activation of immune cells, which consequently regulate the behavior of osteoprogenitors.

0099

#### Association Between Patient-Reported and Clinician-Reported Outcome Measures at Implant Sites

Sofya Sadilina, Nicolas Müller, Franz Strauss, Ronald E. Jung, Daniel S. Thoma, Stefan P. Bienz

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**Objectives** The present systematic review aimed at answering to the following PICO question: « In patients with single implant-supported crowns (in the aesthetic region) (P), are patient-reported outcome measures (PROMs) (E) associated with clinician reported outcome measures (ClinROs) (C) in terms of esthetics (O)?».

**Methods** Following an a-priory protocol, an electronic search was conducted in PubMed, CENTRAL, Scopus, Embase and Web of Science up to August 10, 2023 to identify studies on healthy patients with an implant-supported crown in the esthetic region. Only randomized controlled trials evaluating both PROMs and ClinROs were assessed for incluson. Corresponding authors of the included articles were contacted by e-mail and were asked to provide the raw data on PROMs and ClinROs. The outcome measures regarding esthetics were extracted, pooled and correlations between mean ClinROs and PROMs were assessed using the Pearson correlation coefficient using a statistical software (Stata version 18. College Station, TX: StataCorp LLC).

**Results** The search identified 3075 titles after removing duplicates. Twenty-five unique studies reporting on 1240 patients with 1240 implant-supported crowns were included. A significant positive correlation was found between PES and patient satisfaction regarding aesthetics reported by VAS (r=0.41; R<sup>2</sup>=0.17;



p=0.02). Similarly, a positive significant correlation was found between WES and the aesthetics results reported by the patients (r=0.53; R<sup>2</sup>=0.28; p=0.02). Conversely, no correlation was found between PES and patient overall satisfaction measured (r=0.18; R<sup>2</sup>=0.03; p=0.25) or WES and patient overall satisfaction (r=-0.03; R<sup>2</sup>=0.00; p=0.82). No other distinguishable associations patterns, for example in buccal soft tissue dehiscence, between specific types of PROMs and ClinROs were observed.

**Conclusions** Randomized clinical trials evaluating patient-reported outcome measures regarding esthetics show a positive correlation with clinician-reported outcomes as the pink esthetic score in patients with single implant-supported crowns.

#### 0100

#### Green Bone: Guided Bone Regeneration in Osteoporosis

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**Objectives** The repair and treatment of large bone defects in patients with compromised bone metabolism due to ageing and medical conditions such as osteoporosis present often a clinical challenge. Therefore adjunctive methods to enhance bone healing are needed. The aim of the study was to promote bone regeneration using functionalised scaffold with Rhamnogalacturonan-I pectins (RG-I) *in vitro* and *in vivo* using aging and osteoporotic rodent models.

Methods The biomaterials were poly(l-lactide-co-ɛ-caprolactone) scaffolds and the RG-I was from potato. The chemical and physical properties of functionalised biomaterials with RG-I nanoparticles were characterised using confocal and atomic force microscopy. Functionalised scaffolds with RG-I (tested sample) were evaluated in vitro with human osteoblasts from osteoporotic patients. In vivo evaluation was performed using critical size calvaria bone defect model in ageing and osteoporotic rat models. Scaffolds were implanted randomly in the calvaria defects. The control was scaffold without RG-I. Bone formation was evaluated radiographically and histologically. The data was analysed using one-way ANOVA. Results The chemical and physical properties results indicated success of the functionalisation of scaffolds with RG-I. Osteoblasts response suggested osteogenic and anti-inflammatory properties on the scaffold functionalised with RG-I. The in vivo results in aged and osteoporotic rat calvaria model of early (2 weeks) bone regeneration showed increase of osteogenic markers and decrease of proinflammatory markers and RANKL, compared to control. BV/TV (bone volume/tissue volume) in the defect with RG-I scaffold was significantly greater compared with control in aged (8 weeks) and osteoporotic rats(2 and 8 weeks). The histological evaluation in both rat models revealed larger areas of new bone formation in RG-I scaffolds than in control. In conclusion, the plant-derived nanoparticles significantly increased osteogenic and decreased pro-inflammatory response in vitro and in vivo.

**Conclusions** These finding may have a crucial impact on bone repair process especially in elderly and osteoporotic patients.



#### 0101

# Short vs Longer Dental Implants. a Systematic Review of RCTs

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**Objectives** The aim of this systematic review was to systematically review randomized controlled trials (RCTs) that compare short implants (≤6mm) with rough surface and longer implants (>6mm) in atrophic alveolar ridge in terms of implant survival rates, peri-implant marginal bone level changes (MBL), prevalence of peri-implantitis and technical complications.

**Methods** A thorough electronic search was performed in electronic databases in September 2023. RCTs with follow-up of at least 1-year post-loading comparing the clinical outcomes of short implants with rough surfaces to longer implants in posterior jaws of systemically and periodontally healthy, partially edentulous adult subjects were considered for inclusion. The revised Cochrane risk-of-bias tool for randomised trials was used for Risk of bias assessment. Fixed-effects meta-analysis of the selected studies was applied to compare the outcome variables. Random-effect meta-analysis was performed, on the basis of within-study comparisons.

**Results** From an initial search of 3468 articles, 16 were selected for meta-analysis and incorporated 408 short implants and 475 longer implants inserted in 317 and 388 patients, respectively. The survival rates of longer implants in pristine or augmented bone were significantly increased compared to short implants (95%CI: 2%-5%, p<0.001). Longer implants displayed increased MBL -from both implant placement and loading (95%CIs: -0.17-0.04, -0.47-0.19, respectively, p>0.05)-, and prevalence of peri-implantitis (95%CI:0%-5%, p>0.05). However, the differences were not statistically significant. Concerning technical complications, no statistically significant differences were observed between short and longer implants at implant and patient level (implant-level 95%CI:-4%-6%, p>0.05, patient-level 95%CI:-21%-10%, p>0.05). **Conclusions** Short implants represent an alternative treatment option for the rehabilitation of posterior jaws to avoid additional bone augmentation procedures. However, they should be selected cautiously due to a potentially limited survival rate compared to longer implants. Particularly in cases where bone augmentation procedures are associated with reduced predictability and increased risk for complications, short implants provide a promising alternative.

#### 0103

#### Long-Term Survival of Implant-Supported Overdentures: a Nine-Year Randomized Clinical Study

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**Objectives** In many clinical cases anatomical conditions such as atrophied alveolar ridge do not allow insertion of normal diameter implants. At this point, reduced diameter implants (>3.0 to<3.5 mm) can be a sufficient solution to avoid complex surgical treatments. The aim of this trial was to evaluate long term survival, prosthetic and biological complications for two-piece reduced-diameter implants in the interforaminal region supporting overdentures with Locator attachments.

**Methods** Twenty-five patients with edentulous mandibles received four diameters reduced implantsupported dentures with Locator attachments. Following implantation, anterior implants were



immediately loaded with Locator-attachments, while posterior implants underwent conventional healing. Three months post-implantation, half of the patients received two Locator-attachments on anterior implants; the other half, received four. After three months the groups switched. From nine months on, all 4 implants in each patient were loaded. Follow-up examinations included documentation of implantrelated complications, modified gingiva index, modified plaque index, OHIP-G and radiographic measurements of bone loss.

**Results** Up to nine years after restauration eighteen patients with seventy-two implants were available for the follow-up. During the observation period, one implant was lost resulting in implant survival of 98%. The outcomes of mPI and mGI for the 18 patients ranged between of 0-2 on the scale. During the observation period 136 prosthetic complications occurred requiring aftercare measures. Frequently encountered were minor complications, such as changing retention inserts. Another 9 Locator abutments had to be replaced due to wear. Effects of the initially different loading protocols on the complication rate of the two subgroups were not found. Functional limitations, psychological discomfort and other OHIP-G domains remained low and hardly differed between the last recalls. All participants would recommend the treatment option of mandibular dentures supported by four implants.

**Conclusions** Overdentures placed on 4 interforaminal implants using Locator attachment can be recommended as long-term treatment option for the edentulous mandible. Considerable aftercare caused by predominantly minor complications has to be taken into account.

#### 0104

#### The Oral Microbiota Changes in Orthodontic Patients: Systematic Literature Review

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**Objectives** Treatment with fixed orthodontic appliances (FOA) makes patients' oral hygiene more difficult and may have an impact on the balance of oral microbiota. During orthodontic treatment there is a higher risk of white-spot lesions, dental caries, and periodontal complication because of the change in oral microbiota. The aim of this study is to analyze the oral microbiota changes in patients with FOA. **Methods** A systematic review was performed according to PRISMA statement. The search was performed in PubMed, Google Scholar, ScienceDirect. Inclusion criteria: research articles published less than 5 years ago, studies in English language. Exclusion criteria: systematic reviews, case reports or series. The risk of bias of each study was assessed using the Cochrane Risk of Bias Tool (RoB-2).

**Results** In 6 articles, 133 patients with FOA were included. The changes of oral microbiota were analyzed after 15.4 (5.8) months, before orthodontic treatment, 1 month, 3 months and 6 months after beginning of the treatment with FOA. One study found that Streptococcus mutans significantly increased during orthodontic treatment with FOA from beginning to 3 months and to 6 months (p<0.05). However, two studies did not find statistically significant results (p>0.05). In addition, two studies showed that Lactobacilli species count significantly increased after bracket bonding (p<0.05). During orthodontic treatment the colonization of Candida yeast increased, with dominance of C. albicans. Two studies showed that levels of Candida albicans in the saliva and occlusal plaque were higher but not statistically significant (p>0.05). On the other hand, one study found statistically significant count of Candida albicans in patients with FOA (p<0.05).



**Conclusions** In conclusion, orthodontic treatment with fixed appliances has an impact on the balance of oral microbiota, which might lead to the risk for bacterial and fungal related diseases.

#### 0105

#### Evaluation of Relationship Between Malocclusions and Scoliosis: a Systematic Review

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**Objectives** Scoliosis is a medical condition identified by abnormal curvature of the spine resulting in postural distortion. Idiopathic scoliosis may affect the function of the stomatognathic system due to its clinical manifestations and potential contributing factors. The objective of this study was to examine the association between different types of malocclusions and scoliosis.

**Methods** The search was conducted in databases following PRISMA guidelines. To be included, the study had to be less than 5 years ago and written in English. The risk of bias of each study was assessed using the Cochrane Risk of Bias Tool (RoB-2).

**Results** Seven studies were included, comprising 1,575 subjects aged 5-30, along with one study involving subjects aged 5-60+. Compared to healthy individuals, patients with scoliosis have greater prevalence of malocclusions, 15.9 % of patients with jaw deformity had scoliosis. Except for the absolute values (p=0.023), there was no significant correlation between the Cobb and Me angles in the actual values (p=0.606). Malocclusion patients had significantly higher prevalence of postural pathologies (fusion C2-C3, kyphosis, lordosis, scoliosis) compared to normal occlusion (p<0.001). However, in another study correlation between trunk asymmetry and sagittal jaw relationship was not significant (p=0.651). Malocclusions are correlated with chewing patterns, therefore patients with scoliosis had a considerably higher proportion of reversal cycles when chewing on both sides, both with soft and hard bolus (p<0.001). Furthermore, scoliosis patients showed significantly more asymmetric canine and molar connections, midline deviations, deep overbite, unilateral posterior crossbite, canted occlusal plane (p<0.05), anterior partial open bite (p=0.323), lateral partial cross bite (p=0.230), scissors bite (p=0.248), and higher prevalence of deviated mandible (p<0.05).

**Conclusions** Scoliosis is related to various oral health issues, including malocclusions and jaw deformities. This underscores the importance of comprehensive interdisciplinary care to address both spinal and craniofacial health concerns in patients with scoliosis.

#### 0106

#### Evaluation of TMJ Disc Displacement With MRI Based Radiomics Analysis

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**Objectives** The purpose of this study was to propose a machine-learning model and assess its ability to classify temporomandibular joint (TMJ) disk displacements on magnetic resonance (MR) T1-W and PD-W images.

**Methods** This retrospective cohort study included 180 TMJs from 90 patients with TMJ signs and symptoms. A Radiomics platform was used to extract (Huiying Medical Technology Co., Ltd, China) imaging features of TMJ pathologies, condylar bone changes and disc displacements. Thereafter, different machine learning (ML) algorithms and logistic regression were implemented on radiomic features for feature selection, classification, and prediction. The following radiomic features included first-order statistic, shape, texture, gray level co-occurrence matrix (GLCM), gray level run length matrix (GLRLM) and gray level size zone matrix (GLSZM). Six classifiers, including logistic regression (LR), random forest (RF), decision tree (DT), k-nearest neighbors (KNN), XGBoost and support vector machine (SVM) were used for a model building which could predict the TMJ pathologies. The performance of models was evaluated by sensitivity, specificity and ROC curve. The TMJ diskdisplacements were classified as; (0) Normal, (1) ADDwR, (2) ADDwoR.

**Results** A total of 90 patients and 180 TMJs (19 men and 71 women; mean age, 33.6±16.8; range between 13-79 years) were included in this study. KNN classifier was found to be the most optimal machine learning model for prediction of TMJ pathologies. The AUC, sensitivity, and specificity for the training set were 0.944, 0.771, 0.918 for normal, ADDwR and ADDwoR while testing set were 0.913, 0.716, 1 for normal, ADDwR and ADDwoR. For TMJ Disk Diplacment Large Area High Gray Level Emphasis, firstorder\_Skewness, firstorder\_minumum, RootMeanSquared, GrayLevelNonUniformity, firstorder\_Kurtosis, Long Run High Gray Level Emphasis, were selected.

**Conclusions** This study has proposed a machine learning model by KNN analysis on TMJ MR images, which can be used to TMJ disc displacements.

#### 0107

#### Mandibular Asymmetry Index in Treated Patients Affected by Temporomandibular Disorders

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**Objectives** To evaluate any changes in condylar and mandibular ramus height in adult patients affected by temporomandibular disorders (TMD) treated with an upper occlusal splint.

**Methods** This retrospective observational study included 48 patients between 18 and 70 years old diagnosed with TMD according to DC/TMD criteria. They were treated with an occlusal splint in the upper arch for about 12 months. For each patient, the digital dental models were studied to define the occlusal Class according to Angle and cross-bite. OPTs were analyzed using the Habets method to calculate the asymmetry index between the condyles and mandibular branches pre- and post-treatment with the upper occlusal splint. For the statistical analysis, the Shapiro-Wilk normality tests, t-tests, or Wilcoxon tests were used on collected data with R studio.

**Results** The sample presented the absence of dental crossbite in 62.5%, specifically, bilateral in 12.5%, while unilateral crossbite in 22.9% on the right, and 2.1% on the left side.

Condylar height showed a statistically significant difference (*p*=.022), showing a reduction in condylar asymmetry at T1. The measurement of the condylar branch, likewise, showed a statistical significance



(*p*=.037), revealing an improvement of the mandibular symmetry in the vertical direction after treatment. **Conclusions** Patients with TMD treated with an upper occlusal splint, showed a statistically significant improvement in the asymmetry index of the mandibular condyle and rami pre- and post-treatment, while no clinical differences were found regarding the occlusal characteristics.

#### 0108

# Occlusal Splint or Botulinum Toxin-a for jaw Muscle Pain Treatment: a Randomized Controlled Trial

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**Objectives** To conduct a randomized controlled trial comparing the effect of occlusal splint and botulinum toxin-A on jaw muscle pain resulting from probable bruxism.

**Methods** Sixty patients were randomly allocated into two intervention groups. The primary outcome was the reduction of jaw muscle pain assessed by the Graded Chronic Pain Scale (v2.0) (GCPS). Secondary outcomes were also assessed: Parameters of jaw opening and mandibular mobility; Distribution of muscle pain; Jaw Functional Limitation Scale–20 (JFLS-20), Oral Behaviors Checklist (OBC), and Oral Health Impact Profile-14 (OHIP-14). Multilevel mixed-effects regression models were used to analyze the data.

**Results** Fifty-nine patients (30 received occlusal splint and 29 botulinum toxin-A) were analyzed at baseline, 3 and 6 months follow-up. No differences between the interventions were observed concerning the GCPS (p=0.627), although a significant reduction was observed at 3 (IOR=13.26, 95%CI[6.61–26.59]) and 6 months (IOR=12.36, 95%CI [4.93–30.98]). Botulin toxin-A shows a lower score reduction on JFLS-20 than occlusal splint (IOR=0.29, 95%CI[0.11–0.82]). Botulinum toxin-A presented inferior results for the parameters: opening without pain (p=0.045), unassisted maximum opening (p=0.024), assisted maximum opening (p=0.041), and protrusion (0.016). An improvement in OHIP-14 scores was observed at 3 (IRR=1.08, CI95%[1.02–1.14]) and 6 months (IRR=1.10, CI95%[1.04–1.16]), regardless of intervention. **Conclusions** The findings indicate that occlusal splint and Botulinum toxin-A can effectively decrease the scores of the Graded Chronic Pain Scale, improve OHRQoL, and enhance functional outcomes in bruxist patients with jaw muscle pain. Occlusal splint demonstrated slight advantages in specific parameters.

0109

#### Covid-19 Impacts on Bruxism and Emotional Well-Being of Dentistry Students

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**Objectives** To investigate and compare emotional well-being and incidence of bruxism among first and last-year University of Tartu dentistry students pre- and post-COVID.

**Methods** Randomized sample included ten first-year and ten last-year students. Participants were clinically examined for signs of bruxism and completed a questionnaire with seven sections: general information, academic progress, sleep quality, emotional well-being, perceived stress scale, bruxism



symptoms and possible impact of COVID-19. The study was carried out in 2020 and in 2024 under analogous conditions, statistical analysis used Pearson correlation.

This study was approved by The Ethical Commitee of University of Tartu: 372/T-7.

**Results** Mental exhaustion was reported by all fifth-year students, excessive anxiety by 40% of students from each year. Nicotine and tobacco products were used by 80% of first-year and 40% of fifth-year students. First-year students prone to bruxism experienced higher emotional difficulties (r=0.774). "Probable bruxism" was present in 60% of fifth-year students, whose alcohol consumption and bruxism symptoms correlated negatively (r=-0.765). Among first-year students there was strong correlation between bruxism and several emotional parameters. In contrast, last-year students showed strong correlation between academic progress and several emotional parameters.

First-year students' emotional well-being correlated with changes in anxiety during lockdown (r=0,453), changes in ability to concentrate during lockdown (r=-0.433) and possibilities to practice a hobby during lockdown (r=0.485). Last-year students exhibited correlation between emotional well-being and living alone (r=0.562) as well as between emotional well-being and changes in anxiety during lockdown (r=-0.780).

In comparison with the initial study, general emotional well-being among dental students has deteriorated, yet symptoms of bruxism as well as sleep disorders have become less frequent. **Conclusions** Study's findings suggest that symptoms of bruxism and emotional disorders continue to occur among dentistry students. Deterioration of emotional well-being may cause academic difficulties, amplify use of nicotine and tobacco products and increase the incidence of bruxism. COVID-19 can be considered among causes of upward trend in emotional difficulties.

#### 0110

#### **Comparing Methods for Bond Strength Evaluation of Fiber Posts**

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**Objectives** To assess the differences in measured bond strength of adhesively cemented fiber posts using pull-out and push-out tests.

**Methods** Three different fiber posts were luted with their respective bonding systems: 1) Futurabond U with Rebilda DC (Voco, Cuxhaven, Germany), 2) LuxaBond Universal with LuxaCore Z dual (DMG, Hamburg, Germany) and 3) control: RelyX Unicem 2 (3M, Minnesota, USA). After post cementation, pushout samples were each sawed into 3 discs (thickness 1 mm) from the coronal, middle and apical roots third, while pull-out samples were embedded as a whole into a trigger hook for the universal testing machine. Following testing, fracture patterns were analysed using high-resolution digital microscopy. For each group additional samples were (Bruker, Billerica, USA). Statistical analysis was conducted using UNIANOVA with Tukey tests and Chi-Square tests; significance level p<0.05.

**Results** Pull-out samples bonded with Futurabond U (11.37 MPa ±2.0) revealed significantly higher bond strength compared to LuxaBond Universal (9.18 MPa ±2.2) and RelyX Unicem 2 (9.28 MPa±1.6), both p=0.03; Tukey. Push-out samples revealed significantly higher bond strength for LuxaBond Universal (23.6 MPa ±1.8) compared to Futurabond U (14.7 MPa ±1.3; p=0.000) with no significant difference to RelyX Unicem 2 (18.2 MPa ±0.2; p=0.087; Tukey). In both pull-out (p=0.006) and push-out (p=0.000; Chi-Square) samples, failure modes were significantly influenced by the material. Pull-out samples revealed more



fractures at the fiber post surface, while push-out samples revealed a variety of fracture patterns. Voids did not have a significant influence on bond strength for either test (p=0.860/0.965; Chi-Square). **Conclusions** The test method seems to influence bond strength values and fracture patterns of adhesively luted fiber posts.

0111

# Effect of Surface Treatment on Bond Strength of Fiber-Reinforced CAD/CAM Blocks

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**Objectives** The aim of the study was to compare the shear-bond strength (SBS) of conventional CAD/CAM composite (Cerasmart 270) and experimental short fiber-reinforced CAD/CAM composite (SFRC) to luting cement with different surface treatments before and after aging.

**Methods** Discs (14 mm × 18 mm × 3 mm) obtained from Cerasmart 270 and SFRC blocks were mounted in acrylic resin (Palapress Vario; Heraeus Kulzer,) and polished flat using an automatic grinding machine (Rotopol-1; Struers) with 180 and 320 grit silicon carbide papers to create a standard surface for bonding. Two surface treatment protocols were applied to surfaces of Cerasmart 270 and SFRC specimens: 1) sandblasting (SB) (n=40) and 2) sandblasting followed by a 60 sec application of hydrofluoric acid (HF) (n=40). Subsequently, luting cement (G-CEM One; GC, Tokyo, Japan) was placed on the treated surfaces. Two specimens from each material with different surface treatments were evaluated with SEM analysis. Half of the specimens (n=20) were subjected to the SBS test after 48 hours of storage in water at 37°C, while the other half (n=20) underwent the SBS test after 16 hours of aging by boiling. SBS test was performed using a universal testing machine (Lloyd Universal Testing Machine LRx; Lloyd Instruments) at a crosshead speed of 1.0 mm/min until failure occurred. The failure modes of the specimens were analyzed with visual inspection. Data were analyzed using ANOVA.

**Results** In the SB treated group, higher SBS values were obtained in the SFRC blocks compared the Cerasmart 270; aging did not adversely affect the bond strenght for both materials. When 60 sec HF acid was applied after SB, there was no significant difference between the materials (p<0.05), but SBS values decreased after aging.

**Conclusions** Sandblasting alone is sufficient for bonding SFRC to luting cement, while the addition of HF acid after sandblasting appears necessary for achieving optimal bonding with Cerasmart 270.

Aging (Surface treatment)	SFRC-CAD	CERASMART 270
Non-aged (SB)	19,973	14,370
Aged (SB)	20,728	15,505
Non-aged (SB+HF)	18,372	19,288
Aged (SB+HF)	16,844	15,113

Table1

The shear-bond strength of CAD/CAM blocks to luting cement.



# 0112

# Effect of Different Luting Protocols on Bond-Strength of Fiber-Reinforced CAD/CAM-Blocks

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**Objectives** The aim was to evaluate the shear-bond strength (SBS) of experimental short fiber-reinforced CAD/CAM composite (SFRC-CAD) and commercial CAD/CAM composite (Cerasmart 270) to different luting resins before and after hydrothermal aging.

**Methods** Discs (2mm thick) obtained from SFRC-CAD and Cerasmart 270 were mounted in acrylic cylindrical-blocks and polished flat using an automatic grinding machine with 180 grit silicon carbide papers to create a standard surface for bonding. Followed by sandblasting with aluminum-oxide and cleaning with air. Subsequently, primer (G-CEM One Enhancing Primer) with or without bond (G2 Bond) are applied on the treated surfaces. Two different luting resins were used: fiber-reinforced composite (everX Flow Bulk) and self-adhesive resin (G-CEM One). Total 16 groups determined on types of restorative material, bonding protocol, luting material and aging procedure (n=8/group). Half of the specimens (n=64) were subjected to the SBS test after 24-hour of storage in water at 37°C, while the other half underwent the SBS test after 16-hour of hydrothermal aging by boiling. SBS test was performed using a universal testing machine at a crosshead speed of 1.0 mm/min until failure occurred. The failure modes of the specimens were analyzed with visual inspection. Data were analyzed using ANOVA and Mann-Whitney U test for comparison.

**Results** No statistically significant differences in SBS between everX Flow and G-CEM One groups (p>0.05) regardless of the bond application. The SBS of SFRC-CAD+everX Flow+bond (23.2±3.6 MPa) was notably higher (p<0.05) compared to Cerasmart 270+everX Flow+bond (18.9±2.4 MPa). However, there was no significant difference observed in the similar groups with using G-CEM One.

**Conclusions** The SFRC-CAD composite demonstrated SBS values similar to those of Cerasmart 270. Additionally, everX Flow Bulk proved to be an effective luting resin, yielding results comparable to those of self-adhesive resin.

#### 0113

#### Adhesive Applications' Effect on Aged Cad/Cam Blocks Repair Bond Strength

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**Objectives** The purpose of this study is to evaluate the repair bond strength of aged resin-based CAD/CAM blocks after surface treatment and different adhesive applications.

**Methods** Two CAD/CAM blocks (Lava Ultimate and Cerasmart) were selected for the study. One hundred twenty specimens were fabricated from each block. The samples were stored in distilled water at 37°C for six months. All samples were sandblasted with aluminum oxide. Specimens were randomly divided into six groups for the following different adhesive procedures: Group 1: control group (no adhesive application); Group 2: GC universal hydrophobic bond; Group 3: GC universal adhesive system; Group 4: silane+gc universal adhesive system; Group 5: 9% hydrofluoric acid+silane+gc universal adhesive system;



and Group 6: Monobond Plus+GC universal hydrophobic bond. Repair restorations were performed with a posterior composite resin (Nova Compo HS). The specimens were stored in distilled water for one week after applying the repair composite resin. The specimens were subjected to micro shear bond strength testing at a 1 mm/min crosshead speed until failure. Data were analyzed using Kruskal Wallis and Mann Whitney U test (p<0.05). Failure types of the samples were determined by stereomicroscope. **Results** For both CAD/CAM materials, a statistically significant difference was observed between the control groups and adhesive-applied groups (p<0.05). The materials were compared, and no statistical difference was observed between the groups with adhesive applications (p<0.05). Both adhesion and cohesion fracture patterns were observed in the Lava and Cerasmart CAD/CAM samples. **Conclusions** Aluminum oxide sandblasting alone is not sufficient for repairing CAD/CAM blocks. Different adhesive applications increased the repair bond strength of CAD/CAM blocks. Except for the control group, the repair bond strength values of the Lava are significantly higher than those of Cerasmart.

# 0114

# Universal Adhesives' Influences on Adhesion of Repaired CAD/CAM Systems

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**Objectives** The aim of this in vitro study was to evaluate the influences of different universal adhesives on the repair bond strength of CAD/CAM systems.

**Methods** 90 samples (5x5x2mm) were obtained from three different CAD/CAM materials: a feldspathic ceramic (CEREC, Dentsply), a nano-ceramic hybrid (Grandio Blocs, Voco) and a lithium disilicate glass-ceramic (IPS e-max CAD, Ivoclar) (N=30). Each CAD/CAM samples were randomly divided into 2 subgroups according to types of universal adhesives (two-component self-cure universal adhesive: Tokuyama Universal Bond II and one-component light-cure universal adhesive: Clearfil Universal Bond Quick) (n=15). The surfaces of CAD/CAM were roughened by diamond bur. Then, orthophosphoric acid and universal adhesives were utilised according to the manufacturers' instructions. The repair procedure was completed with a nano-ceramic composite (Ceram-X Sphere TEC-One) using a cylinder-shaped mold. They were kept in distilled water at 37°C for 24h and thermocycled for 10,000 cycles(5–55°C). The shear bond strength (SBS) was evaluated with a universal test machine (crosshead speed:1 mm/min). Fractured surfaces were examined with a stereomicroscope. Statistical analysis was performed with a two-way ANOVA and Bonferroni tests (p<0,05).

**Results** In terms of restorative materials, for Tokuyama Universal Bond II applied groups, CEREC exhibited significantly highest SBS; whereas for Clearfil Universal Bond Quick applied groups, Grandio Blocs showed significantly highest SBS (p<0,05). Comparing the adhesive systems, for CEREC and IPS e-max, Tokuyama Universal Bond II led to significantly higher SBS than Clearfil Universal Quick Bond. However, for Grandio Blocs, there were no significant differences in SBS between both adhesives (p>0,05). Stereomicrocope analysis determined that increased number of cohesive and mixed failures were observed for CEREC and IPS e-max, when Tokuyama Universal Bond II was applied.

Conclusions For repair procedures of feldspathic ceramic and lithium disilicate glass-ceramic, two-



component self-cure universal adhesive caused significantly greater bond strength than one-component light-cure universal adhesive.

#### 0115

#### Fracture Toughness of CAD-CAM Materials/Implant Ti-Base Interface

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Objectives To evaluate the interfacial fracture toughness (IFT), after aging or not, of Ti-base material bonded to four different classes of ceramic and composite CAD-CAM materials. Methods High translucent zirconia (Katana; KAT), lithium disilicate-based glass-ceramic (IPS. emax; EMX), polymer-infiltrated ceramic network material (Vita enamic; ENA), and dispersed filler composite (Cerasmart 270; CER) were cut into equilateral triangular prisms (6.3 ±0.2 mm) to be bonded to titanium prisms with identical dimensions using a self-adhesive composite cement (Panavia SA Cement Universal). The surfaces were pre-treated following the manufacturers' recommendations. IFT was determined using the Notchless Triangular Prism test in a water bath at 36°C before and after thermocycling (10,000 cycles) (n=40 samples/material). Weibull analysis was carried out. Developed interfacial ratio (Sdr) measurements and SEM analysis of pre-treated surfaces were also performed. Results The IFT of materials ranged from 0.82± 0.24 to 1.10± 0.21 before thermocycling and from 0.71 ± 0.24 to 1.02 ± 0.25 after thermocycling. Statistical differences were only found between the IFT of CER and the two top performers in each scenario (KAT and EMX before aging; KAT and ENA after aging). Thermocycling only significantly decreased the IFT of EMX (-16%, p=0.033). Before thermocycling, there was no statistical difference in the Weibull modulus of IFT of the different groups and the influence of thermocycling on the Weibull modulus was insignificant. Sdr measurements showed significant differences between the different groups with ENA (7.60)>Ti (4.97)>CER (2.85)> KAT (1.09)=EMX (0.96). Conclusions CAD-CAM materials do not exhibit equal bonding properties to Ti-base material, which could be explained by their specific surface properties after pretreatment and/or their chemical affinity with the composite cement. IFT of Li-Si glass-ceramic group was more affected by aging than other materials, while surface roughness, and then cement micromechanical bonding potential is lower.

# 0122

# Ethical Challenges of Artificial Intelligence for Smile Design

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**Objectives Purpose**. Dental softwares are increasingly usin Artificial intelligence (AI) for smile design. However, using AI raises numerous technical and ethical concerns that are currently not discussed. This study aims to identify and evaluate these ethical issues.

**Methods Methods.** An international consortium of dental experts specialized in AI was engaged to formulate ethical challenges raised by the use AI for smile design. An e-Delphi protocol was secondly used to obtain an agreement of the ITU-WHO group on key ethical principles related to the use of AI (Wellness, Respect for autonomy, Privacy protection, Solidarity, Governance, Equity, Diversity, Expertise/prudence, Accountability/responsibility, Sustainability, and Transparency). Each principle included examples of ethical challenges that patients and practioners could encounter when using AI for smile design.

**Results Results.** On the first round of the e-DELPHI, 28 participants agreed that seven items should be considered in smile design (diversity, transparency, wellness, privacy protection, prudence, law and governance, and sustainable development), but the remaining four items (equity, accountability and responsibility, solidarity, and respect of autonomy) were rejected and had to be reformulated and resubmitted. After this second round, participants agreed to all items.

**Conclusions Conclusions.** This work first emulated and proposed possible AI Ethics challenges when practitioners and patients use AI for smile design. Following a Delphi protocol, 11 items were emulated, and agreement was obtained. This work paves the way to further development of AI softwares and still open the discussion of how we can act for more trustworthy AI in dentistry.

#### 0123

# Machine Learning vs. Deep Learning for Tooth Wear Analysis

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**Objectives** This study aims to compare the efficacy and explainability of machine learning (ML) and deep learning (DL) techniques in reconstructing the anatomy of upper central incisors, particularly in cases of tooth wear, to enhance digital smile design.

**Methods** A dataset of permanent maxillary incisor teeth was collected from three universities and categorized based on the degree of alteration of the incisal surface. ML and DL approaches were employed to learn and simulate tooth shapes. ML approaches were based on a combined approach of isotopological remeshing with principal component analysis, while DL approaches were based on the learning of Deep Signed Distance Functions. The performances of both approaches were evaluated using five anatomical features: tooth volume and length, external surface, tooth inclination and root/crown angle. Distances between initial and reconstructed shapes were also compared. Explainability was assessed through feature contribution analysis for ML approaches.



**Results** Among the 345 STL files collected, 285 were included in the dataset. The shapes were learned for ML and DL approaches with a maximal Euclidian distance inferior to 0.3 mm. For the ML approach, the first five modes of shape variations represented 70.9% of the overall shape variability in the population. The surface and volume of the tooth could mostly be explained by the variations in the mode 1. Regarding the simulation of intact teeth, DL presented significantly more precise and accurate reconstructions compared to ML, with differences observed in surface, volume, and maximal distance (p < 0.05). **Conclusions** Overall, our comparative analysis underscores the potential of DL as a robust and accurate tool for digital smile design, particularly in addressing challenges associated with tooth wear. However, further research should focus on refining DL models and integrating explainable AI methodologies to ensure transparency and foster trust among clinicians and patients.

# 0124

# Smartphone-Generated 3D Facial Images: Reliable for Cleft Patient Assessment?

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**Objectives** To evaluate the validity and reliability of smartphone-generated three-dimensional facial images (SGI) for routine evaluation of the oronasal region of cleft patients by comparing their accuracy to that of direct anthropometry (DA) and 3dMD.

**Methods** Eighteen soft-tissue facial landmarks were manually labelled on each of the 17 (9 males and 8 females; mean age 23.3 ± 5.4 years) cleft lip and palate (CLP) patients' faces. Two surface imaging systems, *3dMDface* and *Bellus3D FaceApp*, were used to perform two imaging operations on each labelled face. Subsequently, 32 inter-landmark facial measurements were directly measured on the labelled faces and digitally measured on the 3D facial images. Statistical comparisons were made between SGI, DA, and 3dMD measurements.

**Results** The SGI measurements were slightly higher than those from DA and 3dMD, but the mean differences between inter-landmark measurements were not statistically significant across all three methods. In terms of clinical acceptability, 16% and 59% of measures showed differences of  $\leq$ 3 mm or  $\leq$ 5°, with good agreement between DA and SGI and 3dMD and SGI, respectively. A small systematic bias of ± 0.2 mm was observed generally among the three methods. Additionally, the mean absolute difference between the DA and SGI methods was the highest for linear measurements (1.31 ± 0.34 mm) and angular measurements (4.11 ± 0.76°).

**Conclusions** SGI displayed fair trueness in contrast to DA and 3dMD. It exhibited higher accuracy in the orolabial area and specific central and flat areas within the oronasal region. Notwithstanding this, it has limited clinical applicability for assessing the entire oronasal region of CLP patients. Ideally, SGI should accurately encompass the entire oronasal region for optimal clinical use. In terms of clinical significance, SGI can be considered for macroscopic oronasal analysis or for patient education where accuracy within 3 mm and 5° may not be critical.



#### 0125

#### Effect of SLM Platform Placement Orientation on RPD Framework Fit-Accuracy

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#### Objectives

The aim of this study was to compare RPD framework fit accuracy following variable placement orientation (PO) on an SLM building platform and stabilizing bar addition.

#### Methods

A custom RPD framework CAD was performed on a digitised (Trios-3 intraoral scanner, 3Shape™A/S, Copenhagen, Denmark) 3-D printed single experimental prototype resin-model of an edentulous maxilla bearing three custom 3D geometric tooth-form shapes. Co-Cr fine powder alloy (Mediloy S-Co, Bego, Germany) was processed through SLM (TruPrint Series 1000, Trumpf, Germany) into framework samples (n=24) by dividing into 3 building platform PO groups (n=8: Horizontal[H], Diagonal[D], Vertical[V]), further divided into 2 subgroups each (n=4: With stabilizing-bars[B], without bars[NB]). Qualitative/quantitative fit-evaluation was then performed for all samples following virtual framework-to-model seating utilizing a previously developed custom digital protocol and a free inspection software (GOM-Inspect,2018-Hotfix5,Rev.115656, GOM GmbH, Braunschweig, Germany). Mean fitting distances were calculated from 220 equidistant vertical framework-to-model measuring locations per sample and groups were statistically compared (p=0,05, ANOVA-on-ranks, Kruskall-Wallis multiple-comparisons, Bonferroni adjustment)(IBM SPSS, Version:29.0.1.0(171), USA)

**Results** PO Sub-Group medians(Q1,Q3)(mm) were: HNB: 0.150(0.140,0.164), HB:0.136(0.121,0.152), DNB:0.230(0.219,0.241), DB:0.144(0.137,0.154), VNB:0.238(0.232,0.247), VB:0.171(0.166,0.176). Pairwise comparisons indicated only the following statistically significant (p<0,05) PO Sub-Group differences: HB-DNB, HB-VNB, DB-DNB, DB-VNB, HNB-DNB, HNB-VNB.

#### Conclusions

Preliminary results indicate that:

1. PO is important with Horizontal having the least negative impact on RPD framework fit accuracy regardless of stabilizing bar presence followed by Diagonal and Vertical.

2. Diagonal RPD framework fit accuracy can be significantly improved via bar addition.

3. No effect is expected on RPD framework fit accuracy when combining bars and Vertical PO.

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#### 0126

#### Comparative Study: Evaluating Intraoral Scanning Systems for Subgingival Anatomy

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**Objectives** This study conducted a comprehensive comparative analysis of three intraoral scanners (CEREC Primescan, TRIOS, CEREC Omnicam) and a lab scanner (inEosX5) assessing their precision in simulating subgingival tooth preparations

**Methods** Utilizing a dental simulation mannequin with a 3D-printed Teflon structure, 100 structures with depths ranging from 0.5 to 4.0 mm were created within a square mimicking a rectangular tank surface. Four scanner groups (A-D) and five subgroups were established. Two digitization methods, a customized parallelometer and an intraoral simulation, were applied, ensuring a standardized scanning sequence. Trueness was evaluated by comparing CAD-calculated surface areas with actual dimensions, and qualitative trueness analysis was conducted using MeshLab. Surface areas were computed using the formula SA = 2lw + 2lh + 2wh. Statistical analyses, including Pearson's correlation coefficient, Kolmogorov–Smirnoff and Levene's tests, three-way ANOVA, and paired sample t-tests, elucidated relationships and differences (a=0.05).

**Results** A robust correlation (r = 0.850, p < 0.001) between intraoral scanner choice and scanned area depth was found. Inverse correlations were noted for experimental methods. Three-way ANOVA demonstrated significant scanner-depth interaction (F(12,760) = 760.801, p < 0.001).

**Conclusions** Emphasizing high-resolution sensors and advanced technologies, the study underscores the optimal choice for subgingival digitization, acknowledging variations among scanners.

Group	Acquisition Technology	Powdering	Software version	Manufacturer
Primescan	High-resolution sensors and short wave light with optical high frequency contrast analysis for Dynamic Deep Scan	No powder	CEREC 5.1.8	Dentsply Sirona
Trios 3	Confocal microscopy ultrafast optical sectioning	No powder	TRIOS Design studio 2022.1	3Shape A/S
Omnicam	Active triangulation (multicolor stripe projection)	No powder	CEREC 5.1.8	Dentsply Sirona
inEos X5	Digital light stripe projection	Yes	inLab 22.2.0	Dentsply Sirona

Technical characteristics of the scanners systems used.



#### Deep Learning Utilization in Forensic Identification From Children's Orthopantomograms

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**Objectives** The first objective of this research was to develop and test deep learning(DL) models that can detect and properly identify and number teeth from orthopantomograms(OPGs) in humans with mixed dentition. The second objective was to compare various available models and evaluate the potential directions for further development in image recognition DL models.

**Methods** The research used 598 OPG images of subjects between 6 and 16 years. Some images were excluded due to low contrast, poor visibility of anatomical structures and artefacts. Teeth were marked in the form of a square that framed each individual tooth. The marked portions were divided into a training group and a test group. The training group was presented to the convolutional neural networks with the exact type of the tooth according to FDI notation. 2 models were developed and compared in order to explore the potentials of different available DL models.

The first model ran it through a 44 channel ResNet18 neural network.

The second model ran them through a 5 layer Yolov8 neural network. Additionally, we investigated the feasibility of categorizing teeth without considering left and right properties. Given the symmetric nature of teeth in these quadrants, we augmented the number of images to determine if a larger dataset would yield improved results. Deciduous incisors were excluded due to insufficient number of present teeth. **Results** The first neural network had a precision rate of 90,44%

The second neural network model accurately identified the teeth in images with an average precision of 90,75%, while in the additional experiment with the second network, the accuracy increased to 91,53%. **Conclusions** Both models effectively distinguished between deciduous and permanent teeth and correctly labelled them with high precision. The model based on Yolov8 architecture had slightly better precision. Based on prior studies, and received results it is inferred that a larger dataset would yield even more favourable results. Both architectures are applicable and there is no preference in further network development. The significance of this approach lies in its ability to analyse a large volume of OPGs within seconds, enabling the quick narrowing down of potential matches and expediting the forensic identification process, particularly in mass disaster scenarios.

#### 0128

#### Yolov5 Based Detection and Enumeration of Teeth on Bitewing Radiographs

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**Objectives** To build YOLOv5 based a deep learning model for detection and enumeration of teeth and validation of the diagnostic performance of model

**Methods** The dataset consisted of 3491 anonymised bitewing radiographs exported in jpeg file format acquired randomly using various intraoral phosphor plates with different sizes and resolutions. Ground truth labeling was performed in CranioCatch annotation software by 2 oral radiologists .Experts were instructed to draw minimum-size boxes around each tooth (including the entire crown and root) and label each box using the FDI two-digit numbering system.All images have been resized to 224x224 pixels. The



3491 anonymized bitewing images were randomized into training, validation, and test sets of 2792, 367, and 332 radiographs respectively. The proposed AI model approach for classifying bitewing radiographs as left or right trained with YOLOv5. Confusion matrix was used to calculate sensitivity, precision, and true positive and false positive/negative values to examine the performance of the algorithm. **Results** Sensitivity and Precision were 0.9940 and 1, respectively, for the classifying task. In addition, the predicted F1 score was 0.99970, demonstrating a favorable balance between recall and precision. On the right side, the IDF1 score was 89%, with a confidence of 0.73. The mAP for all classes was high, accurately modeling 90.9% with a 0.5 threshold. On the left side, the IDF1 score was 89% with a confidence level of 0.37. The mAP for all classes was high, accurately modeling 91% detections with 0.5 thresholds. **Conclusions** On bitewing radiographs sometimes different areas of the teeth cannot be completely reflected. This situation leads to a reduction in the detection ability of the model. However our study shows that CNN algorithms can be very accurate and effective for detection and teeth enumerations.

# 0129

# Assessing Language Models in Dental Education for Accuracy and Consistency

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**Objectives** The aim of this study was to evaluate and compare the performance of various language models in the context of dental education.

**Methods** Four language models were evaluated: ChatGPT 3.5 (OpenAl), ChatGPT 4 (OpenAl), Claude 3 (Anthropic) and the open model Mistral AI. The procedure sheets of the CNEOC (Collège National des Enseignants en Odontologie Conservatrice) were used to design a first set of 428 multiple choice questions (MCQ). The questions were answered and classified by two experts depending on their category (emergencies, restorative procedures, disinfection, etc.). Accuracy was assessed by comparing the differences between the expert's responses and the response given by each language model. Consistency was assessed using two metrics: robustness (the ability to provide identical responses to paraphrased questions). The context understanding was also evaluated based on the model's response to the appropriate category for each question. Finally, the lexicon of endodontic terms of the AAE (Association of American Endodontists) was used to create a secondary set of 539 questions and the accuracy was assessed as the ability to predict the correct term when given its definition.

**Results** The more advanced models (Claude 3, ChatGPT4) demonstrated significantly higher accuracy in answering the MCQs compared to the simpler models (ChatGPT3.5, Mistral AI), but the robustness was low for all models. All performances for defining terms and for context understanding were high, except for Mistral AI.

**Conclusions** While advanced language models demonstrate high accuracy and potential for dental education, their limited robustness necessitates caution in educational use. To improve performance, future studies should explore the integration of additional resources.



# Performance of the natural language models

Feature	Chat GPT3.5	Chat GPT4	Mistral Al	Claude 3
Accuracy	57%	71%	44%	72%
Robustness	71%	67%	50%	63%
Lexicon	76%	77%	56%	78%
Category	89%	89%	31%	98%

#### 0130

# Effect of Saliva Contamination on Immediate Repair of Composite Resins

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**Objectives** To evaluate the effect of different surface treatment techniques on the bond strength between composite resin layers during the addition of new composite resins after abrasion of freshly cured composite resins with a diamond bur, under conditions with and without saliva contamination. **Methods** Disc-shaped samples were prepared from Tetric N-Ceram Bulk Fill. The disks were subjected to repair procedures immediately after formed. All samples were abraded with a flame-tipped diamond bur. They were then divided into 4 groups (n=12) according to the applied surface treatments: 1-Noncontaminated SE Bond without primer (NCSEB), 2- Noncontaminated Asit+ SE Bond without Primer (NCASEB), 3- Saliva Contamination + SE Bond without Primer(SCSEB), 4- Saliva Contamination + Acid + SE Bond without Primer(SCASEB). Following the surface treatment, a composite cylinder block was created on the surface of the disc-shaped composite samples with the same composite resin used. The prepared samples were kept in distilled water at 37 C for 24 hours. Then shear bond strength (SBS) test was performed. Data were analyzed using one-way ANOVA and Tukey's multiple comparison test (p < 0.05).

**Results** Mean bond strength values of the groups: NCSEB: 22.28±8, NCASEB: 18.71±4,5 SCSEB:12.92±4,2 SCASEB:13.67±4,9. The difference between groups 1 - 3 and groups 1-4 was found to be statistically significant. (p< 0.05)

**Conclusions** Saliva contamination after bur abrasion reduces bond strength. Applying acid before bonding did not increase bond strength in both contaminated and uncontaminated groups.

#### 0131

#### Adhesive's Effect on 24-Hour Bond Strenght of Bioactive Materials

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**Objectives** This in vitro study evaluated the effect of universal adhesive on 24-hour shear bond strength (SBS) of bioactive restorative materials to dentin.

**Methods** Totally 70 sound human molars were used and flat midcoronal dentin surfaces were obtained. They were randomly divided into 5 groups according to restorative materials [two bioactive materials- one alkasite/CN: Cention N (Ivoclar Vivadent) and a dual-cure bulk-fill composite/AC: Activa BioACTIVE Restorative (Pulpdent) and one conventional composite-nanohybrid/EP: Estelite Posterior Quick (Tokuyama Corp.)] and presence of universal adhesive/UA: G Premio Bond (GC Corp.) (n=14). 1)Group EP (control); 2)Group CN; 3)Group CN+UA; 4)Group AC; 5)Group AC+UA. Universal adhesive was utilised with self-etch mode. Restorative materials were applied using a cylinder-shaped mold according to the manufacturers' instructions. All samples were stored for 24 h at 37 °C and then subjected to SBS test using a universal testing machine (AGS-X Shimadzu Corp.) (crosshead speed:1 mm/min). Failure modes were evaluated under a stereomicroscope. Two-way analysis of variance (ANOVA) and Bonferroni tests were used for statistical analysis(p<0.05).

**Results** Group EP (control) showed statistically higher SBS than other tested groups. (p<0.05). In terms of restorative materials, no significant differences in SBS were detected between Group AC and Group CN(p>0.05). Besides, Group AC+UA showed similar SBS to Group CN+UA(p>0.05). Regarding the presence of adhesive system, Group AC+UA and Group CN+UA exhibited statistically higher SBS than Group AC and Group CN(p<0.05). Stereomicroscope analysis revealed that a higher number of mixed failures were observed for Group AC+UA and Group CN+UA than Group AC and Group CN. **Conclusions** The use of universal adhesive might be beneficial for 24-hour bond strength of bioactive restorative materials to dentin.

#### 0132

#### Ability of Direct Restoratives to Withstand Contamination and Dentin Alteration

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Objectives The aim of this study was to monitor the ability of different categories of direct restorative materials to adapt to clinically relevant conditions such as contamination or dentin alteration. Methods Bonding to saliva contaminated, decontaminated and altered tooth substrates (artificially hypermineralized, demineralized) were investigated and compared with clinically ideal conditions of sound, non-contaminated dentin substrates. A total of 300 human dentin specimens were randomly allocated into 15 groups (n=20) and restored with: 1) self-adhesive resin-based composite (Cention Forte/CF), 2) resin-modified glass ionomer cement (Fuji II LC/FJLC) or 3) an experimental conventional glass ionomer cement (EXP). Decontamination was implemented by rinsing followed by reapplication of cavity conditioner/primer. Shear bond strength (SBS) was performed after 1 week of storage in distilled water at 37°C and followed by fractographic and reliability analysis. Statistical analysis was performed by one- and two-way analysis of variance, Games-Howell post-hoc test ( $\alpha$ =0.05) and Weibull analysis. Results Categories of contamination and dentin alteration were separately evaluated in comparison to sound dentin. (Table) The univariate analysis confirmed a significant influence (p<0.001) of the analyzed parameters: contamination ( $\eta_p^2$ =0.085), dentin alteration ( $\eta_p^2$ =0.553), and material ( $\eta_p^2$ =0.675;  $\eta_p^2$ =0.656). Post-hoc analysis identified no significant difference in SBS of each material with contamination, however significant reduction with demineralization. SBS of FJLC and EXP were only affected by demineralized



substrate (p<0.001; p=0.004). CF exhibited significant increase with hypermineralization and decontamination (p=0.008; p=0.026). Bond reliability decreased in demineralized substrate groups for all materials. Predominant failure of CF was adhesive, while mixed failures were also observed for EXP and FJLC.

**Conclusions** CF performed better under all tested conditions compared to FJLC and EXP. Demineralization of the dentin substrate had a highly detrimental effect, although saliva contamination was tolerable for all materials.

Shear bond strength (SBS) in MPa (mean ± standard deviation), Weibull modulus (m) with 95% confidence interval in brackets for each group. Different lowercase letters in each row and uppercase letters in each column within category indicates significant differences in SBS.

		CF		FJLC		EXP	
		SBS (MPa)	m	SBS (MPa)	m	SBS (MPa)	m
Contamination	Sound	19.7±7.7 <sup>Ba</sup>	2.6 (2.4; 2.9)	8.8±4.3 <sup>Ab</sup>	1.6 (1.4; 1.8)	4.9±2.8 <sup>Ac</sup>	1.8 (1.6; 1.9)
	Cont.	16.6±5.6 <sup>Ba</sup>	3.5 (3.1; 3.9)	6.2±4.2 <sup>Ab</sup>	1.4 (1.3; 1.5)	5.0±2.6 <sup>Ab</sup>	2.1 (1.9; 2.4)
	Decont.	25.7±5.9 <sup>Aa</sup>	5.2 (4.7; 5.8)	7.2±5.4 <sup>Ab</sup>	1.4 (1.3; 1.5)	5.5±2.8 <sup>Ab</sup>	1.6 (1.4; 1.8)
Dentin alteration	Sound	19.7±7.7 <sup>Ba</sup>	2.6 (2.4; 2.9)	8.8±4.3 <sup>Ab</sup>	1.6 (1.4; 1.8)	4.9±2.8 <sup>Ac</sup>	1.8 (1.6; 1.9)
	Hyper	26.8±6.3 <sup>Aa</sup>	4.9 (4.1; 5.6)	9.9±4.5 <sup>Ab</sup>	1.5 (1.2; 1.8)	4.6±2.1 <sup>Ac</sup>	2.2 (2; 2.4)
	Dem.	5.3±3.4 <sup>Ca</sup>	2 (1.8; 2.2)	0.8±0.8 <sup>Bc</sup>	1.1 (1; 1.2)	2.5±1.4 <sup>Bb</sup>	1.3 (1.1; 1.5)

# 0133

# Impact of Immediate Versus Delayed Dentin Sealing on Bonding Effectiveness

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**Objectives** To evaluate the effect of immediate (IDS) versus delayed (DDS) dentin sealing on the microtensile bond strength ( $\mu$ TBS) of CAD-CAM composite adhesively luted onto dentin.

**Methods** Upon sandblasting (29 µm alumina, Velopex), silanization (Clearfil Ceramic Primer Plus, Kuraray Noritake) and non-cured adhesive application ('C-SE2'; Clearfil SE Bond 2, Kuraray Noritake), CAD-CAM



composite slabs (Katana Avencia, Kuraray Noritake) were adhesively luted (AL) onto bur-cut dentin using composite (Clearfil AP-X, Kuraray Noritake) following 8 protocols:  $_1$ 'DDS\_LCadh': C-SE2 light-cured (LC) on dentin prior to AL;  $_2$ 'DDS\_prov': temporary restoration, 2-week saliva storage, C-SE2 LC, AL;  $_3$ 'DDS\_noLCadh': C-SE2 (non-LC), AL;  $_4$ 'Pulpless\_noLCadh': = DDS\_LCadh except having filled the pulp chamber with composite (non-vital tooth);  $_5$ 'IDS\_non\_contamin': C-SE2 LC, flowable composite (Clearfil Majesty Flow High, Kuraray Noritake), sandblasting, phosphoric-acid etching, C-SE2 (non-LC), AL;  $_6$ 'IDS\_water': = IDS\_non\_contamin but 2-week water storage before AL;  $_7$ 'IDS\_water': = IDS\_non\_contamin but 2-week water storage before AL;  $_7$ 'IDS\_water': = IDS\_non\_contamin but 2-week saliva storage;  $_8$ 'IDS\_provisional': = IDS\_non\_contamin but IDS covered with temporary restoration, 2-week saliva storage. After one-week immersion in distilled water, half of the specimens were cut for µTBS testing and the other half submitted to 1,200,000 chewing cycles, subsequently cut into  $\mu$ -specimens and submitted to 10,000 thermal cycles before being tested. Light-microscopy fracture analysis ('adhesive interfacial failure', 'cohesive failure in dentin', 'cohesive failure in composite', 'mixed failure') of all specimens was performed, followed by SEM fracture analysis of selected specimens. Data were analyzed using 2-way ANOVA and Tukey ( $\alpha$ =0.05).

**Results** No  $\mu$ TBS was recorded for DDS\_noLCadh (all pre-testing failures or PTF). Significantly lower  $\mu$ TBS was recorded for Pulpless\_noLCadh. The  $\mu$ TBS of aged IDS\_saliva was significantly lower than that of the protocols with the highest  $\mu$ TBS recorded. No significant decrease in  $\mu$ TBS was recorded upon aging. **Conclusions** Light-curing the adhesive separately before bonding improved  $\mu$ TBS. IDS did not improve bonding effectiveness as compared to DDS.

#### 0135

# Thirty Months Clinical Evaluation of 10%DMSO Primer in Carious-Cervical-Lesions

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**Objectives** FDI-criteria for evaluation of the restoration were used in this randomized clinical trial to evaluate the effect of 10% DMSO/H<sub>2</sub>O application before etch and rinse adhesive on the durability of carious-cervical-lesions' (CCL) restorations.

**Methods** 80CCLs met the criteria for inclusion. Prior to bonding, cavities were treated with (37% H3POO4), for 15-seconds followed by 15-seconds rinse. Both study groups received bonding with Single-Bond2 (3M-ESPE) and restoration with Z350XT nanohybrid-composite (3M-ESPE) under rubber-dam isolation. In intervention group, solution of 10% DMSO/H2O was applied for 60-seconds, followed by air-drying after etching and before adhesive application. Assessment of the restorations was conducted at baseline, 12-months, 24-months, and 30-months using the FDI-criteria for evaluation. Statistical analyses involved the use of Kolmogorov-Smirnov and Shapiro-Wilk tests to assess data normality. Categorical data were summarized using percentages, and the Wilcoxon test with a significance level of P=0.05 was utilized for comparisons.

**Results** Biological properties (secondary-caries, postoperative-hypersensitivity), Functional properties (retention, marginal adaptation), Aesthetic criteria (staining) were evaluated by two assessors after randomization and blinding. Biological and Aesthetic properties were significantly better in intervention group after 30months (p>0.05). Functional properties showed no significant difference between the two groups at all follow-ups (p>0.05).



**Conclusions** 10%DMSO Primer improved the durability of etch and rinse adhesives, which were used to bond composite restorations to CCLs. Longer follow-ups should be evaluated in the future.

#### 0136

#### Bond Characteristics of Dual-Cure Self-Adhesive Resin Cements on Eroded Dentin.

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**Objectives** Bond characteristics of dual-cure self-adhesive resin cement to human dentin exposed to erosion have been rarely investigated. The purpose of this study was to evaluate the bond characteristics on eroded dentin of three different dual-cure resin cements using shear bond strength test and observe the ultrastructural changes on the cement-dentin interface.

**Methods** Sixty dentin surfaces from caries-free human teeth were collected and randomnly divided in two main groups. Thirty dentin samples were exposed (two times daily for 10 minutes) to a solution of hydrochloric acid (2,5mmol/l), simulating dental erosion, for a period of 14 days, while the other thirty samples were maintained in artificial saliva. All samples were then bonded with one of three dual-cure resin cements: SpeedCem Plus (SCP), Bis-Cem (BC) and Rely-X U200 (RXU2). An immediate share bond strength (SBS) test was undertaken and the interface of the bonded specimens was examined by Scanning Electron Microscopy and Atomic Force Microscopy.

**Results** The SBS test of SCP to eroded dentin exhibited the highest values, while the bond of BC and RXU2 was significantly lower (p<0.05). The SBS significantly differ between eroded and non-eroded (healthy) dentin groups (p<0.05), with reduced values on dentin exposed to erosion. An interdiffusion zone was observed in all groups, however, the morphology of the bonded interface had variations among the tested cements and eroded vs. non-eroded dentin samples.

**Conclusions** Bonding interface characteristics to both eroded and non-eroded dentin differed among the cements evaluated. SpeedCem cement provided the most reliable shear bond strength and was best able to adapt the erosion challenge.

#### 0137

#### Profilometry of Dental Enamel After Femtosecond Laser Irradiation

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**Objectives** Femtosecond lasers release optical pulses lasting mere femtoseconds, usually spanning from a few to hundreds of femtoseconds. These lasers concentrate energy within an extremely brief time frame per pulse, resulting in remarkably high peak powers beyond the capabilities of continuous wave lasers. The aim of our study is to explore the consequences of femtosecond laser light exposure on dental enamel.

Methods The enamel of two freshly extracted healthy human molars were subjected to irradiation with



Laser - Pharos model Ph2-10-1000-02-H0-B (LightConversion UAB, Lithuania), with bi/burst mode and automated harmonic generator, operating at three wavelengths - 1030 nm, 515 nm and 343 nm. The maximum output powers were 10 W, 5.9 W and 2.8 W respectively. The operating pulse widths are 170 fs at 1030 nm, 130 fs at 515 nm, and 110 fs for 343 nm. The output powers of the laser radiation at all wavelengths with which the samples were treated was finally attenuated by internal power control, giving possibility to set the appropriate value in order to have equal power densities on the objects. The effects of the treatment were studied with the help of microscope ZEISS LSM 900 with Airyscan 2, resolution - lateral (XY) down to 120 nm, axial (Z) 350 nm. Profilometric images were used to obtain, access, and compare topographical data from the irradiated surfaces.

**Results** The 3D profilometric analyses of irradiated enamel show surface roughness. No evidence for significant differences of the ablation effects on the treated dental enamel between the studied wavelengths were found in any of the three directions. The amount of removed tissue by the femtosecond laser irradiation is small. Carbonization on enamel is not evident.

**Conclusions** Besides the detected changes on the treated dental enamel and because of the limitations of this study, future investigations are needed to explore different parameters of femtosecond lasers effects by profilometric techniques on the hard dental tissues.

#### 0145

#### Universal Self-Adhesive Cements - Degree of Conversion and Contact Angle

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**Objectives** The aim was to investigate the influence of curing mode (dual or self-cure) and storage time (24 h and 60 d storage) on the degree of conversion and contact angle of universal self-adhesive resin cements.

**Methods** The universal self-adhesive resin cements RelyX Universal (RXU, 3M) and G-CEM ONE (GCO, GC) were investigated. The conventional resin-luting composite Variolink Esthetic DC (VLE, Ivoclar) served as the control. For the degree of conversion (DC) and contact angle (CA), cylindrical samples (diameter x height, 8 mm x 2 mm) were prepared from each material under dual (n=6 per material, 20s light-curing at a minimum of 870mW/cm<sup>2</sup>) or self-curing (n=6 per material) and stored in artificial saliva at 37°. After 24h and 60d of storage, the degree of conversion was measured by FTIR-ATR spectrometry (IRAffinity-1S with QATR-S, Shimadzu), and the contact angle using the sessile drop method (DSA 30, Krüss).

**Results** One-way ANOVA did not reveal statistically significant differences in DC between RXU ( $24h_{setf-cure}$  70,44±9,09%,  $60d_{setf-cure}$  74,08±7,20%) and GCO ( $24h_{setf-cure}$  64,92±3,55%,  $60d_{setf-cure}$  71,18±2,50%) in self-cure after 24h and 60d (p>0.05). In dual-cure, RXU ( $24h_{dual-cure}$  79,44±2,85%,  $60d_{dual-cure}$  81,12±3,24%) had a significantly higher DC than GCO ( $24h_{dual-cure}$  62,93±9,86%,  $60d_{dual-cure}$  71,37±4,41%) and VLE ( $24h_{dual-cure}$  57,15±1,36%,  $60d_{dual-cure}$  56,78±2,96%), independently of the storage time (p < 0.05).

One-way ANOVA showed that after 24h, regardless of the curing mode, VLE had significantly lower CA compared to RXU and GCO (p<0.05). After 60d, independently of curing mode, the CA of RXU and GCO decreased and were significantly lower than those of VLE (p<0.05, table 1).

Conclusions The initiator systems of the universal self-adhesive resin cements under investigation are



capable of sufficient polymerisation in both curing modes. The decrease in CA after storage can be a result of increased hydrophilicity, which has to be further investigated.

# Contact angle (CA)

Curing mode	Storage time	Material	CA [°] ± SD
Self-cure	24h	VLE	65.86 ± 9.73 B
		GCO	95.38 ± 16.26 A
		RXU	110.94 ± 12.42 A
	60d	VLE	69.96 ± 3.44 A
		GCO	56.74 ± 5.51 B
		RXU	58.97 ± 8.11 B
Dual-cure	24h	VLE	69.09 ± 4.44 C
		GCO	103.37 ± 5.39 A
		RXU	94.33 ± 6.53 B
	60d	VLE	73.49 ± 4.17 A
		GCO	55.83 ± 3.16 C
		RXU	63.50 ± 4.51 B

Mean contact angle (CA) [°] and standard deviation (SD) of materials under investigation. Capital letters indicate homogenous subsets (Tukey HSD, significance level  $\alpha$ = 0.05) within the same storage time (24h or 60d) and same curing mode (self or dual-cure).

# 0146

# New Understandings of the Complexities of Filler-Polymerisation Interrelationship

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**Objectives** The variability of resin matrix and filler type, size and quantity can lead to inconclusive results when testing commercial composites. In this study, experimental nanohybrid composites with systematically varying filler content are used to investigate their effects on eleven polymerisation-related parameters. The functionality of novel methods, micro-CT and optical photothermal infrared spectroscopy (O-PTIR), is also evaluated.

**Methods** Five experimental dental composite materials were prepared with a Bis-GMA/TEGDMA resin matrix and increasing amounts of micro- and nanofillers (55-75 wt%). The degree of conversion was assessed using Fourier transform infrared spectroscopy (FTIR) and O-PTIR. Micro-CT was used to analyse volumetric shrinkage and a custom-designed linometer was used for linear shrinkage. The light transmission was measured with a MARC spectrometer. Spearman correlation analyses correlated the investigated parameters.

**Results** With increasing filler content, degree of conversion, maximum polymerisation rate, polymerisation shrinkage and maximum polymerisation rate decreased. The time to reach the maximum shrinkage rate was more than twice as long as the time to reach the maximum polymerisation rate. Volumetric shrinkage consistently showed higher mean values than linear shrinkage in most groups. Degree of conversion and volumetric shrinkage decreased with increasing depth of cure. The filler content had strong negative correlation with degree of conversion by FTIR ( $r_s$ =-.89, p<.001) and O-PTIR measurements at 2 mm depth ( $r_s$ =-.70, p<.001), volumetric ( $r_s$ =-.70, p<.001) and linear shrinkage ( $r_s$ =-.88, p<.001) as well as the maximum shrinkage rate ( $r_s$ =-.85, p<.001). Light transmittance correlated only moderately with the filler content ( $r_s$ =-.50, p=.005), and weak correlation was found between transmittance and other parameters.

**Conclusions** The intricate relationship between filler content and polymerisation-related parameters underlines the importance of studying their spatial and temporal evolution for the design and analysis of dental composite materials. The integration of micro-CT and O-PTIR techniques offers new insights into the polymerisation behaviour of composite materials.

#### 0147

#### Properties of Dental Composite With Biosafe Bisguaiacol-Based Monomers From Wood

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**Objectives** Bisphenol-A dimethacrylate (BisGMA) is the main matrix monomer in resin-based composites (RBCs) but contains Bisphenol-A (BPA) as monomer backbone. Elution of BPA from RBCs raises public concern. The KU Leuven bio-based platform of bisguaiacols synthesized biosafer BisGMA analogues. This study aimed to measure the degree of conversion (DC), elastic modulus (EM), flexural strength (FS), including fractographic analysis, and Knoop hardness (KH) of composites, containing either novel BPA-free BGPGMA or BGFGMA, or BisGMA (control). The in-house prepared experimental composites differed



for the abovementioned monomer and further contained 14.85wt% TEGDMA, 0.06wt% camphorquinone and 0.24wt% EDMAB (photo-initiator system), and 70wt% silanated barium-borosilicate glass filler. **Methods** Twenty-two one-sided mirror-polished bar-shaped specimens were prepared to measure (1) DC using micro-Raman spectroscopy at the time points 'uncured', 30 min, 2 hrs, 72 hrs and 1 week after lightcuring, (2) EM using an impulse excitation technique, (3) FS using four-point bending, including fractographic analysis by SEM, and (4) KH using a micro-hardness tester. Statistical analysis involved One-Way ANOVA and Tukey's multiple comparisons test (p<0.05).

**Results** DC of the BGPGMA and BGFGMA composites (81.8% and 80.8% at 1 week, respectively) was significantly higher than that of the BisGMA composite (78.9% at 1 week). For all composites DC increased significantly to flatten out after 72 hrs. No significant difference in FS and IET was recorded among all three composites, with FS ranging around 105 MPa and IET around 14 GPa. For all composites, fracture initiated approximately for 1/3 of the specimens either at the surface, at a matrix agglomeration or at an air bubble. The composites significantly differed for KH (lowest KH measured for BGFGMA [56.4 kg/mm^2]), except for the BGPGMA (61.6 kg/mm^2) versus BisGMA (59.1 kg/mm^2) composite. **Conclusions** BGPGMA and BGFGMA resulted in promising composite properties, by which both BPA-free monomers appear promising novel biocompatible BisGMA alternatives.

# 0148

# Dental Composite With Silanized Nanofiller Providing Anti-Bacterial Potential

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**Objectives** Although dental composite is routinely used in daily dental practice, composite restorations have a relatively short lifespan and are vulnerable to caries recurrence. This study aimed to design and prepare experimental composites with anti-bacterial potential based on nanoparticles that can release antibacterial molecules upon gradual surface wear.

**Methods** Large-pore mesoporous silica (MSN-SiO<sub>2</sub>) was loaded with the antibacterial agent cetylpyridinium chloride (CPC). Non-silanized nanoparticles and nanoparticles silanized with two silane bifunctional monomers (dimethyloctadecyl[3-(trimethoxysilyl)propyl]ammonium chloride; 3-(trimethoxysilyl)propyl methacrylate), being referred to as CPC@MSN-SiO<sub>2</sub> and S\_CPC@MSN-SiO<sub>2</sub>, were investigated by micro-Raman spectroscopy (µRaman) and powder X-ray diffraction (XRD). To determine surface area and volume of the nanoparticles, N<sub>2</sub> adsorption-desorption isotherms were collected by a gas adsorption analyzer. Thermogravimetric analysis (TGA) was used to determine CPC-loading and nanoparticle-silanization degree. Different concentrations (0-20wt%) of CPC@MSN-SiO<sub>2</sub> and S\_CPC@MSN-SiO<sub>2</sub> were added to conventional silanized barium-borosilicate glass filler, prior to being mixed into an existing experimental BisGMA/TEGDMA resin-matrix formulation to achieve a final 70wt% filler loading. Multi-species oral biofilms were grown on experimental composite discs for 24h and 96h, upon which the bacterial viability was analyzed by qPCR. Flexural strength was measured using four-point



# bending.

**Results** µRaman/XRD confirmed successful CPC-loading of MSN-SiO<sub>2</sub>, as was confirmed by detection of the CPC-specific pyridine-ring. Weight loss due to decomposition of organic substances of about 18.2wt% for CPC and 3wt% for silane was recorded by TGA. qPCR showed significant inhibitory effects of experimental composites incorporating 20wt% S\_CPC@MSN-SiO<sub>2</sub> on *S. mutans* and *S. Sobrinus*. No significant difference in flexural strength between a 20wt% S\_CPC@MSN-SiO<sub>2</sub> and control (containing pure 70wt% barium-borosilicate glass filler) composite was recorded.

**Conclusions** The developed experimental composites incorporating novel functional S\_CPC@MSN-SiO<sub>2</sub> nanofiller revealed promising antibacterial potential against cariogenic bacteria, which could extend the clinical lifespan of adhesive composite restorations.

#### 0149

#### Response of Differently Structured Polymer-Based Composites to Increasingly Aggressive Aging

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**Objectives** It is hypothesized that the way polymer-based composites (composits) are structured and cured may have an impact on the way they respond to aging.

Methods A polymer-ceramic interpenetrating network material (Vita Enamic, VE), an industrially polymerized (Brillinat Crios ST, BC), and an in situ light-cured composite with discrete inorganic fillers (Admira Fusion5, AF5) were selected. A total of 308 parallelepiped shaped specimens (18/2/2 mm<sup>3</sup>) were either cut from CAD/CAM blocks (VE, BC) or condensed and cured in white POM molds. Specimens (n=22) were subjected to 4 different aging conditions: a) 24 h storage in distilled water at 37°C; b) thermal cycling (TC) for 10,000 cycles 5/55°C; c) TC followed by storage in a 75% ethanol/water solution (EtOH) for 72h; and d) TC followed by an 3 week demineralization/remineralization cycling (DRC). CAD/CAM samples were also measured dry before the aging process. Three-point bending tests, quantitative and qualitative fractography, instrumented indentation tests (IIT), SEM and reliability analyzes were used. Uni- and multifactorial ANOVA, Tukey's post hoc test, and Weibull analysis was performed for statistical analysis. **Results** A multifactorial analysis indicates a significant (p<0.001) and very strong effect of the material on the measured properties ( $\eta P^2 > 0.9$ ). VE exhibited two to three times higher elastic moduli and hardness parameters compared to BC and AF5, which were comparable. Strength was highest in BC but was accompanied by high beam deformation. The effect of aging was comparatively smaller and was more evident in the IIT parameters, e.g. indentation modulus ( $\eta P^2=0.574$ ), hardness (0.504), creep (0.341) than in the flexural strength (0.289) and modulus (0.170). Reliability was high (m>15) in VE, BC and regardless of aging protocol, while it was significantly reduced in AF5 following protocols b-d.

**Conclusions** Degradation occurred in all materials, which responded to the aggressive aging conditions with a deterioration in the measured properties of less than 10% compared to the initial situation.



#### 0150

#### Enhancing Pmma Properties: Nano Graphene, Boron Nitride Impact in Vitro

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**Objectives** The aim of the study was to characterize the efficacy of loading nanographene oxide (nGO) and boron nitride (BN) alone and in combination on the physical, chemical, and mechanical properties of PMMA. The objectives were to fabricate the neat and modified specimens. Then characterize them with spectroscopy and microhardness and contact angle analysis.

**Methods** Four different groups were prepared, including the control group (G1).2.5 wt% nGO was added to the liquid component (G2), 1 wt% boron nitride was added to the powder component (G3) and 2.5 wt % nGO with 1 wt % BN combined (G4.) The resulting nanocomposite were characterized using microhardness and compressive strength analysis, contact angle analysis and degree of conversion was calculated using Fourier Transform Infrared spectroscopy. Statistical significance was done using Kruskal-Wallis test for the microhardness, and a one-way ANOVA was conducted for the degree of conversion and contact angle measurements.

**Results** The addition of nGO (184 ± 16) (p > 0.001) significantly increased the microhardness compared to the unmodified PMMA (156 ± 15.3). Results from the contact angle analysis revealed that the incorporation of GO (84.09° ± 1.49) and BN alone increased the contact angle. However, the addition of both nanofillers enhanced the hydrophilicity (61.4° ± 2.36). The nanofillers added decreased the degree of conversion.

**Conclusions** This study explored the potential of using nGO and BN alone and in combination with PMMA in low concentrations. The addition of both nanofillers have had some effect on the physcial, chemical and mechanical properties. Higher hardness was observed when using nGO and hydrophilicity was also increase with addition of both nanoparticles. This suggests that usefullness of nGO and BN alone and in combination could serve as a promising dental biomaterials for dentures and other dental removeable prosthesis.

#### 0152

#### **Does Enamel Sealing Protect Enamel From Polishing Procedures?**

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**Objectives** The effects of abrasive surface treatments on the enamel surface after sealing the neighboring enamel surface with adhesive resins or modeling liquid were evaluated in terms of surface roughness and surface topography.

**Methods** A composite filling (2x6x2mm) was placed on 54 intact incisor human teeth along the midline, from the cervico-incisal direction. The mesial side of the teeth served as the control group, while the distal sides were used as the experimental group. The application process was as follows: One-step self-etch bond (Optibond All-In-One, Kerr) was applied to the first group, two-step self-etch bond (Clearfil SE Bond, Kuraray) was applied to the second group, and modeling liquid (GC) was applied to the third group and



light cured for 10 seconds (Valo, Ultradent).Subsequently, each group was subdivided into three subgroups.In the first subgroup, red and yellow stripe flame-shaped diamond burs were respectively applied to the tooth surface, in the second subgroup, discs (Super-Snap, Shofu) were used, and in the third subgroup, two steps rubber polishers (Clearfil Twist Dia, Kuraray) were applied.Surface roughness was evaluated using a profilometer (SJ-201; Mitutoyo) (n=5) and an AFM device (NT MDT) (n=1).The surface properties of these materials were examined using scanning electron microscopy (SEM) measurements were performed (Evo LS10, Carl Zeiss).The data were statistically analyzed.

**Results** There was no significant difference among the groups in terms of roughness (p>0.05).According to AFM and SEM images bonding residues and fewer stripes and striations were seen on the disc and rubber polisher groups in the sealed areas.Significant stripes were seen in the bur groups. **Conclusions** The results obtained suggest that the enamel sealing does not protect the enamel surface against burs.Enamel sealing was able to protect the enamel surface in other polishing processes.

# 0153

# Can Simulated Mastication Remineralise Mineral-Deficient Dentine Restored With ion-Releasing Materials?

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**Objectives** To evaluate whether simulated chewing could promote the remineralise of mineral-deficient dentine (artificial caries) restored with an experimental restorative material containing fluoride-doped calcium phosphate fillers (FDCP), in combination with a surface conditioner doped with biomimetic analogues of remineralisation.

**Methods** Standardised occlusal cavities were prepared in caries-free human molars (n:8/group), submitted to pH cycling (14 days) using demineralising (pH 4.8; 8h) and remineralising (pH 7.0; 16h) solutions, creating artificial dentine lesions. An experimental resin-based adhesive and flowable composite, containing FDCP (10wt% and 20wt%, respectively), were applied +/- dentine pre-treatment (60s) using a water-based conditioner doped with sodium-tripolyphosphate and polyacrylic acid (analogues of remineralisation). A glass-ionomer cement (RIVA SC, SDI, Australia) and a conventional adhesive/composite system (Bond-Force II/Estelite Quick, Tokuyama, Japan) were placed. 50% specimens were sectioned immediately (1.5mm slabs). The remainder were stressed in a chewing simulator [dual-movement system: vertical (3mm); horizontal (2mm) at 60 mm/s] with artificial saliva (49N, 1.6 Hz; 100,000 cycles)) and then sectioned. 4 slabs/group underwent microhardness testing along 3 parallel indentation lines (10 gf; 5s) 50 μm periodicity, up to 200 μm from the interface. The remaining 4 slabs/group were immersed in fluorescein-isothiocyanate (12h) and the dentine-material interfaces analysed using confocal scanning microscopy (CLSM). The microhardness data were statistically analysed (α=0.05).

Results The simulated mastication induced mineral diffusion and a significant increase (p>0.05) in





microhardness underneath the interfaces between 100 and 150 µm, in specimens restored with the experimental material containing FDCP with the use or the biomimetic conditioner (p<0.05). No significant sign of remineralisation (p>0.05) was observed in specimens restored with GIC or conventional adhesive/composite.

**Conclusions** Simulated chewing in artificial saliva promotes the remineralisation of artificial caries lesions in dentine when restored with the biomimetic conditioner and experimental material containing FDCP.

0154

#### Assessment of Osteogenic Efficacy of Demineralised Dentin Matrix Hydrogel

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Objectives The use of a demineralized dentin matrix (DDM) has garnered substantial importance in dentistry. This study was carried out to evaluate the osteoinductive performance of DDM hydrogel (DDMH) in comparison to nano-hydroxyapatite hydrogel (NHH) on critical-sized calvarial bone defect (CSDs). Methods Human extracted teeth were minced into particles and partially demineralized to produce DDM particles. DDM and n-HA particles were added to the sodium alginate (SA) then, dripped into calcium chloride solution to obtain DDMH or NHH. The formulated hydrogels were characterized, and cell viability was evaluated by MTT assay. Alkaline phosphatase (ALP) activity was assessed to test the hydrogel's osteogenic potential on bone marrow mesenchymal stem cells (BMMSCs). Then, two CSDs were bilaterally trephined in the calvarium of sixteen healthy rabbits, then were categorized into four groups: group 1, the defect was left empty; group 2, defects were filled with SA hydrogel; group 3, defects were treated with NHH; group 4, defects were treated using DDMH. Histological and immunohistochemical analyses were carried out to evaluate the areas of newly formed bone after 4 and 8 weeks. Results characterization of the tested hydrogels revealed that they had negative values of zeta potential and showed a porous microstructure under SEM. The viability results revealed that BMMSCs were able to grow and proliferate in the presence of either DDMH or NHH. ALP level was significantly increased in the groups treated with 50% DDMH compared to 50% NHH after 21 days in culture. In vivo, DDMH showed newly formed woven bone bridged the defect area. Osteocalcin immune expression was significantly

higher in the DDMH group in comparison to in the NHH or SA groups after 8 weeks. **Conclusions** The results showed that adding DDM to SA-hydrogel improved the osteogenesis process in rabbit CSDs. The DDMH showed noticeably higher levels of new bone formation and showed great promise for accelerating the healing process.

#### 0155

#### Evaluation of Setting Time of Chlorhexidine-Diacetate Added Glass-Ionomer Cement

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**Objectives** Many regions around the globe have limited access to electricity, water or dental facilities, thus self-adhesive materials used with the atraumatic restorative technique (ART) are suitable and affordable restorative options for them. Furthermore, a restorative material should reduce the risk of residual caries and provide an antibacterial environment. Thus, the aim of this study is to evaluate the setting time of a chlorhexidine-diacetate added glass-ionomer cement.

**Methods** Nova Glass-L (Imicryl, Konya, Turkey) glass-ionomer cement (GIC) without addition was used as a control group (group 1). Chlorhexidine-diacetate was added to the GIC at concentrations of 1.25% (group 2), 1.75% (group 3), and 2.5% (group 4). Forty-disc specimens (n=10) were prepared following the manufacturer's instructions in metal molds (8x5mm). Setting time measurements were performed with a device manufactured according to ISO 9917-2:2017 standards. A needle applying 400gr of load every 10 seconds was inserted in the molds containing freshly mixed GIC materials. When the needle tip is not visible from the other side of the mold, the setting time was terminated. The results were analyzed using ANOVA and Tukey tests (p<0.05).

**Results** 2.5% chlorhexidine-diacetate addition increased the setting time of GIC (3.25min) compared to the control group (2.8min) (p<0.05). The setting time of 1.75% (3.08min) and the other groups compared to the control was not significant. However, the difference between 1.25% (2.72min) and 2.5% additions was also found to be significant.

**Conclusions** GIC with 1.25% or 1.75% chlorhexidine-diacetate additions did not affect the setting time of the material.

#### 0156

#### In-Vitro Biomineralization Efficiency of Bioactive Resin Composites

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# **Objectives** The aim of this study is to examine the in vitro biomineralization efficacy of bioactive resin composites

**Methods** Activa BioACTIVE-RESTORATIVE (Pulpdent) and Presto (Pulpdent) were selected as bioactive resin composites. These materials were compared with MTA (Angelus) and Biodentine (Septodont), which are currently used as pulp capping materials exhibiting biomineralization properties. Extracts were obtained from samples prepared according to the manufacturer's instructions, and in addition to the undiluted extract, 1/2, 1/4 and 1/8 dilutions were prepared. The cytotoxicity was evaluated by WST-8 assay after 24 hours of extract treatment on human-derived dental pulp stem cells (DPSCs), using DMSO as the positive control and culture medium as the negative control. The ALP activity of DPSCs was assessed after 7 and 14 days of treatments. The amount of calcified nodules was evaluated using the alizarin red S (ARS) staining at day 21. Odontogenic medium was used as the control group for ALP activity and ARS staining experiments. The media were refreshed every 48 ± 2 hours. For the statistical analysis, two-way ANOVA, repeated measures ANOVA, and t-tests were used.

**Results** Activa BioACTIVE-RESTORATIVE (Undiluted) and Biodentine (Undiluted, 1/2 and 1/4 concentration) were considered cytotoxic as they demonstrated viability below the 70% threshold set by ISO10993. For all materials, greater ALP activity was observed on the 14th day compared to measurements taken on the 7th day. According to the two-way ANOVA, ranking of ALP activity was as follows: Presto > Biodentine = Negative control > Activa BioACTIVE-RESTORATIVE > Angelus MTA. In the ARS staining test, bioactive resin composites exhibited significantly lower values compared to MTA and



# Biodentine (p<0.05).

**Conclusions** Since the effects of each material on DPSCs differ, the in vitro biomineralization efficacy has not yielded a definitive conclusion in favor of any group. Further animal experiments and clinical trials of these biomaterials are necessary for clinicians to make an informed decision regarding their use.

# 0157

# Borosilicate Hydrogel: Innovations in Dental Tissue Regeneration

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**Objectives** Hydrogels have proven to be excellent scaffolds for tissue regeneration. Additionally, borosilicate glass particles have been shown to enhance the biological behavior of dental pulp cells and exhibit acellular bioactivity. In this context, the aim of this study was to assess the in vitro biological behavior of human gingival fibroblasts (HGFs) in contact with an experimental aluminum-free borosilicate glass-functionalized hydrogel.

Methods Two experimental borosilicate particles without aluminum were selected, with Biodentine® particles chosen as the control material. The morphological structure of the elaborated hydrogel based on poly (L-lysine) dendrimers (DGL), with or without experimental aluminum-free borosilicate particles (BAGs), was analyzed using Micro-Computed Tomography (µCT). Scanning Electron Microscopy (SEM) combined with Energy-Dispersive X-ray Spectroscopy (EDX) was employed to investigate the surface composition of the hydrogel compositions. Cytocompatibility with human gingival fibroblasts (HGFs) was assessed using Live/Dead<sup>™</sup> staining, and cell colonization was evaluated via confocal imaging. Additionally, Alizarin Red staining was utilized to detect and quantify the formation of mineralized nodules after 7 and 14 days of incubation.

**Results** The µCT results revealed that the addition of BAGs does not affect the hydrogel porosity, while EDX analysis confirmed the presence of BAGs particles on the surface of the functionalized hydrogel. No cytotoxic effects were observed in contact with the BAGs or Biodentine®-functionalized hydrogels, as indicated by Live/Dead staining. The presence of BAGs promoted cell proliferation and colonization of the hydrogels. Furthermore, Alizarin Red staining showed a notable increase in the number of calcium nodules in the presence of the experimental BAGs-functionalized hydrogels.

**Conclusions** The experimental aluminum-free borosilicate glass-functionalized hydrogel shows promise in enhancing the textural properties of existing hydrogels and thereby accelerating their bioactivity. These findings offer new insights into the biological behavior of experimental hydrogels containing aluminumfree borosilicate and their potential clinical application for dental tissue regeneration following further development.



#### 0158

# Smart/Stimuli-Responsive Antimicrobial System for Soft Tissue Integration

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**Objectives** Soft-tissue integration is crucial for the long-term success of dental implant rehabilitation. Our preliminary studies validated the drug incorporation method into our layer-by-layer (LbL) system on titanium (Ti) substrate. Here, we developed a stimuli-responsive film onto our LbL system with excellent *in vivo* adhesive capacity to prevent biofilm formation and to improve soft tissue seal on abutment surfaces. **Methods** Detailed multilayer coating characterization was performed by different microscopy and spectroscopy approaches to probe physical and chemical properties. The drug-delivery capacity of the LbL system was proven over 15 days. Microbiology experiments were carried out with human saliva to uncover the broad-spectrum of the drug against bacteria involved in implant infection. Additionally, the effect of stimuli-responsive film on cell behavior was evaluated by cells in monolayer and collagen matrix. Finally, the inflammatory response of degradation products and the collagen deposition by fibroblasts into the surrounding tissue, were assessed in a rat subcutaneous implantation model.

**Results** The stimuli-responsive film instability in acidic environment over time was identified through changes in roughness and wettability values. The antibacterial capacity of stimuli-responsive film was confirmed with a higher concentration of drug released at acidic pH up to 15 days. Quantitative and qualitative assessments demonstrated the non-cytotoxic effect over a sufficient period to measure the hazard potential. *In vivo* experiments revealed the absence of inflammation and confirmed an increase in collagen production in the stimuli-responsive film group compared to Ti.

**Conclusions** Stimuli-responsive film is a novel dual-function coating that promotes soft tissue seal and preserves antibacterial activity of the LbL system. Conveniently, the film discloses a slight capacity of controlling the drug release under neutral condition. From a clinical point of view, these unique properties enable the stimuli-responsive film on LbL system to be applied as a potential coating to abutment surfaces addressed to patients diagnosed with peri-implant mucositis.


#### Exploring the Bioaccumulation Potential of Monomers Through Experimental LogP Determination

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**Objectives** Hydrophobic organic compounds can accumulate across biological membranes. To explore the bioaccumulation potential of monomers commonly used in dental materials, we experimentally determined their octanol-water partition coefficient (logP) using the shake-flask method and compared it with *in-silico* computed values.

**Methods** Monomers BisEMA-3, BisEMA-6, BisEMA-10, BisGMA, HEMA, TEGDMA, and UDMA were added to the pre-saturated 1-octanol/water system. The mixture was then equilibrated for 24, 48, and 72 hours, respectively. Next, the samples were analyzed using UPLC-MS/MS and the logP value was calculated using the formula logP = log(PeakArea<sub>octanol</sub> x V<sub>octanol</sub> / PeakArea<sub>water</sub> x V<sub>water</sub>). In addition, three *in-silico* models, namely KOWWIN, ACD/LogP, and XLogP3, were used to compute the logP values. The relationship between experimental and computed values was explored using linear regression and mean absolute error.

**Results** Although there was no statistical difference between the logP values at different time points (*two-way ANOVA*, *p*>0.05), it can be considered that the final equilibrium was reached at the 72-hour time point. At this time point, the mean experimental logP values, from highest to lowest, were as follows: BisEMA10 > BisEMA3 > BisEMA6 > BisGMA > UDMA > TEGDMA > HEMA. In addition, a trend of lower experimental values than computed *in-silico* values was observed. This trend was more noticeable for more hydrophobic monomers. For BisEMA-3, -6, -10, BisGMA and UDMA, the difference between the experimental and predicted values varied by more than ±1 log unit. The mean absolute error between the experimental and computed logP was similar for all *in-silico* models; the lowest was for KOWWIN (1.38), followed by XLogP3 (1.46) and ACD/LogP (1.58).

**Conclusions** Valuable experimental logP values of monomers commonly used in dental materials were successfully determined with UPLC-MS/MS. Lower experimental values than the ones calculated are reassuring regarding bioaccumulation potential. The experimentally determined values could improve the *in-silico* models.



#### Plasma Technology to Improve the Stability of DNase-I Antimicrobial Coatings

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**Objectives** Peri-implantitis can be described as a plaque-associated pathological condition that occurs in the tissues around dental implants and can lead to treatment failure. It has been reported that more than 20% of peri-implant inflammation is one of the most common complications in dental implantology, and this problem highlights the critical need for an antimicrobial coating strategy that is covalently bound and has long-term stability. DNase I is known to be a potent anti-biofilm enzyme that degrades extracellular DNA, a component of the biofilm matrix that contributes to biofilm attachment, structural stability and increased antimicrobial resistance. Although there have been several studies based on DNase I antimicrobial coating strategies, the need for long-term stable coatings remains a challenge. Therefore, in this study, a thiol (-SH)-based surface modification strategy has been developed in which - SH groups can serve as surface reactive sites for specific covalent binding of biomolecules, resulting in long-term stability of the biomolecule coating layer. In short, we aim to provide a facile and reliable method for DNase coating on thiol functionalized titanium dental implants.

**Methods** Cold Atmospheric Pressure Plasma (CAPP) systems are emerging as a versatile technology for the creation of biofunctional structures with several advantages: reagent free, does not affect the bulk structure of the substrate, environmentally friendly.

**Results** Plasma polymerisation based thiol functionalisation of Ti substrates was achieved with a homogeneous polymer coating of approximately 35 nm thickness with higher surface free energy and hydrophilic properties. Furthermore, this interface provided increased DNase enzyme activity on the Ti substrate which end up with higher surface hydrophilicity and total surface energy.

**Conclusions** Thiol functionalisation provided stable, uniform and thicker bioactive DNase I coatings on the Ti sample surfaces with improved antibacterial activity and soft tissue cell interaction.

#### 0161

#### **Bio-Ceramic Capping Materials' Effect on Vital Pulp Therapy Success**

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**Objectives** Various materials are utilized to cap teeth and facilitate dentinal bridge formation, which effectively seals the pulp and mitigates further damage caused by deep caries or trauma. While studies have demonstrated that mineral trioxide aggregate (MTA) promotes dentinal bridge formation and maintains pulp vitality, there has been limited investigation into the in vitro and in vivo effectiveness of Biodentine. This study endeavors to conduct a controlled vital pulp therapy, specifically direct pulp capping on mouse molars, with the aim of comparing the dentinogenesis capabilities of MTA and Biodentine in mice

Methods A class I cavity was created on the first upper-right molar of mice under magnification. Pulp



exposure was performed using K-File 10. The cavity was then capped using either MTA or Biodentine. To compare the healing process, mice were sacrificed at 3, 8, 14, 28, and 56 days after surgery. The healing process was evaluated using micro-computed tomography ( $\mu$ CT), histological staining, and sequential fluorochrome injections. Additionally, the proliferation of pulp cells was assessed using EdU labeling **Results**  $\mu$ CT analysis, H&E, and Masson trichrome staining showed that Biodentine-treated mice had a more developed dentine bridge than MTA-treated mice after 28 and 56 days of recovery. Biodentine showed wider Calcein and Alizarine bands in the fluorochrome experiment than MTA, indicating that the dentine deposition rate was faster in the Biodentine group. The number of the early EdU labeled cells (label-retaining cells) was higher in Biodentine and MTA groups on day 3 and 8 **Conclusions** Our findings imply that Biodentine promotes an earlier and more developed dentin bridge than 0 MTA for the promotes an earlier and more developed dentine bridge than the Biodentine promotes an earlier and more developed dentine bridge than MTA for the promotes an earlier and more developed dentine bridge than the Biodentine promotes an earlier and more developed dentine bridge than 0 MTA -treated group after VPT

# 0162

# Capping With Calcium Silicates Induces Macrophage Differentiation to M2 Phenotype

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**Objectives** Depending on their stimulation, pulp fibroblasts have been shown to induce macrophage differentiation into M1/M2 Phenotypes. This work was designed to investigate the effect of subjecting pulp fibroblasts to a tricalcium silicate-based material on macrophage differentiation.

Methods A Calcium silicate-based material (Biodentine<sup>™</sup>) was placed in MEM medium (0.05cm2 /mL) for 24h to obtain the materials' extracts. Human pulp cells were isolated from third molars and stem cells (DPSC) were separated from fibroblasts using STRO-1 magnetic sorting. Fibroblasts were physically injured and incubated with Lipoteichoic Acid (LTA) to mimic a carious lesion. The material extract was added to these cells to simulate pulp capping. Undifferentiated macrophages (M0) were then incubated with fibroblast supernatants. M0 macrophages chemically induced into M1 or M2 phenotypes were used as controls. Secretion of pro-inflammatory TNF-α and anti-inflammatory Il-10 were analyzed by ELISA; phagocytic capacity of S. Mutans was assessed using Gentamycin protection assay. DPSCs proliferation and recruitment towards macrophage supernatants were investigated with MTT and Boyden chambers respectively.

Results Incubation of fibroblasts with calcium silicate-based material significantly decreased macrophage TNF-α secretion while it increased that of IL-10 as compared to M1 or to macrophages incubated with supernatants of LTA-treated fibroblasts. Use of the Biodentine's extracts significantly decreased macrophage phagocytic activity and DPSCs recruitment which remained comparable to that of M2. DPSCs proliferation significantly increased with M2 and with macrophages incubated with Biodentine-treated fibroblast extracts as compared to those obtained with LTA-treated fibroblasts. **Conclusions** These results show that pulp fibroblasts incubation with Biodentine™ induces macrophage differentiation into the anti-inflammatory M2 phenotype. This indicates that the calcium silicate-based material plays an important role in pulp regeneration by modulating the macrophage activity.



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#### 0163

#### Effect of Various Irrigants on Stem-Cell Behaviour and TGF- $\beta_1$ Release

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**Objectives** The aim of this study was to determine the effect of EDTA and to compare with alternative irrigants on stem-cell behaviour and TGF-  $\beta_1$  release.

**Methods** The dentin discs were randomly distributed into 7 groups. All groups were irrigated with NaOCl and then with final irrigants respectively; EDTA, citric acid, phosphoric acid, phytic acid, etidronic acid, chitosan and distilled water. Flow cytometry analysis was used to characterize stem-cells. In order to examine the effect of these irrigants on cell survival, adhesion, morphology and TGF- $\beta_1$  release; MTT test, SEM and ELISA assay were used. Kolmogrov-Smirnov test, One-way ANOVA and repeated measures of ANOVA were used for statistical analyses (P<0.05).

**Results** According to MTT analysis, there was no statistical significant difference between phosphoric acid (highest proliferation), EDTA, phytic acid and distilled water on day 3 (p>0.05), there was statistical significant difference between EDTA (highest proliferation) and the other groups on day 5 (p<0.05) and there was no statistical significant difference between etidronic acid (highest proliferation) and EDTA on day 7 (p>0.05). According to SEM evaluation, the efficiency of removing the smear layer was found to be insufficient in the chitosan and distilled water group compared to the other groups. No adverse effects of the solutions were detected in terms of cell adhesion. The presence of many different cell morphologies was demonstrated with the SEM evaluation. According to the ELISA analysis, the highest TGF- $\beta$ 1 release was observed with phytic acid on days 1, 3, and 7 (p<0.05). The highest TGF- $\beta$ 1 release was observed with the SEM evaluation is used to the other groups. No adverse effects of the solutions are detected in terms of cell adhesion. The presence of many different cell morphologies was demonstrated with the SEM evaluation. According to the ELISA analysis, the highest TGF- $\beta$ 1 release was observed with phytic acid on days 1, 3, and 7 (p<0.05). The highest TGF- $\beta$ 1 release was observed with phytic acid on days 1, 3, and 7 (p<0.05).

**Conclusions** Within the limitations of this study; etidronic acid and phytic acid have comparable results to EDTA, and these solutions can be considered as promising solutions for regenerative endodontics in the future.

#### 0164

#### Matrix Metalloproteinases Polymorphisms and Gene Expressions in Apical Periodontitis

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**Objectives** This study aimed to: (a) determine and compare the level of relative gene expression of matrix metalloproteinases (MMP)-2, -9, and their tissue inhibitor (TIMP2) in samples of AP and control healthy pulp tissues; (b) determine the frequencies of genotypes of single nucleotide polymorphisms (SNPs) in these genes in both groups; (c) determine the association of certain genotypes with gene expression levels.

**Methods** The experimental group consisted of 50 AP samples harvested after apicoectomy, while control group consisted of 50 healthy pulp samples collected from teeth extracted due to orthodontic reasons.



The level of relative gene expression was analyzed by reverse transcription and quantitative polymerase chain reaction (RT-qPCR), and genotyping for polymorphisms by restriction fragment length polymorphism analysis. Chi-square, Mann Whitney U test and logistic regression analysis were used for statistical data processing.

**Results** The relative expression level of the MMP2 and MMP9 genes were statistically significantly higher in AP than in healthy controls (P=0.011, P=0.019, respectively). There was no statistically significant difference in the genotype distribution for the examined genes between the groups. Carriers of at least one copy of the wild-type gene for both MMP2 and MMP9 polymorphisms had higher expression values of this gene than homozygous carriers of the altered genes (P=0.037, P=0.042, P=0.031, P=0.046, respectively).

**Conclusions** Matrix metalloproteinases are involved in the process of bone resorption in apical periodontitis, and polymorphisms in investigated genes change their expression in this study sample.

#### 0165

# Cryotherapy in Patients With Pulpitis: Efficacy in Postoperative Pain Management

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**Objectives** One of the most important aspects in endodontics is the management of postoperative pain in patients after a root canal treatment. One of the proposed analgesic methods, the last years, is the use of a cold solution in order to reduce the temperature of the root-canal system. If cryotherapy is effective, it can be a cheap and easy solution in reducing postoperative pain. The aim of this systematic review is to evaluate whether cryotherapy can reduce postoperative pain in patients with pulpitis after endodontic treatment.

**Methods** A search of MEDLINE-PubMed, conducted up to and including March 2024. A three-stage screening was done, in title, abstract and full-text level, by two independent reviewers. The included literature was also hand searched for relevant studies. To assess the risk of bias Cochrane Collaboration's tool was used. Meta-analysis was conducted with a random-effects and fixed-effects model depending on the heterogeneity between the studies.

**Results** Three studies involving 417 patients were included in this review and all three were included in the meta-analysis. In all three conventional root-canal treatment was performed as therapy. The overall risk of bias was low. All studies used a visual analog scale (VAS) to measure pain intensity. Patients treated with cryotherapy presented lower means of post-endodontic pain than the control group after 24 hours (mean difference =  $-0.05([-0.38, 0.27]; p=0.075, l^2=62\%)$ , 48 hours (mean difference =  $-0.04([-0.21, 0.12]; p=0.62, l^2=61\%)$ ) and 72 hours (mean difference =  $-0.15([-0.31, 0.01]; p=0.33, l^2=9\%)$ ).

**Conclusions** Based on the evidence presented in this systematic review, intracanal cryotherapy application did not significantly reduce postoperative pain 24, 48 and 72 hours after a root-canal treatment. Future clinical trials could investigate whether cryotherapy is an effective analgesic for vital pulp treatment strategies.



#### Antioxidative Potential of Dental Pulp Stem Cell Conditioned Medium

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Objectives Dental pulp-derived mesenchymal stem cells (DPSCs) are known for their rich secretion profile, with their secretome used in regenerative medicine, including bone tissue engineering. Gelatin methacryloyl (GelMA), among various biomaterials, stands out for its biocompatibility, tunability, and functionality, being often selected as a scaffolding material. Nevertheless, its curing process by high visible energy light potentially deteriorates general cell health. By using GelMA of Good Manufacturing Practice (GMP) grade, this study aimed: 1) to achieve a comprehensive understanding of the biological effects of photo-curing process on DPSCs in GelMA, with a specific focus on oxidative stress; and 2) to develop a strategy to mitigate the adverse effects by employing DPSC-conditioned medium (DPSC-CM). Methods DPSC-CM was produced by culturing cells from three donors in serum-free medium for 48 hours, followed by purification through centrifugation. Mass spectrometry-based proteomics was performed to identify the protein content, including antioxidants, in DPSC-CM. The effects of oxidative stress induced by photo-curing on encapsulated DPSCs, as well as the rescue potential of DPSC-CM, were evaluated by bulk RNA sequencing, RT-qPCR, cell kinetics assays (cell viability, apoptosis, senescence, motility, differentiation), and ex ovo chorioallantoic membrane assay. Results Following photo-curing, pathways related to oxidative phosphorylation and DNA repair were enriched in the presence of DPSC-CM, which carried 91 plausible antioxidants, while the control samples exhibited enrichment in inflammatory pathways. DPSC-CM significantly reduced the degree of cellular oxidation and stress responses post-curing, resulting in improved cell viability, growth, motility, and osteogenic differentiation, as well as fewer apoptotic and senescent cells. The deteriorated biocompatibility of freshly crosslinked DPSC-laden GelMA hydrogel was confirmed by the disrupted vasculature of chorioallantoic membranes in chicken embryos, which was prevented by the DPSC-CM. Conclusions This study demonstrates the robust antioxidative effects of DPSC-CM and its high compatibility and prominent properties for tissue engineering applications.

#### 0167

#### Induction of Endothelial-Like Phenotype of Biobank-Stored Dental Pulp Stem Cells

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**Objectives** Dental pulp stem cells (DPCSs) are shown to be multipotent, being capable of differentiating into multiple lineages including endothelial cells under a defined condition. However, endothelial profile of induced DPSCs has not been well characterised, and it is not known if DPSC stored in a biobank for a



prolonged period still maintain such capacity.

**Methods** DPSC from 3 donors, isolated and stored in a biobank for over 5 years, were revived and induced to differentiate into endothelial-like cells using 3 different endothelial induction media: EGM-2, EGM-2MV and DMEM containing with 2% FBS and VEGF 50 ng/ml. Their endothelial profile and DPSC-induced vasculogenesis were evaluated using custom-made RT-qPCR array, tube formation assay, and *ex ovo* chorioallantoic membrane assay.

**Results** After recovery, DPSCs still maintained the characteristic phenotype of mesenchymal stem cells (MSCs) including the expression of CD73, CD90, CD105 while lacking CD34, CD45, and HLA-DR. The cells were capable of differentiating into osteoblasts, adipocytes, and chondrocytes. Under endothelial induction, unexpectedly, DPSCs significantly downregulated various plausible endothelial markers including CD34, CD45, CD54, CD106, CD144. However, CD31 was highly upregulated regardless of the type of endothelial medium compared to the non-induced counterpart. Notably, the induced DPSCs exhibited functionalities resembling vascular endothelial cells with the promotion of vasculature formation.

**Conclusions** The study suggests that despite limited expression of plausible endothelial markers, the endothelial-like cells derived from DPSCs stored long-term in the biobank still maintain the capacity of endothelial differentiation with vasculogenic functionality.

#### 0168

#### A Multi-Functional Single Stem Cell-Based Microrobot for Treating Neurological Diseases

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**Objectives** Stem cell-based therapy has already been used for treating neurological diseases. However, researchers are still facing challenges of how to deliver stem cells to the target area and differentiate them into the correct type of cells. This research aims to explore a magnetically actuated single stem-based microrobot called "SCAPBOT" to deliver the stem cells from apical papillae (SCAPs) to bypass the blood brain barrier for the treatment of neurological diseases.

**Methods** The magnetic iron oxide nanoparticles (MIONs) were synthesized and then characterized TEM and SEM. After the fabrication of magnetic, oxygen generating and BDNF loaded GelMA hydrogel, the SCAPBOT was manufactured by using droplet microfluidic platform. The SCAPBOT's level of oxygen was measured by oxygen sensor meter. SCAPs were assessed for whether it has been differentiated into neural lineage by BDNF through immunostaining with antibodies to the specific neuronal marker. For investigating *in vitro* magnetic actuation, the SCAPBOT were observed with time-lapse imaging within a microfluidic channel under an external magnetic field. One image per well will be taken, with a total of 8 technical repeats per biological repeat. Data were analyzed using ImageJ with images from 3 biological repeats.

**Results** The microstructure of SCAPBOT was observed to confirm that it had a suitable shape and size. The capacity of oxygen release indicated that the CaO<sub>2</sub> was distributed among the GelMA hydrogel. Moreover, the biocompatibility of the MIONs, SCAPs viability, and cytotoxicity of microrobot showed that the SCAPBOT had a high level of viability and proliferation. Furthermore, the results of immunocytochemistry revealed that the SCAPs had expressed neurogenic biomarkers and differentiated into the neuronal lineage. The SCAPBOT could also achieve safe, effective, and controllable locomotion when it was actuated within a microfluidic channel under an external magnetic field.



**Conclusions** This research has developed a novel multi-functional SCAPBOT that can transport therapeutic stem cells such as SCAPs to a precise location, direct stem cells toward a pre-destined cell lineage, and support its survivability, proliferation, and differentiation for the treatment of neurological disorder.

# 0183

# Revisiting Stem-Cell Markers in Human Dental-Pulp and Apical-Papilla Cells

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**Objectives** To investigate CD-184 (CXCR4) as a stable surface marker of human dental pulp stem cells (hDPSCs) and stem cells from the apical papilla (SCAPs).

**Methods** hDPSCs and SCAPs were isolated using the outgrowth method from immature human third molars extracted from young, healthy patients. After isolation, the cells were cultured and passaged until P5 using DMEM + 10% FBS + 1% antibiotics/antimycotics. The expression of stem-cell surface markers, including Stro-1 and CXCR4, was evaluated by flow cytometry using two collection methods (trypsin digestion vs cell scraper). The proliferation, migration and multiple lineage differentiation capacity were tested using a battery of tests. The data was statistically analyzed using SPSS/Python using p<0.05 as statistical significance reference.

**Results** hDPSCs and SCAPs showed a high positive expression of CD73, CD90, CD105, and varying positive levels of Stro-1 and CXCR4. The hematopoietic markers CD31, CD34, and CD45 were not detected. However, the expression of CXCR4 was significantly higher than Stro-1 in both cell types (P<0.05) for both collection methods. The scrapping method yielded a significantly higher detection of Stro-1+ and CXCR4+ cells than trypsinization. On the other hand, hDPSCs and SCAPs showed similar proliferation and multi-differentiation potentials (P>0.05).

**Conclusions** CXCR4 appears to be a more specific stem cell surface marker for labeling hDPSCs and SCAPs compared to STRO-1. Moreover, the collection method significantly affects the characterization of hDPSCs and SCAPs.

# 0184

# Angiogenic Potential of a C5a-Loaded Collagen Scaffold for Dentin-Pulp Regeneration

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**Objectives** In vital pulp therapy, when a pulp capping material is used to replace the destroyed tissue, the subsequent tertiary dentin production occurs at the expense of the pulp volume. An innovative scaffold made of collagen loaded with microspheres containing Complement C5a was developed to induce dentin-pulp regeneration without pulp volume loss. Neo-angiogenesis is a major requirement for pulp regeneration. It is essential for providing the healing tissue with oxygen/nutrients and for paving the



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pathway for stem cell recruitment. This work was designed to investigate the angiogenic potential of C5aloaded and C5a-free collagen scaffolds.

**Methods** Scaffolds were incubated in MEM medium for 48 hours to obtain the extracts. Collagen concentration was quantified in the extracts using a commercially available kit based on the detection of hydroxyproline using a colorimetric method; C5a release was quantified by ELISA. The effect of the extracts on endothelial cell (HUVEC) viability and proliferation was evaluated with MTT test, while the effect on their recruitment was investigated using Boyden chambers. Additionally, HUVECs were labelled with a red fluorescent probe to investigate the scaffold colonization.

**Results** Collagen was released in the extract of all scaffolds while C5a was released only in the C5aloaded scaffolds. The extracts were not toxic to endothelial cells. Moreover, the extracts of both C5aloaded and C5a-free scaffolds significantly increased HUVEC proliferation and recruitment. However, these effects were higher with the C5a-loaded extracts. Finally, HUVECs colonized the scaffold and were visible within the collagen scaffold migrating towards the C5a-containing microspheres.

**Conclusions** These findings demonstrate an enhanced angiogenic potential of the collagen scaffold when loaded with C5a. In addition to its effect on pulp cell colonization and pulp stem cells recruitment, these results show that the new C5a-loaded collagen scaffold holds promise for a potential use in pulp-dentin regeneration without pulp volume loss.

#### 0185

#### Polymeric Nanoparticles for Chemokine Mediated Dental Pulp Tissue Engineering

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**Objectives** Small molecules like chemokines, growth factors, and cytokines can stimulate endogenous cell migration to injury sites and initiate wound healing. However, using molecules such as chemokines comes with many hurdles due to their instability, short half-life, and sensitivity to enzymatic degradation. This study aims to develop polymeric nanoparticles (NPs) for chemokine encapsulation and efficient delivery.

**Methods** Medium molecular weight chitosan (CS) was mixed with tripolyphosphate (TPP), and polymeric NPs were obtained by ionic gelation. After synthesis, these NPs were purified, treated with a cryoprotectant and freeze-dried. Then, NPs were redispersed, followed by dynamic light scattering (DLS) size and charge characterization. Chemical characterization was performed using Fourier-transform infrared spectroscopy (FTIR). Morphology and topography were confirmed with scanning and transmission electron microscopy (SEM & TEM). The effect of NPs on cell behaviour was assessed by NP incubation with dental pulp stem cells (DPSCs) for viability assessment at 1, 3, and 7 days.



**Results** The nanoparticle synthesis successfully resulted in a monodisperse solution with particles averaging a size of  $180 \pm 1.8$  nm and a polydispersity index of 0.22. The zeta potential was stable over all measurements, with an average of  $45.3 \pm 0.9$  mV. FTIR confirmed the presence of all chemical groups and successful ionic gelation, while both microscopy methods confirmed NP spherical morphology. Finally, cytotoxicity experiments confirmed their biocompatibility.

**Conclusions** Uniform and stable CS-TPP nanoparticles have been successfully synthesized. These nanoparticles have shown preliminary biocompatibility with DPSCs and will be further used for drug loading with chemokine CXCL12, allowing a unique interaction with the CXCR4 receptor expressed by DPSCs and targeting a cell-free approach for dental pulp repair and regeneration.

#### 0186

# Deciphering key Elements for Cell Homing Strategy for Regenerative Endodontics.

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**Objectives** We developed an implantable medical device to sustain blood clot formation in the root canal after endodontic preparation, a new technique for regenerative endodontics for mature teeth. To validate this approach, we aimed to understand the mechanisms underlying the endodontic regeneration through cell homing strategy using blood clot. That implies monitoring cytokine release, testing which ones are essential for PDLSCs migration and finally how PDLSCs interact to favor angiogenesis.

**Methods** We performed a cytokine array on blood clots formed in our medical device and quantitatively analyzed crucial cytokines for stem cell migration by ELISA. 2D cell migration of PDLSCs was tested to validate chemotactic effects and threshold concentrations. We designed a new 3D cell migration assay to evaluate the maximal distance of chemotaxis activation for our PDLSCs.

we evaluated PDLSCs potential to induce angiogenesis via co-culture assays. finally, we tested our cell homing strategy through ectopic transplantation in a mouse model.

**Results** Various cytokines are released by blood clot, notably PDGF BB, C5a, SDF-1, TGF beta and bFGF which appear promising for dental stem cell migration. Modification can be seen in contact with the material as an augmentation of pro-inflammatory cytokines. 2D migration assay reveals that PDGF BB significantly trigger chemotaxis. 3D migration in human collagen gel shows that diffusion of serum components above a distance of 2mm seems not to trigger cell migration anymore.

3D coculture demonstrates that the secretion of cytokines such as VEGF enables PDLSCs to guide angiogenesis.

In vivo tests are in progress and will identify tissue and vessel development using histological sections. **Conclusions** Serum facilitates PDLSCs migration and organization of a vascular network prompt to help endodontic regeneration. Even if cytokine activation of the stem cell niche via blood clot appears limited to short distances, once activated, PDLSCs serve as a relay to support regenerative mechanisms.



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#### 0187

# Pulsed-Electromagnetic Fields Protect DPSC From Oxidative Damage and Trigger Differentiation

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**Objectives** To investigate the dual potential of pulsed electromagnetic fields (PEMF) in protecting dental pulp stem cells (DPSC) from oxidative stress-induced damage and triggering differentiation mechanisms. **Methods** DPSC were treated with tert-butyl hydroperoxide (tBHP; 100, 150, or 200 mMol, 6 or 24 h duration) before or during the exposure to PEMF (2 mT, 10 min). In addition, conditioned media (CM) was obtained from naïve DPSC exposed to PEMF after 24 h from exposure. DPSC were treated with wither CM mixed with tBHP or by tBHP alone followed by exposure to PEMF. Cell viability (MTS assay) and morphology (confocal microscopy) were evaluated after 6 and 24 h after the treatments (n=3). Single-cell RNA sequencing (scRNA-seq) was carried out 24 h after exposure to PEMF to identify genes triggered by the exposure. Statistical analyses were performed with one-way ANOVA and Tukey, and global significance was preset at 5%.

**Results** tBHP decreased cell viability and induced significant changes in cell morphology regardless of the concentration and treatment duration tested. However, exposure to PEMF during and after the treatment with tBHP maintained both cell viability (> 90%) and morphology regardless of the concentration and duration of tBHP treatment tested. The scRNA-seq identified 411 genes significantly upregulated in DPSC exposed to PEMF.

**Conclusions** PEMF has the potential to protect and reverse oxidative stress-induced damage caused by tBHP and upregulate over 400 genes. The results indicate that PEMF might serve as a non-invasive method to protect pulp cells from oxidative damage and trigger differentiation for pulp regeneration.

#### 0188

# Immunohistochemical Study of Angiogenic and Antigen Presenting Cells in Pulp

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**Objectives** The purpose of this research was to analyze the role of angiogenic mechanisms in the human dental pulp as a defense response to dental caries and the presence and quantitative changes of class II antigen-presenting cells.

**Methods** In this study, we have examined 60 maxillary/mandibular premolars under 4 different clinical conditions: healthy teeth, shallow, moderate, and deep cavities. Teeth were extracted and immediately cut longitudinally; pulp tissue was extirpated and fixed in formalin for 24 hours at 4 °C. The specimens were embedded in paraffin, according to standardized laboratory procedure. Sections were cut at 5 µm thicknesses and stained by the streptavidin-biotin complex immunoperoxidase method. Cells were identified by using the following monoclonal antibodies: HLA-DR, CD68, and CD34. Wilcoxon and Mann-Whitney tests were used for statistical analysis.



**Results** In the pulp of healthy teeth HLA-DR-positive cells were distributed mainly in and around the odontoblast layer, with few CD68 positive cells located more coronary around the blood vessels and single CD34 positive cells. The number of HLA-DR, CD68, and CD34 positive cells showed an increase in teeth with shallow and moderate cavities. HLA-DR were located, for the most part just beneath the odontoblast layer. CD68 positive cells were present coronary mainly around the blood vessels, with an increased number of CD34 positive cells. A substantial change in the number of antigen-presenting and endothelial cells occurred in deep cavities, which caused aggregation of HLA-DR-positive cells and macrophages in the dental pulp corresponding to the lesion and CD34 positive cells subsequently coalesce to form solid vascular cords inside the connective tissue.

**Conclusions** Human dental pulp responds to dental caries with increased number of endothelial and antigen presenting cells. Interaction of class II antigen-presenting cells and the formation of new blood vessels plays a significant role in the defense and repair processes of the dental pulp.

#### 0189

# Comparision of Retreatment Outcome With Chlorine Dioxide and Sodium Hypochlorite

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**Objectives** The study aimed to compare the clinical and radiographic outcome of endodontic retreatment of teeth with apical periodontitis using sodium hypochlorite (NaOCl) or hyper-pure chlorine dioxide (hClO<sub>2</sub>).

Methods Twenty-five teeth were randomly assigned into two groups according to the disinfectant used. In both groups, existing root canal filling was removed and irrigated with either 0.12% hClO2 or 2.5% NaOCl as control. Root canal obturations were performed with lateral compaction at the second appointment. Patients were recalled after one year. The periapical status was scored using the periapical index (PAI) and evaluated as healed (<3), healing or un-healed (≥3). The presence of pain was assessed with visual analog scoring. The improvement in PAI was statistically compared between groups by the Mann-Whitney U Test. The difference in the proportion of the healed, healing, and unhealed cases between groups was assessed by the Chi-Square test.

**Results** Nineteen (NaOCl, n = 9; hClO<sub>2</sub>, n = 10) teeth were available at the 1-year follow-up. In the hClO<sub>2</sub> group, 21.1% of teeth were classified as healed, 26.3% as healing, and 5.3% as unhealed. In the NaOCl group, 5.3% of teeth were classified as healed, 26.3% as healing, and 15.8% as unhealed (p=0.252). The change in PAI was not significantly different between groups:  $1.8 \pm 1.03$  in the hClO<sub>2</sub> group and  $1.0 \pm 1.2$  in the NaOCl group (p=0.182). After one year, all teeth were functioning with no sinus tract, and two teeth showed pain on percussion in each group.

**Conclusions** Based on the preliminary results, the less harmful hClO<sub>2</sub> resulted in comparable healing of periapical lesions after retreatment as the gold-standard NaOCl after one year. Nevertheless, the healing trend indicates a favorable outcome for this new biocompatible endodontic irrigant solution. However, a more extended follow-up period is needed to confirm the results.



# Effect of Irrigation Protocols on Sealer Penetration Determined by Specific Fluorophore

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**Objectives** To assess the effect of sequential versus continuous chelation in root canal irrigation on the penetration depth of a calcium silicate-based sealer, mixed with a specific fluorophore dye. **Methods** Forty single-rooted teeth were selected and prepared using Reciproc R25 instruments. The teeth were randomly assigned to four groups according to the irrigation protocol used (n = 10): Root canals in the two sequential chelation groups were irrigated with plain sodium hypochlorite (2% NaOCl) during instrumentation. Subsequently, 17% EDTA was administered (2.5mL), either with a slim tip (Endo-top) or with additional ultrasonic activation (Irrisafe Ultrasonic Tip 20/25mm, 30s, 35% power). In the continuous chelation groups, root canals were irrigated using a fresh mixture of 2% NaOCl containing 9% Dual Rinse HEDP during and after instrumentation. Again, in one of these groups the final irrigant (2.5mL) was applied just with the irrigating tip, in the other group it was ultrasonically activated. Obturation in all groups was performed with Ceraseal sealer mixed with Fluo-3 dye and gutta-percha using the single cone technique. Samples were sectioned at 3 mm from the root apex and observed using one-way ANOVA. The significance level was set at p < 0.05. Student's t-test was used to compare the penetration values of the two groups within ultrasonic activation or within needle irrigation.

**Results** No significant differences regarding sealer penetration were found between sequential and continuous irrigation protocols (p > 0.05). However, penetrability results were higher in the groups with ultrasonic activation compared to needle irrigation (p < 0.05).

**Conclusions** Ultrasonic activation EDTA and a combined NaOCl/HEDP irrigant enhances sealer penetration into dentinal tubules similarly.

#### 0191

#### **Association Between Physical Activity and Dentine Caries**

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**Objectives** The objective was to assess the association between physical activity, dental caries and erosive tooth wear (ETW) among middle-aged Finnish adults. Physical activity has been shown to have positive association with general health, but its impact on oral health has been only sparsely studied, with the recent studies posing contradictory results. Current knowledge of the topic is mostly based on studies with specific study populations, such as elite athletes, children, or male conscripts, with many of these studies relying on self-reported data.

**Methods** The data (n=1964) was acquired from North Finland Birth Cohort 1966 (NFBC1966) 46-year follow-up examination conducted between 2012 and 2013. Oral clinical examination was conducted by seven calibrated dentists assessing caries (ICDAS values) and ETW (BEWE scores) status. Physical activity



was objectively measured in two-weeks' use of Polar Active recording system, and a computer-based questionnaire was conducted. ICDAS-values, BEWE-indices and the results of questionnaires and Polar Active system were categorized and analysed with cross-tabulations and multivariable logistic regression models. 95% confidence intervals [CI], Odds Ratios [OR] and p-values were calculated.

**Results** Low physical activity associated with increased dentine caries (OR 1.57, 95% CI 1.16 – 2.14). ETW associated with increase OR to dentine caries (OR 1.24, 95% CI 0.67 – 0.88). No statistically significant association was found between physical activity and ETW.

**Conclusions** In this study among middle-aged Finnish adults, high physical activity associated with lower caries prevalence. Among the same population, no connection between physical activity and ETW was found. The results are somewhat inconsistent with previous literature.

# 0192

# Root-Canal Treatment Success Evaluation With Loose Rather Than Strict Criteria

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**Objectives** To determine which of the loose or strict radiographic criteria for root-canal treatment success is most predictive of long-term *clinical* success (patient-centred).

**Methods** Loose radiographic criteria for treatment success are defined as reduction of periapical radiolucency, while strict criteria imply absence or complete resolution of periapical radiolucency. Clinical success is defined as the absence of signs and symptoms. This paper uses a similar data set and methodology as a recently published one and (Van Nieuwenhuysen et al., IEJ 2023). Briefly, data concerning the root canal treatments (N=2500) were systematically collected and prospectively followed for up to 25 years. Information was recorded among clinical, technical, radiographic and patient-related characteristics (~150 variables/treatment). The data were analysed by multivariable Cox proportional hazards model and survival curves were generated ( $\alpha$ =0.0125).

**Results** Survival probability for strict *radiographic* success decreased more rapidly than for *clinical* success, the former reaching just under 75% after 20 years, while the latter remained slightly above 85% (follow-up rate = 56.4%, mean and median follow-up times = 6.5 and 5 years, respectively). "Size of periapical bone radiolucency", corresponding to strict criteria, was not significant for *clinical* failure (p=0.0178) in the multivariate model. However, considering "favourable radiographic evolution" - corresponding to loose criteria (change to a lower size category) - instead of "size of periapical radiolucency" (strict criteria) in the multivariate model revealed high significance (p<0.0001).

**Conclusions** Based on the present results and analysis, it appears that the emphasis should be put on the *radiographic* <u>evolution</u>, which is associated with *clinical* success, rather than on the presence or <u>size</u> of the periapical radiolucency. This advocates the use of "loose" rather than "strict" radiographic success criteria, which is a form of theoretical abstraction lacking the necessary dynamics of healing processes, particularly in a patient-centered perspective.



#### Raman Spectroscopy and OCT Analysis of Dentin Remineralization Using Riboflavin

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**Objectives** Biochemical alterations within the lesion have the potential to discriminate the lesion zones. The aim of this study is to investigate the effects of calcium phosphate-containing toothpastes and 2% Riboflavin on dentin remineralization with Spectral-Domain Optical Coherence Tomography (SD-OCT) and Raman Spectroscopy.

**Methods** Ninety dentin disc specimens were obtained from caries-free extracted human molars and divided in 9 groups (n = 10). Group I: Universal bonding agent(Kerr Optibond, CA, USA) Group II: Universal bonding agent and 2% Riboflavin (RF), Group III: Functional Tricalcium Phosphate(fTCP) containing toothpaste(3M Clinpro 5000, USA), Group IV: fTCP based toothpaste + 2% RF, Group V: Calcium glycerophosphate(CaGP) containing toothpaste (R.O.C.S. Repair and Protect, Moscow) Group VI: CaGP based toothpaste + 2% RF Group VII: positive control(remineralization solution), Group VIII: negative control(deionized water) Group IX: 2% Riboflavin. The optical depth of backscattered light and calcium phosphate peak values were measured using a High Definition SD-OCT(Carl Zeiss, USA) and a Renishaw in via Raman spectroscopy(Renishaw, UK). All samples were scanned using the Anterior Segment Five-Line Raster mode of SD-OCT and mineralization depth was measured by Raman probing the symmetric valence vibration near 956 cm<sup>-1</sup> as a marker for crystallinity. Statistical analyses were performed by using One-way ANOVA, Tamhane, LSD tests. The level of significance was set at p < 0.05.

**Results** Raman analyses demonstrated that there was a statistically significant difference between the study group surfaces subjected to the pH cycling process and remineralization agents and the control group surfaces only subjected to pH cycling(p < 0.05). The mean value of Group IV that has the highest R<sup>2</sup> is 23326.2±4562.11. All study groups except Group I and Group VIII were significantly efficient in reducing optical lesion depth on dentin (p=0.001).

**Conclusions** Remineralizing agents with %2 RF have positive effects on the remineralization potential of artificial caries of dentin surfaces.

#### 0194

#### Machine Learning Algorithms for Detecting and Classifying Caries

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**Objectives** To train an algorithm to detect and classify caries by analyzing occlusal pictures. **Methods** Intraoral occlusal photographic images were acquired using a reflex camera. Caries were segmented using the LabelMe tool, after a preprocessing phase where images were oriented and cropped for data standardization. Each segmented cavity was labeled according to the ICDAS scale and the depth of the carious lesion, extracted from radiological images obtained via endoral periapical radiography using the E-D classification. From each segmented Region of Interest, radiomic features capturing quantitative shape information, pixel-level statistical information, and texture were extracted from each color channel of the image (RGB). Automatic algorithms based on Machine Learning were employed to classify healthy



and decayed teeth using these radiomic features. A robust classification pipeline was adopted, with an 80:20 dataset split into training and test subsets, and 5-fold cross-validation to train, optimize the classifiers, and perform optimal feature selection before testing on an independent test set for performance estimation.

**Results** Different Machine Learning algorithms were tested for each group of features extracted from each color channel. The best classification performance metrics yielded highly relevant results, varying according to the color channel used for feature extraction and the selected features. Accuracy ranged from 85% to 97%, sensitivity from 84% to 100%, and specificity from 87% to 100%. The accuracy appears to be significantly different compared to that which would be obtained randomly (p-value < 0.05) and furthermore, carrying out a McNemar's Test shows that there is no significant difference (p-value > 0.05) between the number of false positives and false negatives, validating the results of the classification carried out.

**Conclusions** The algorithms demonstrated high performance in detecting and classifying caries. Combining data from pictures and radiographs offers a promising diagnostic approach, potentially reducing the necessity of x-ray administration to patients.

#### 0195

#### Remaining Caries-Free, a Personal Concern: Salutogenic Experiences in Adults

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**Objectives** Studies regarding the absence of caries have only appeared in recent years and the salutogenic perspective on this is therefore an almost unexplored area. A deeper understanding of the health factors behind caries freedom could lead to better help and treatment for affected individuals as well as better support for those without caries to remain caries-free.

This qualitative study aimed to explore middle-aged individuals' experiences of positively influencing factors to remain caries-free.

**Methods** The inclusion criteria were age over 40 years and DFT=0. A strategic selection was made from the dental records from the Public Dental Health in the region of Västra Götaland, Sweden, to include informants with different backgrounds in terms of gender, age, socioeconomics, and living in urban areas or in the countryside. Invitations and information were sent after which written consents were obtained. A total of 15 individuals were included and interviewed via online meetings. The audio-recorded interviews were then transcribed verbatim, and the textual data was analyzed using qualitative content analysis with an inductive approach. The study was approved by the Swedish Ethical Review Authority (registration number 2020-04819).

**Results** To remain caries-free were by the informants described as a personal concern. The study not only showed the importance of continuity, information and good communication in dental care, but also that the transmission of information, encouragement and good dietary and oral hygiene habits with additional fluoride intake, from family and school were important. Such early engagement and care foster good routines, firmly rooted in a personal concern to oral health and a consequentialist approach that emphasizes the long-term benefits of preventive care.



**Conclusions** Being thorough and responsible seem to be personal qualities that promote freedom of caries. Experiences of gratitude and pride in managing to stay caries-free were also expressed.

#### 0196

#### Sugary and Acidic Products on Saliva: Tribological and Protein Adsorption Perspective

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**Objectives** The purpose of this study was to compare the lubrication, adsorption behaviour, and total protein concentration (TPC) of whole mouth saliva (WMS) after the consumption of fruit juice. **Methods** Apple juice (J) with pH 3.55 and 11.1gm/100ml sugar content was selected as the erosive product; water (W) was the control. Thirty-two healthy participants contributed saliva in two visits across five time points: Unstimulated saliva (US), stimulated saliva after 1 minute (SJ1 or SW1), and stimulated saliva after 10 minutes (SJ10 or SW10). Three methods were utilized: tribology with polydimethylsiloxane (PDMS) pairs for lubrication analysis, ex-vivo preparation of juice-saliva on quartz crystal microbalance with dissipation (QCM-D) to assess adsorption, and total protein concentration (TPC) quantification via Bicinchoninic acid (BCA) assay on randomly selected saliva samples (n=20 each).

**Results** Unstimulated saliva (US) initially had the lowest friction coefficient (µ) of 0.011(0.007), indicating enhanced lubrication. Stimulation with juice [SJ1: 0.045(0.024)] and water [SW1: 0.112 (0.048)] significantly reduced lubrication after one minute (p<0.05). After 10 minutes, SJ10 maintained higher frictional properties compared to SW10, indicating prolonged increase in saliva friction. Significant differences were observed within water and juice groups for immediate versus 10-minute intervention (p<0.05). Exposure to fruit juice led to significant reduction in hydrated mass of preabsorbed salivary films (US-Juice) from 23.7± 2.0 to 15.7± 0.3, restored after rinsing with buffer (US-Juice-buffer). TPC of US [1.67 (0.38) mg/ml] was significantly higher than SW1 [1.11(0.92)mg/ml] and SJ10 [1.084 (0.73) mg/ml] (p<0.05). Significant differences were observed between juice-stimulated saliva after one minute (SJ1) and 10 minutes (SJ10), similar to tribology results.

**Conclusions** Fruit juice consumption reduced lubrication, caused dehydration and mass loss, and altered TPC compared to unstimulated saliva. Differences between immediate and 10-minute interventions highlight saliva's dynamic nature, potentially impacting oral acid buffering and enamel protection, especially considering consumption duration.

#### 0197

# Titanium-Dioxide Nanotubes Reinforced Glass-Ionomers' Fluoride Release and Anti-Bacterial Properties

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**Objectives** This in vitro study evaluated the addition of titanium-dioxide (TiO<sub>2</sub>) nanotubes to a conventional glass-ionomer cement (GIC) on fluoride release and anti-bacterial properties. **Methods** A conventional GIC (Ionofil Molar, Voco GmbH) was reinforced with varying amounts of nanotubes (0.1%, 0.5%, 1% ve 2% wt) and functionalized TiO<sub>2</sub> (f-TiO<sub>2</sub>). The specimens were assigned to 9 groups: Group IM0: no addition TiO<sub>2</sub> (control), Group IM1: 0.1% TiO<sub>2</sub>, Group IM2: 0.5% TiO<sub>2</sub>, Group IM3: 1% TiO<sub>2</sub>, Group IM4: 2% TiO<sub>2</sub>, Group IM1f: 0.1% f-TiO<sub>2</sub>, Group IM2f: 0.5% f-TiO<sub>2</sub>, Group IM3f: 1% f-TiO<sub>2</sub>, Group IM4f: 2% f-TiO<sub>2</sub>. Disc-shaped specimens (5x2mm) were fabricated according to the manufacturers' instructions. Fluoride releases were tested with ion chromatography at 1st, 2nd, 7th, 14th and 21st days (n=8). Direct contact tests against *Streptococcus mutans* and *Lactobacillus casei* ATCC strains were conducted at 1st, 7th and 21st days to determine the antibacterial activities (n=5). Repeated measures ANOVA and Bonferroni tests were done for statistical analyses (p<0.05).

**Results** For all tested groups, significantly higher amount of fluoride releases were detected on 1st and 7th days. Besides, on 2nd,7th,14th and 21st days, Group IM4 (2% TiO<sub>2</sub>) and Group IM4f (2% f-TiO<sub>2</sub>) caused statistically higher amount of fluoride release than control group whereas on 1st day, there were no significant differences in fluoride release between control group and all reinforced groups. At all time intervals, a reduction in the numbers of both bacteria were found for all reinforced groups compared to control group. Particularly, a significant decrease in the number of S.mutans was observed on 21st day; while the number of L.casei statistically fell down on 7th day.

**Conclusions** The reinforcement of  $TiO_2$  nanotubes might result in differences for antibacterial activities and fluoride release of GIC at some time intervals.

#### 0177

#### Comparative Study of Primo Vascular System in Dental Tissues

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**Objectives** The existence of a lymph-associated primo vascular system (L-PVS) was first claimed by Kim in the early 1960s and was only recently confirmed by various experimental groups. Long threadlike structures floating in large-caliber lymph ducts were first observed with the dye Janus green B in the lymph ducts stemming from the lumbar nodes in the abdominal cavity of a rabbit. The current work is connected indirectly toways to obtain sufficient specimens of the L-PVS from the oral mucosa. The study will overcome the limitations that in the literature only compared the efficacies of the dyes in visualizing the L-PVS and did not uncover the biochemical mechanism for their different behaviors.

**Methods** For the detection of PVS, immuno-histochemical investigations will be performed on tissue samples from the gingiva of patients who had been removed due to inflammation. Histopathological examination of each specimen will first be performed by HE staining and PAS reaction. Then, 6 unstained consecutive sections will be mounted for immuno-histochemistry. The first section will be labeled with the antibody CD31.The following sections will be labeled with OKT3/4 (ORIGENE, clone =T19B7) CD133, and D2-40 using thefully automated Ventana Bench mark Ultra system. Evaluation of the



immunohistochemical reaction will beperformed on an Olympus BX40 microscope.

**Results** This presentation reports results for two dyes, HE staining and PAS reaction. Further, lymphatic vessels will be selectively labeled with antibody D2-40 (4th section). This labeling will provide an orientation on the specimen so that if stem cells or PVS cells can be labeled with Oct3/4 and CD133, they can be topographically assigned to the existing vascular or lymphatic system. Through the sections, we can only say using our initial results that a PVS up to now does not come to visualize and individual stem cells can be detected in the wall and surroundings of lymphatic vessels.

**Conclusions** The primo vascular system (PVS) is a very important topic of study nowadays because of their role in transport and regeneration of dental tissue and in cell migration. The PVS was detected in different organs of different animal species but not in the dental tissues. In this work, we will observe the PVS inside the dental tissues for the first time.

# 0178

# Fibroblasts Conditioned Medium Prevents Osteonecrosis in a MRONJ Mouse Model

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**Objectives** To present a mouse model which explores the interaction between bone and soft tissue after tooth extraction while receiving high dosage of Zoledronic acid

**Methods** C57BL/J6 female mice received high dosage of ZOL equivalent to the human oncologic dosage. After one week of treatment, a local infiltration of palatal murine fibroblasts conditioned medium (CM) was performed, and the first maxillary molar was extracted. Treatment with ZOL was continued for four more weeks.

Bone morphometry parameters were analyzed using µCT. Histological analysis included H&E and Masson Trichrome staining. One week after extraction bone and soft tissue were taken to proteomic analysis. Mice which were treated with ZOL and local infiltration of CM were compared to mice which were treated locally with growth medium (DMEM) and systemic PBS.

**Results** µCT revealed that mice which received systemic high dosage of ZOL showed significant increase in bone volume compared to mice which received systemic PBS. Mice which received systemic ZOL and local infiltration of DMEM showed areas of necrotic bone and almost no presence of collagen fibers. Complete healing was achieved in mice which received systemic PBS. The group which received systemic ZOL and local infiltration of CM showed newly formed bone and normal collagen deposition. Proteomic analysis showed that unique proteins essential to the normal bone healing process were found exclusively in the group which received systemic ZOL and local infiltration of CM.

**Conclusions** The interaction of the soft tissue and bone is known to be crucial to the bone healing process. This study demonstrated for the first time the ability of fibroblasts conditioned medium to induce normal bone repair during treatment with high dosage of ZOL. This may lead to develop new ways to prevent osteonecrosis after tooth extraction.



# Oral Lichen Planus Treatment: MicroRNA Linked With Cancer Risk

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**Objectives** Growing evidence suggests that the treatment of oral lichen planus could differently influence the reduction of key biomolecular mediators linked with early risk of oral cancer development. This randomized controlled clinical trial compared the impact of topical treatment with clobetasol of oral lichen planus (OLP) on gingival crevicular fluid (GCF) miRNAs concentrations levels and clinical outcomes in OLP patients, as well as on correlation among miRNAs expression and the efficacy of treatment. Moreover, it was evaluated if certain baseline miRNAs levels impacted the efficacy of OLP treatments protocols.

**Methods** Thirty-four OLP patients were enrolled and randomly allocated to receive topical clobetasol 0,05% (n=18) or placebo (n=16). The outcomes assessed were miR-7a-3p, miR-7a-3p, miR-7a-5p, miR-21-3p, miR-21-5p, miR-100-3p, miR-100-5p, miR-125b-2-3p, miR-125b-5p, miR-200b-3p, miR-200b-5p of GCF, and clinical outcomes (OLP symptoms, signs and disease severity scores) at baseline, 1-, 3-, 6-months, and at 1-year follow-up after treatment.

**Results** At 1 year, in comparison with placebo, clobetasol treatment significantly increased the expression in GCF of miR-7a-3p (p<0.001), miR-7a-23p (p<0.001), miR-21-3p (P<0.001), miR-21-5p (p < 0.001) and miR-100-5p (p=0.016), while significantly lower that of miR-125-b2 (P<0.001), miR-125-b5 (p=0.031), mIR-200-b3 (p=0.048), and miR-200-b5(p=0.009). Generalized multivariate analysis showed that high baseline levels of miR-7a-3p (p= 0.036), miR-7a-2-3p (Pp=0.025), miR-21-3p (p= 0.012), miR-100-3p (p= 0.023), miR-125b-5p (p< 0.001) e miR-200b-3p (p= 0.002) and clobetasol treatment (p= 0.015) were significant predictors of reduction in OLP disease severity score at 1-year follow-up. While the Jonckheere-Terpstra test showed that patients with high mean baseline levels of miRNA more benefit from clobetasol treatment at 1-year follow-up.

**Conclusions** At 1-year follow-up, patients receiving clobetasol showed a greater reduction miRNA and in OLP severity score than patients treated with placebo. Moreover, patients with high baseline miRNA levels are linked with oral cancer risk development gained more benefits from the clobetasol treatment at 1-year follow-up.

#### 0180

# Mandibular Advancement Versus CPAP on Quality-of-Life in Obstructive Sleep Apnea

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**Objectives** We recently reported in the CRESCENT trial that mandibular advancement devices (MAD) are non-inferior to CPAP in reducing blood pressure in patients with obstructive sleep apnea (OSA) and hypertension. This pre-specified analysis aims to compare the relative effectiveness of MAD versus CPAP in improving quality-of-life (QoL) at a 6-month follow-up.

Methods Between October 2019 and December 2022, 220 participants recruited from 3 Singapore public hospitals with OSA (apnea-hypopnea index [AHI] ≥15 events/hour) were randomly assigned to MAD or CPAP (1:1 ratio). QoL questionnaires (Epworth Sleepiness Scale [ESS], SAQLI, FOSQ-30, SF-36, and EQ-5D) were administered at baseline and at 6 months.

**Results** The MAD and CPAP groups were well balanced (85% male, median age 61 [interquartile range (IQR) 56-65] years, body mass index 27.5 [25.3-30.6] kg/m<sup>2</sup>, AHI 38.2 [24.5-51.7] events/hour). MAD protrusion averaged  $9.4 \pm 2.0$  mm, while CPAP pressure averaged  $10.3 \pm 2.5$  mmHg. Treatment adherence for MAD and CPAP was 5.4 [3.7-6.7] hours and 4.9 [3.0-5.9] hours, respectively. A total of 100 participants in each group completed the 6-month follow-up (91% completion rate). Both MAD and CPAP groups showed improvements in ESS, SAQLI, FOSQ, and SF-36 (domains: role-physical, bodily pain, general health, vitality, and role-emotional) (p<0.005 for all). CPAP (p=0.013), but not the MAD group, improved SF-36 (domain: physical functioning). In the between-group analysis, while the CPAP group was more effective than the MAD group in improving ESS (mean difference: 1.45 [95% CI: 0.44-2.46, p=0.005]), no between-group differences were observed in the improvement of SAQLI (-0.08, p=0.475), FOSQ-30 (-0.51, p=0.127), SF-36 (domains ranging from -0.41 to 2.95 with p-values ranging from 0.115 to 0.795), and EQ-5D (-0.03, p=0.322).

**Conclusions** Both MAD and CPAP were effective in improving QoL at the 6-month follow-up. The relative effectiveness was similar, except CPAP was slightly more effective in improving ESS.

#### 0181

#### Implication of the Expression of B-raf and Ki-67 in Proliferative Verrucous Leukoplakia

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**Objectives** Oral Proliferative Verrucous Leukoplakia is a distinct form of leukoplakia with a progressive clinical course, diverse histopathology, and high rate of malignant transformation.

To evaluate and compare the expression of B-raf and Ki-67 in Oral proliferative verrucous leukoplakia (PVL) Oral Verrucous Carcinoma (VC) and Oral Squamous cell carcinoma (OSCC)

**Methods** Following approval from the Institution Ethics Committee, Kasturba Hospital (IEC- 880/2020), formalin Fixed paraffin embedded tissue blocks of histopathological diagnosed cases(n=10/gp) of oral PVL, VC and OSCC were retrieved from the archives of the department. Two 4 um thick sections were cut from the FFPE tissue blocks and tissue sections were immunohistochemically stained with B-RAF (B-raf 1, BF-0234, Affinity Biosciences, USA) and Ki-67 (Clone Ki-67, GM001, Pathnsitu, USA) respectively. Normal oral mucosa and Colon Carcinoma tissue section was used as controls. The cytoplasmic expression of B-raf and the nuclear expression of Ki-67 in the lesions was semi quantitatively evaluated and statistically



# analyzed (ANOVA, Tukey's, p<0.05)."]

**Results** The cytoplasmic expression of B-raf by keratinocytes(mean percentage of positive cells) among oral PVL was 55.60±30.5, oral VC was 43.20±18.7and Oral SCC was 59.70±29.5. The cytoplasmic expression of B-raf in PVL was comparable with that of the expression seen in Oral SCC squamous cell carcinomas, but much higher than that seen in VC (p= .366) The mean nuclear Ki-67 labelling index (LI) among the oral PVL was 29.0 ±20.7, VC 27.2±30 and oral SCC was 53.30±24.6. The expression of Ki-67 was higher in Oral Squamous cell carcinomas compared to Verrucous leukoplakia and Verrucous Carcinoma ( p=.052)

**Conclusions** The assessment of the expression of B-raf and Ki -67 along with clinico pathological features can give and insight into the molecular changes that are occurring in the keratinocytes. which will assist in developing better treatment strategies. The study is still in progress, wherein more lesions are being evaluated

# 0176

# Development of Clinically Relevant Models for Van der Woude Syndrome.

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**Objectives** Van der Woude syndrome (VWS) is the most common syndromic form of orofacial clefts mostly associated with pathogenic variants of the transcription factor Interferon regulatory factor 6 (*IRF6*). According to the function of IRF6, VWS patients were found to display more wound-healing complications and impaired skin homeostasis compared to non-syndromic cleft lip and palate individuals. However, a proper molecular and cellular analysis is lacking as there are no cell models available that are derived from VWS-affected lip tissue. The objective was to establish immortalized VWS lip-derived keratinocytes from a patient with a pathogenic *IRF6* variant. We hypothesize that such cells represent the ideal model to study IRF6-related pathogenesis and further shed light on the specific role of IRF6.

**Methods** Primary keratinocytes isolated from the lip of a VWS patient harboring a pathogenic *IRF*6 variant regulated by non-sense-mediated mRNA decay mechanism, were rendered immortal by introducing the catalytic subunit of telomerase, along with suppression of the cell cycle inhibitor gene, *p*16<sup>*INK4a*</sup>. Retention of original characteristics was assessed by various functional assays and 3D skin cultures.

**Results** The novel VWS immortalized lip cells maintained genetic stability, key phenotypic features, and responsiveness to certain stimuli. Also, haploinsufficiency of IRF6 was retained in the novel line. 3D VWS lip models were generated resembling *in vivo* lip tissue more realistically. We further proved that these cells form robust platforms for 2D wound healing and 3D microbial infection studies. The consequences of IRF6 haploinsufficiency will be investigated concerning wound healing, proliferation, and epithelial differentiation compared to healthy and non-syndromic-cleft lip immortalized keratinocytes.

**Conclusions** The availability of immortal VWS lip-derived keratinocytes that retain the tissue's original properties opens intriguing new avenues for studying IRF6 haploinsufficiency and modeling lip-associated defects. This holds the promise of an important step towards the development of optimized, personalized treatment options and preventive strategies for VWS.



# Oral Health in Two Different Oncologic Cohorts: Case-Control Study

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**Objectives** Bone Metastatic Cancer (BMC) patients and Head and Neck Cancer (HNC) patients require specific dental care in order to prevent and manage the adverse effects of radiotherapy (RT) and bone antiresorptive (AR) drugs. The aim of this observational case-control study was to compare the oral health (OH) status between HNC patients (case group) and BMC patients (control group). Moreover, secondary outcome was to identify any risk factors associated with poor OH status.

Methods The present case–control study was approved by the EC of Policlinico Universitario A. Gemelli IRCCS, and included BMC (case) patients and HNC (controls), matched for age, in a 1:3 ratio. All patients were evaluated at Fondazione Policlinico A. Gemelli, Rome. The OH status was clinically and radiographically evaluated using the DMFT index, a full periodontal charting and a radiological examination (orthopantomographs). The OH status was defined as "poor" in cases of DMFT ≥13 and/or stage III or IV periodontitis. A univariate statistical analysis was performed to detect the association between the different clinical variable and OH. The associated variables underwent a multivariate logistic regression, in order to retrieve the independent risk factors for poor OH.

**Results** The final sample included 234 patients (i.e., 58 BMC and 176 HNC). The mean age was 60.2, SD: 12.8). One hundred and sixty-two patients (69.2%) showed a poor OH.

Among the HNC patients, 139 (78.9%) were affected by poor OH; compared to 23 (39.6%) among the BMC patients. HNC was an independent risk factor for poor OH (RR: 5.1, 95% CI: 2.2-11.73, p<0.0001), as well as age (RR for different decades: 50-59 years RR: 6.4, 95% CI: 2.5-16.7, p<0.0001, 60-69 years RR: 12.6, 95% CI: 4.5-35.1, p<0.0001, 70 years or older RR: 33.6, 95% CI: 10.3-109.7, p<0.0001) and smoking (RR: 4.5, 95% CI: 2.1-10.1, p<0.0001).

**Conclusions** This is the first study to examine the OH status in two different cohorts of cancer patients. HNC patients have a poorer OH compared to BMC patients at first dental visit. Nevertheless, smoking habit and age remain important risk factors for poor OH.

#### 0283

# Comparative Analysis of Artificial Agings on Different Denture Base Materials

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**Objectives Objectives:** Aim of this study was to compare effects of artificially aging on the roughness and surface free energy of two different denture base materials.

**Methods Methods:** Polymethylmethacrylate (PMMA) and polyetheretherketone (PEEK) specimens were aged with two surface treatments (A=grit of 1200; B=grit of 4000; wet; n=10 per material, surface treatment and aging). Artificial aging was performed by thermocycling (TC, 5°C and 55°C, 2x5000 cycles), storage in hydrochloric acid (HA, 7d, pH: approximately 1.52, 37°C) and storage in 1% sodium hypochlorite (SH, 2.5d, 37°C). Contact profilometry (CP; Perthometer S6P, Perthen Mahr, G) was used to measure line roughness R<sub>a</sub> and R<sub>z</sub>. Surface free energy (SFE) was determined using the sessile drop



method (drop volume=2 $\mu$ L; millipore water and diiodomethane; DSA25, Krüss, G). Materials without aging were used as reference. Statistics: Shapiro-Wilk, Kruskal-Wallis test ( $\alpha$ =0.05).

**Results Results**:  $R_a$ ,  $R_z$  and SFE of both materials were significantly (p≤0,001) influenced by aging (TC, HA, SH). Significant (p≤0.049) differences were found between  $R_a$ ,  $R_z$  and SFE. Aging influenced the material properties, particularly surface treatment B and SFE of both materials. Despite uniform surface treatments,  $R_z$  exhibited variations in roughness after artificial aging, especially with surface treatment B. **Conclusions Conclusions:** The aging processes were influenced by different surface treatments, B showing the greatest variations. The parameters were most influenced by SH. The two aged materials showed minor differences to each other. However, for dentures it is recommended to minimize exposure to aging influences and to polish their surface to prevent long-term changes.

material	surface treament	aging	parameter			
		48.118	R <sub>a</sub> (µm)	R <sub>z</sub> (µm)	SFE (mJ/m <sup>2</sup> )	
PMMA	A	no	0.20+/-0.04	1.37+/-0.27	34.89+/-3.41	
	В		0.02+/-0.02	0.33+/-0.04	38.56+/-5.71	
	A	тс	0.20+/-0.03	1.39+/-0.24	33.35+/-3.66	
	В		0.04+/-0.03	0.38+/-0.17	44.38+/-4.75	
	A	НА	0.26+/-0.19	1.47+/-0.23	34.52+/-4.07	
	В		0.06+/-0.03	0.65+/-0.20	33.46+/-4.62	
	A	SH	0.22+/-0.05	1.55+/-0.25	43.65+/-4.58	
	В		0.03+/-0.02	0.47+/-0.10	44.92+/-6.91	
PEEK	A	no	0.18+/-0.04	1.31+/-0.16	32.71+/-4.84	
	В		0.06+/-0.02	0.73+/-0.33	40.13+/-5.53	
	A	тс	0.18+/-0.02	1.24+/-0.09	32.09+/-2.32	
	В		0.06+/-0.02	0.63+/-0.15	32.85+/-3.97	
	A	НА	0.19+/-0.01	1.34+/-0.09	32.86+/-5.81	
	В		0.04+/-0.03	0.48+/-0.19	38.50+/-7.90	
	A	SH	0.19+/-0.03	1.34+/-0.13	33.25+/-3.47	
	В		0.04+/-0.03	0.43+/-0.21	41.14+/-4.31	

 $\label{eq:stars} \textbf{Tab:} means and standard deviations of R_a, R_z, SFE of the materials with different surface treatments and aging$ 



# Adhesion and Biofilm Formation of Candida Albicans to Polymeric Materials

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**Objectives** *Candida albicans* is a commensal yeast but also a facultative pathogen causing candidosis, for example on dental prostheses. However, a basic understanding of how *C. albicans* colonizes such materials has not been adequately gained. Therefore, this study aimed to investigate the adhesion and biofilm formation of *C. albicans* on various polymeric materials.

**Methods** For the *in vitro* analysis, **CLSM** (Confocal Laser Scanning Microscopy) and **SCFS** (Single Cell Force Spectroscopy) techniques were used to evaluate the material properties and behavior of *C. albicans* on the different polymeric materials Polyvinyl chloride (PVC), Polytetrafluoroethylene (PTFE) and Polyethylene (PE). Statistical analyses included Shapiro-Wilk tests and ANOVA (α=0.05).

**Results** *Candida albicans'* adhesion ratio and biofilm formation vary significantly across different polymeric surfaces with varying roughness, as observed through CLSM analysis and volume calculations from the cells. The morphology of the yeast is influenced by the surface characteristics of the materials it interacts with. Moreover, the materials significantly influenced the adhesion forces exerted by *C. albicans* on diverse surfaces.

**Conclusions** In this study, different behaviors of *C. albicans* cells in terms of adhesion, biofilm formation, and adhesion forces on the tested polymer materials were revealed. Discovering the various impacts of polymeric materials on the behavior could help in developing innovative denture materials that aim to reduce *Candida albicans* adhesion and thus reduce the incidence of denture stomatitis.

#### 0285

#### 3D Microleakage Assessment of Bulk-Fill Composite Resins: a Micro-CT Analysis

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**Objectives** This study aimed to evaluate microleakage from class II cavities filled with bulk-fill composite applied at different thicknesses, and with different polymerization modes.

**Methods** A total of 36 mesio-occlusal cavity were drilled into the extracted human third molars at 2 mm and 4 mm thickness. Bulk-fill composite resin (Tetric powerflow and Tetric powerfill) was applied to the cavities after the adhesive resin was applied, and cured using high power and extra power light-curing modes of a VALO light-curing unit. An incrementally applied microhybrid composite was used as the control. The teeth were subjected to 2000 cycles of heating to 55 °C and cooling to 5 °C with a 30-s hold time. Then, they were immersed in a 50% silver nitrate solution for 24 h and scanned with micro-computed tomography. Scanned data were processed using the CTAn software. three (3D) dimensional



analyses of leached silver nitrate were performed.

**Results** Polymerization in extra power polymerization mode generally increases the microleakage values. **Conclusions** Based on 3D measurements, applying bulk-fill composite resin at 2 mm thickness and high power polymerization reduced microleakage.

0286

# Longitudinal Follow-Up of Glass Ionomer Versus Bulk Composite

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**Objectives The objective** is the 2 years longitudinal follow-up and comparison of restoration maintenance at 24 months with a HVGIC versus a Bulk-fil composite + self-adhesive system and to estimate the concordance of restoration maintenance judgement between in situ and remote experts on the basis of images.

Methods Simplified FDI (Aesthetic, functional, biological scores) were assessed at T0, 6, 12 and 24 months and scores agreement between the in situ expert and the remote experts were done using the images taken with microscope and Soprolife camera. Intention-to-treat: Split mouth study with all molar or premolar randomized teeth N = 152 *(65 patients)* HVGIC N=76 – Bulk N=76. Paired teeth: If a data is missing for one of the two teeth, the pair is excluded from the analysis set. The endpoint is the maintenance of the restoration of each treated tooth at 24 months assessed on the basis of the FDI functional properties sub-scores. Cavity risk assessment was based on the CAMBRA concept at T0, including a questionnaire, caries index and plaque index. All restorations were restored under microscope and fluorescence camera using the selective dentine excavation and peripheral seal zone concepts. **Results** FDI : Total score difference HVGIC vs. Bulk-Fil respectively at T0, 6, 12, 24 months: N; Mean (± SD); [Min;Max]; p Normality

T0: N53; 2.13 (± 2.43); [-3.00;12.00]; <.0001. T6: N38; 3.53 (± 5.09); [-4.00;22.00]; <.0001. T12: N39; 4.59 (± 5.42); [-4.00;16.00]; 0.0684. T24: N40; 6.18 (± 6.82); [-1.00;21.00]; <.0001

**Conclusions** Expert in situ and remote one confirmed the overall results which remains in favor of the Bulk composite thanks to the aesthetic and functional scores. In case of occlusal lesion even if extensive one the HVGIC showed good results. The deepness of the lesion and the caries activity did not seem to interfere in the results observed.

#### 0287

#### Short Fiber Glass Ionomer Restorations in Cervical Lesions: 12-Month Trial

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Objectives The aim of this randomized trail was to assess the clinical performance of experimental short fiber-reinforced glass ionomer cement (FR-GIC) in the treatment of cervical caries lesions. Methods Ethical approval was obtained for the study. A total of 45 patients (19 males, 26 females; mean age: 35±6 years old) were randomly enrolled in this trial according to the split-mouth design. The FR-GIC was prepared by adding short glass fibers at a mass ratio of 20% into the powder portion of Fuji II LC (GC, Japan). The cervical lesions in the intervention group were restored with FR-GIC, while unmodified Fuji II LC was applied as the control. One blind operator made all restorations using dentin conditioner and GIC coat (GC) according to the manufacturers' instructions. Clinical evaluation was performed by two blinded operators at baseline, at 6, and 12 months using modified USPHS criteria. The data were subjected to analysis using Friedman's test, followed by the Nemenyi post hoc test with a significance level of  $\alpha$  = 0.05. Results After 1 year, the recall rate was 91%, and restorations were fully retained. There was no statistically significant difference (p>0.05) between the two materials based on the evaluated criteria. Both groups had 4 (10%) cases with Bravo scores for cavos-surface marginal discoloration. Regarding marginal integrity, Bravo scores were observed in 5 (12.5%) cases in the intervention group and 4 (10%) cases in the control group. In the intervention group, the Bravo score was determined in 3 (7.5%) cases for color match and 1 (2.5%) case for gross fracture. For all other parameters and intervals, all cases received an alpha score.

**Conclusions** Both materials in the treatment of cervical caries lesions demonstrated satisfactory clinical outcome throughout the 12-month follow-up.

0288

#### Evaluation of Surface Treatments on Physical Properties of Glass-Ionomer Cement

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**Objectives** To compare the flexural strength, water sorption & solubility, and fluoride release of a hybrid glass ionomer cement (GIC, Equia Forte HT, GC Europe) subjected to different treatments: coating with Equia Forte Coat (GC Europe), bonding agent or petroleum jelly, or light-curing for 20 or 60 s. Control specimens received no treatment.

**Methods** 120 GIC specimens were prepared, divided into 6 groups, treated according to the above mentioned methods, and stored in artificial saliva at 37°C. The flexural strength (three-point bend test, n=30) was assessed using a universal mechanical testing machine after 24 h and 28 days (ISO 4049:2019). Water sorption & solubility (n=90) were measured by weighing the samples at baseline (t=0), after 28 days and, after 24 h dehydration at 60°C, at 29 days. Fluoride release (n=90) was assessed using an ion-selective electrode on storage media after 24h, 48h, and 28 days. Shapiro-Wilk test, Levène test, two-way ANOVA, and Tukey's post-hoc tests were performed for data analysis (p<0.05).

**Results** A significant increase in flexural strength values at 28 days was observed in the 60s light-curing and petroleum-coated groups compared to the control (p<0.05). At 24h, all groups showed insufficient strength values (<80MPa). The only treatment differing from the controls in sorption and solubility was petroleum jelly application (p<0.05), due to remnants of the latter influencing measurements. Compared to the control, light-curing for 60 s showed higher fluoride release values at 24 h & 28 days (p<0.05), while the groups treated with Equia Forte Coat and bonding agent unsurprisingly showed significantly lower



values (p<0.05). Petroleum jelly application and light-curing for 20 s showed similar fluoride release values to the control group.

**Conclusions** Light-curing for 60s or petroleum jelly coating seem to be the most effective treatments to further improve mechanical and physical properties of a hybrid glass ionomer cement.

#### 0289

# Unraveling Soft-Tissue Integration and Surface Engineering Relation in Dental Implants

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**Objectives** Peri-implantitis arises due to biofilm accumulation around dental implant abutments, resulting in periodontal pocket formation, inflammation, infection and possible implant failure. Enhanced soft-tissue integration around the abutment is crucial for establishing a robust mechanical seal, thereby preventing pathogen infiltration and ensuring long-term implant success.

**Methods** Femtosecond laser processing is a cutting-edge technology recently being utilized for generating laser-induced periodic surface structures (LIPSS) which are surface nanotextures that have shown promise in enhancing soft-tissue growth. However, the precise connection between surface characteristics and biological response remains unclear. Given that protein adsorption is the primary biological reaction upon implantation, this study investigates the correlation between in situ protein adsorption kinetics and the surface properties of LIPSS textured titanium (LIPSS-Ti) and complemented with *in-vitro* testing using human gingival fibroblasts.

**Results** SEM imaging confirmed the formation of periodic LIPSS, while AFM analysis quantified their depth to be in the same range as the size of cellular filopodia. XPS analysis revealed an increase in metallic oxide presence alongside a decline in bulk metal signals. The formation of the oxide layer was validated through significant alterations in solid surface zeta potential, notably differentiating LIPSS-Ti from untextured Ti. Additionally, an increase was observed in the overall surface energy of LIPSS-Ti that can be attributed to an increased polar component. A study on protein adsorption coupled with streaming current analysis demonstrated successful protein adhesion on LIPSS-Ti and resulted in a shift of surface zeta potential towards that of the protein. This was confirmed by the affinity of the cells towards the LIPSS-Ti.

**Conclusions** Through the integration of comprehensive surface topography and surface chemistry characterization methodologies, this study elucidates a more profound understanding of the intricate relationship between these properties and the biological functionality exhibited by LIPSS-Ti.



#### Femtosecond Laser Micro-Patterning of Toughened Zirconia Implant Surfaces

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**Objectives** To evaluate phase composition, microstructure and surface properties of yttria- and ceriastabilized zirconia exposed to three femtosecond laser-textured micro-patterns.

**Methods** Commercial 3mol% yttria-stabilized zirconia (3Y-TZP, Tosoh), containing 0.25wt% Al<sub>2</sub>O<sub>3</sub>, and labmade 10mol% ceria-stabilized zirconia (Ce-TZP, Daiichi), containing 0.25wt% Al<sub>2</sub>O<sub>3</sub> doped with 0.2mol% CaO, were studied. Zirconia powders were cold isostatically pressed to disks, pressureless sintered (3Y-TZP at 1350°C, Ce-TZP at 1250°C, 2h) and polished (control). Each zirconia grade was conventionally sandblasted and etched, or experimentally treated using a femtosecond laser (Carbide, CB3-20W) to obtain the following surface patterns: (1) dots, (2) lines, and (3) grid. Phase composition was characterized using X-ray diffraction (XRD); surface roughness (Sa) was measured using optical confocal microscopy and microstructure was analyzed using scanning electron microscopy (SEM). Surface wettability (hydrophilicity) was measured using a static sessile-drop test. Statistics involved Kruskal-Wallis and Welch ANOVA with post-hoc Bonferroni tests (α=0.05).

**Results** Rietveld refinement revealed increased monoclinic phase for sandblasted and etched 3Y-TZP and Ce-TZP (16.8wt% and 40.7wt%, respectively), compared to polished and laser-patterned surfaces (0-2.5wt%). Rhombohedral phase was only detected for sandblasted and etched 3Y-TZP (29.6wt%). Sa values of laser-treated surfaces varied between 0.51 and 1.6  $\mu$ m. SEM revealed regular implant surfaces after laser micro-patterning, while sandblasting and etching produced random surface topographies in both zirconia grades. Laser micro-patterning led to formation of surface cracks in both types of zirconia. Sandblasting and etching increased hydrophilicity ( $\theta \approx 50^\circ$ ), compared to polished surfaces ( $\theta \approx 60^\circ$ ). However, all laser treatments made zirconia surfaces hydrophobic ( $\theta > 90^\circ$ ), except for Ce-TZP micropatterned with dots that exhibited a lower contact angle ( $\theta \approx 77^\circ$ ).

**Conclusions** Regardless of zirconia composition, femtosecond laser micro-patterning resulted in more hydrophobic zirconia surfaces without causing significant phase transformations that are expected using conventional implant-surface modifications. Optimization of laser micro-patterning is however needed to avoid cracks at zirconia surfaces.

#### 0291

#### **Tissue Integration and Vascularization of Peri-Implant Soft Tissue Grafts**

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**Objectives** While peri-implant tissue health and thickness can be evaluated clinically, histological analyses are essential to prove graft integration with the surrounding tissues following soft tissue augmentation and may biologically explain clinical observations (dehiscence, shrinkage, swelling). The aim of this study was to histologically analyse tissue integration and vascularisation of volume collagen matrices (VCMX) and subepithelial connective tissue grafts (SCTG) at 3 and 4 months following peri-implant soft tissue augmentation.

**Methods** This is a secondary histological analysis of two previous randomized controlled trials [I-2]. investigating the efficacy of VCMX (Geistlich Fibro-Gide®, Geistlich Pharma) compared to autogenous SCTG at implant sites. Peri-implant soft tissue augmentation was performed with VCMX or SCTG and biopsies harvested at 3 and 4 months. Analyses included: descriptive histology, blood vessel count and tissue composition (remaining matrix, peri-implant connective tissue containing 3 different components (collagen bundles, elastic connective tissue and loose connective tissue), elastic fibres and background). **Results** A total of 21 samples were analysed (VCMX: 6/9 biopsies at 3/4 months ; SCTG: 6 biopsies at 3 months). VCMX sites displayed less and smaller blood vessels within an overall denser tissue. The collagen bundles were thicker compared to SCTG sites, which overall also presented a looser structure (Fig.1). The percentages of elastic connective tissue were of 22.5% (VCMX/3m), 32,7% (VCMX/4m) and 17.4% (SCTG/3m). The VCMX/3 samples showed the highest proportion of elastic fibres (10,7%) (Fig.2). The buccal volume shrinkage between augmentation and follow-up at 3 or 4 months was greatest for VCMX at 4 months.

**Conclusions** Peri-implant soft tissue augmentation with VCMX resulted in a reduced vascularisation, but a greater tissue density compared to sites augmented with SCTG. The greater shrinkage observed with VCMX might be partly explained by the increased collagen and overall tissue density within the VCMX-augmented tissues.

#### 0293

#### Impact of h-PPP on Bone Formation in Rat Calvaria Defects

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**Objectives** This study aimed to investigate the effect of heating platelet-poor plasma (PPP) on bone formation in rat calvaria defects and to compare its efficacy with unheated PPP when used with collagen membranes for bone regeneration.

**Methods** Ten adult male Sprague-Dawley rats underwent bilateral calvaria defect surgeries. Collagen membranes soaked with PPP were either kept at room temperature or heated to 75°C for 10 minutes before placement over the osteotomy defects. Histology and micro-computed tomography (Micro-CT) were performed three weeks post-operation.

**Results** Micro-CT analysis revealed significantly greater bone volume (BV) in defects treated with room temperature PPP-soaked membranes (median 1.71mm3, range 0.5-6.4 mm3) compared to those treated with heated PPP-soaked membranes (0.4mm3, range 0.00-3.7 mm3) (P=0.015). Similarly, defect coverage was significantly higher in room temperature PPP-soaked membranes (median 36.6%, range 14.1-86.6%) compared to heated PPP-soaked membranes (14%, range 0.0-62.8%) (P=0.009).



**Conclusions** Our findings suggest that heat-denatured plasma impedes bone regeneration in rat calvaria defects, while native coagulated plasma promotes the migration of new bone into collagen membranes. These results imply that heated PPP could serve as a potentially effective occlusive barrier in combination with collagen membranes for bone regeneration.

#### 0294

# Peri-Implantitis Defect Reconstruction Utilizing Bovine Bone Substitute With Hyaluronic Acid.

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**Objectives** Various biologically active materials have been combined with xenografts to produce successful outcomes in peri-implantitis bone (PI-B) defect management. Hyaluronic acid (HA) was merged with a bovine bone substitute (BBS) to overcome xenografts' lack of osteoinductive and osteogenic properties. The study aimed to assess six- and twelve-month clinical, radiographic, and microbiological outcomes after reconstructive surgical therapy on PI-B defects engaging either BBS with or without HA followed by collagen dermal matrix use.

**Methods** In total, patients (mean age 49 ± 8.7) with peri-implantitis (diagnosed 6.4 ± 1.1 years of implant loading) were randomly treated either with BBS plus HA (test group) or BBS alone (control group). Clinical parameters including peri-implant probing depth (PPD), bleeding on probing (BOP), implant stability (ISQ), keratinized mucosa width, radiographic changes in vertical and horizontal marginal bone (MB) levels and microbiological quantification were evaluated at six and 12 months postoperatively. Microbiological quantification was provided by real *polymerase chain reaction* (PCR).

**Results** The treatment was successful in 71% of patients and 85% of implants after 12 months (no BOP, PPD < 5 mm, and no further MB loss). No significant difference was found between groups in terms of PPD during follow-ups. The test group displayed a complete reduction in BOP compared to the control one  $(0.17 \pm 0.39)$ , six months postoperatively. Subsequently, the ISQ value in the test group significantly increased six months after surgery, however, no differences were noted between the groups at 12 months. The vertical MB gain achieved substantially greater values in the test group (p < 0.01) over time. Six and twelve months postoperatively, both groups demonstrated a significant reduction of the bacteria total amounts (p < 0.05).

**Conclusions** A short-term twelve-month outcome suggested that bovine bone substitute merged hyaluronic acid could be successfully utilized in peri-implantitis defects management.



# A Personalized Oral Health Care Form for Institutionalized Older Adults

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**Objectives** This pilot RCT aimed to test the impact of an educational intervention, supported by a Personalized Oral Health Instruction Form (POIF), on the oral health indices in institutionalized older adults.

**Methods** Institutionalized older adults aged 65 and above living in a medicalized home were recruited. Baseline oral health indices, including the Plaque Index (PI), Denture Cleanliness Index (DCI), and Tongue Coating Index (TCI), were recorded for all participants. Caregivers received training on oral health care in small groups. A custom-made software was used to create a POIF for each participant, which was then implemented alongside verbal instructions and an oral hygiene kit in the intervention group, whilst in the control group, the participants received verbal instructions and an oral hygiene kit. After three weeks, a second examination was conducted by the same examiner, who was blinded to the participants' group allocation. Participants and caregivers evaluated the POIF's clarity, ease of interpretation, and overall effectiveness on a visual analogue scale (VAS1-10). Wilcoxon signed rank tests were conducted P<.05. **Results** 46 patients aged 85.5 y  $\pm$  7.7 were included. Significant improvements were observed in the PI, decreasing from a median of 85% IQR [38] to 41% IQR [39] *P*<0.001, with a notable difference between the intervention and control groups (32% vs. 54%, respectively) *P*=.06. While TCI showed no significant change, DCI demonstrated notable improvement, especially in the intervention group 33%indicating better denture cleanliness than in the control group 67%.

Caregivers and residents rated the POIF favorably for clarity (M=6.89, SD:2.20), usefulness (M=6.47, SD: 2.23), and impact on oral health (M=6, SD: 2.14) with a preference for visual aids over text instructions (M=6.25, SD: 2.23).

**Conclusions** The findings confirmed that using tailored, visually supported, printed oral health guidance are well perceived by health workers and residents and demonstrated the potential of such tools in improving oral health outcomes.

0296

#### Oral Health in Swiss Community-Dwellers Aged ≥45 Years

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**Objectives** To describe and assess the oral health status of persons aged ≥45 living in the community in the canton of Bern

Methods Participants aged ≥45 years were selected by random sampling and recruited from the ten regions of the canton of Bern. Data were collected using a questionnaire on socioeconomic status, medical history, and oral health behavior. An oral examination collected data on dental caries (ICDAS, DMFT), periodontal disease, and oral hygiene. Chi<sup>2</sup> tests, Cuzick trend tests, and ordered logistic regression were performed to assess the relationship between age and sociodemographic factors, general health, oral health behaviour, and oral health status. Statistical analysis was performed using Stata18<sup>®</sup> with statistical significance set at p<0.05.

**Results** 275 participants took part in the study. 83% (n=228) brushed their teeth at least twice daily, 80% (n=196) visited the dentist yearly. 33% presented with an Approximal Plaque Index >50%. Mean number of decayed, missing, and filled teeth was 0.18±0.76 teeth, 3.77±5.21 teeth, 8.76±5.18 teeth, respectively. The mean DMFT was 12.71±5.18. Dental caries prevalence was 10% (n=25), while initial caries was found in 13% (n=36) of the participants (ICDAS 1-3, root ICDAS 1). Positive trends were found between an increase in age and diabetes, rheumatoid arthritis, circulatory disease, periodontal disease, Approximal Plaque Index, and missing teeth. There were higher odds of having periodontal disease (OR 1.62), high plaque scores (OR 1.82), and a high number of missing teeth (OR 11.20) in the older age groups. **Conclusions** Despite good oral health behaviour, oral hygiene control was suboptimal. As people retain their teeth longer, improvements in oral hygiene maintenance are essential in the older age groups. Given the higher prevalence of general health conditions in the elderly, a multidisciplinary approach in supporting the maintenance of good oral health throughout the life span is required.

#### 0297

# Dry Mouth, Frailty and Polypharmacy in Acutely Ill Older Adults

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**Objectives** Dry mouth, frailty and polypharmacy are prevalent conditions in older adults imposing risks of negative health outcomes. The aim was to evaluate oral and general health among acutely ill older adults. **Methods** The study was conducted at the municipal in-patient acute care unit in Oslo (Jan-Sep 2023) and included 382 participants. The calculation of Dry Mouth Severity Points (DMSP) is presented in Table 1. Polypharmacy was defined as ≥6 regular medications. Definition of xerogenic medications (XM) was based on current literature and adapted to Norwegian conditions. Frailty, a state of impaired physiologic reserve and decreased resistance to stressors, was defined as ≥5 on the Clinical Frailty Scale (CFS). **Results** Patients with complete sets of DMSP parameters were included (n=256, mean age 84, 180 females). Seventy-four participants scored DMSP=0; 92 scored DMSP=1; 59 scored DMSP=2 and 31 scored DMSP≥3.

Polypharmacy was identified in 189 (74%) patients, and in 87% of those with DMSP= $\geq$ 3. Frailty was present in 133 (52%) patients, and in 65% of the patients with DMSP= $\geq$ 3.



Beta blocking agents were the most regularly used XMs (89 patients), followed by diuretics (n=84) and opioids (n=82). Number of medications, number of XM, and CFS score were significantly elevated in patients with DMSP≥3 compared to all other groups. Opioids were the XMs most frequently used regularly by patients with DMSP≥3, while hypnotics and sedatives were most frequently used as on-demand medications.

**Conclusions** A DMSP based classification showed associations with frailty, polypharmacy, and number of XM. Recognizing this multifaceted connection between oral and general health is vital for providing necessary healthcare for the aging population.

Parameters and cut-off values for calculating Dry Mouth Severity Points (DMSP)

	Cut-off	Dry Mouth Severity Points (DMSP)			
Xerostomia parameters	• •				
The General Xerostomia Ouestion	Frequently or Always	1			
	Never or Occasionally	0			
Shortened Xerostomia Inventory	≥11	1			
	<11	0			
Hyposalivation parameters					
Clinical Oral Dryness Score	≥6	1			
,	<6	0			
Unstimulated Whole Saliva	≤0.1 ml/min	1			
	>0.1 ml/min	0			



# Oral Healthcare Quality Improvements at the Community-Level in Denmark

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**Objectives** High-quality oral healthcare systems need constant adjustment in response to the oral healthcare needs of the population. As a prerequisite to designing quality improvements (QI), an overview of recent and existing QI initiatives and identification of unfulfilled oral healthcare needs are needed. The study investigates current QI efforts for oral healthcare at the community-level for groups in socially disadvantaged positions, in Denmark. Funded by the European Union's Horizon Europe research and innovation program under grant agreement 101057077: https://cordis.europa.eu/project/id/101057077. **Methods** Individual semi-structured interviews were conducted with professional stakeholders involved in the Danish healthcare system for groups in socially disadvantaged positions working in and outside the oral health sector. The data were inductively analysed using Grounded Theory Situational Analysis, aiming to gain an overview of relevant existing and potential cross-sectional collaborations, ways of thinking and working, legislation, recent QI initiatives in the area and gaps calling for QI.

**Results** Interviews were conducted with twelve stakeholders. Eligibility criteria for access to (free) Social Dental Care are found to be difficult to apply due to unclear conceptualisation, resulting in unspent budgets and inequality in access depending on the municipality of residence. Experiences of conflicts between limited dental care rights for asylum-seekers and collaboration with dentists due to dentists' unwillingness to concede with the legal framework, preventing the legally secured minimum level of dental care from always being provided. Dental care was perceived with a focus on access and treatment with the absence of prevention.

**Conclusions** This situational analysis identifies current QI efforts, assesses their advantages and disadvantages, and suggests potential for new QI initiatives at the community-level for groups in socially disadvantaged positions, in Denmark. It may serve as a foundation for the development of future interventions aimed at collaborations between stakeholders to enhance the quality of oral care in the target groups.



# Quality of Life and Psychological Factors in the Prevalence of Xerostomia

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**Objectives** The objective of this study was to assess the relationship between psychological factors, quality of life, and xerostomia prevalence among patients admitted for dental treatment. **Methods** Depression Anxiety Stress Scale (DASS-21), Oral Health Impact Profile (OHIP-14), and The Xerostomia Inventory (XI-11) questionnaires were sent to the patients using WhatsApp and "Google Forms" because of the Covid-19 pandemic lockdown. Statistical analyses were performed to determine the relationship between the DASS-21, OHIP-14, and XI-11 questionnaire scores, using Pearson's correlation test.

**Results** In this study, the rate of depression was 24%, that of anxiety was 29.3%, and that of stress was 20.7%. As depression, anxiety, and stress increased, the likelihood of xerostomia also increased (p = 0.404; p = 0.451; p = 0.338). The xerostomia prevalence among the patients was 54.6%. There was a significant relationship between gender and xerostomia (p = 0.028); women were more prone to xerostomia. Age and xerostomia were found to be significantly correlated (p = 0.023); xerostomia diminished as age increased. Among the patients in this study, 99.3% had a high quality of life, and xerostomia prevalence increased as the quality of life decreased (p = 0.433).

**Conclusions** However, since the quality of life was high in this study, the high prevalence of xerostomia is more related to psychological conditions such as depression, anxiety, and stress, which increased during the pandemic lockdown.

	n	minimum	maximum	average	SD	Skewness	kurtosis
Xerostomia Inventory	300	0.00	34.00	12.93	6.80	0.285	-0.289
Functional restriction	300	0.00	3.50	0.67	0.74	0.940	0.530
Physical pain	300	0.00	4.00	1.12	0.88	0.262	-0.779
Physiological discomfort	300	0.00	3.00	0.56	0.61	0.899	0.308
Physical disability	300	0.00	4.00	0.70	0.85	1.195	1.062
Physiological disability	300	0.00	4.00	0.79	0.85	0.948	0.415
Social disability	300	0.00	4.00	0.81	0.90	1.075	0.674
Handicup	300	0.00	4.00	0.61	0.79	1.419	1.902
Life quality	300	0.00	3.36	0.75	0.64	0.819	0.254

Table 1. Determination of the Normal Distribution of the Questionnaire Scores.


Stress	300	0.00	18.00	3.93	4.42	1.104	0.411
Depression	300	0.00	19.00	2.68	3.76	1.745	2.977
Anxiety	300	0.00	16.00	2.85	3.47	1.595	2.321
DASS Total	300	0.00	53.00	9.46	10.63	1.456	2.025

# Table 2. Determination of the Relationship between the Xerostomia Inventory (XI)

	Xerostomia Inventory	Quality of Life	Stress	Depression	Anxiety	DASS Total
1.Xerostomia Inventory	one	0.433**	0.338**	0.404**	0.451**	0.431**
2. Quality of Life		1	0.427**	0.461**	0.431**	0.481**
3. Stress			1	0.742**	0.757**	0.926**
4. Depression				1	0.742**	0.905**
5.Anxiety					1	0.904**
6. DASS Total						1

0301

# Classifying the Contact of Third Molars With the Mandibular Canal

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**Objectives** To evaluate the performance of deep learning models for classifying the anatomical relationship of the mandibular third molars (3M) and the mandibular canal (MC) on panoramic radiographs.

**Methods** 3Ms and MCs were labeled on panoramic radiographs by a calibrated examiner using bounding boxes. Each bounding box contained 3M and MC on one side. The relationship of 3M with the MC was assessed on CBCT scans as the gold standard and dichotomized as contact/no contact. Data were split into training, validation, and testing sets with a ratio of 80:10:10. Faster R-CNN model was used for detecting 3Ms and MCs and Resnet-50 for classifying their relationship. The metrics for the detection task was AP50, while accuracy, precision, recall, and F1-score were used to assess classification performance.



**Results** A total of 610 images were collected each containing one 3M and one MC. The accuracy of detection of 3Ms and MCs was AP50=99.71%. Classification accuracy was 0.83, precision 0.81, recall 0.86, and F1-score 0.83.

**Conclusions** Deep learning is useful for the detection of 3Ms and MCs and the evaluation of their relationship.

0302

# Bone Quality Assessment of Bone-J Software for Pre-Operative Implant Therapy

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**Objectives** Recently, free download software -Bone J- has been developed, it can pick up optical limited area, and it`s possible to assess numerically and morphologically on a CT image. We have considered whether Bone J is able to be a new method for the diagnosis of bone quality assessment. In this report, we will introduce the methods for assessment and results.

**Methods** The number of patients was 19 and the total of analyzed regions was 51. All patients were to take implant therapy, and taken X-ray examination by the radiology department of Showa University. The CT machine that was used, was the -Revolution ACT-, produced by GE health care Japan. Exposure condition was 140kV, 60mA. Axial slice thickness was 0.625mm. As 3D structure analysis, CT slice displayed directly with *Image sequence* onto -Image J figi-. Crop with Image J`s rectangular ROI tool, and automatically segment into bone and Background with *Plugins*  $\Rightarrow$  Bone J  $\Rightarrow$  *Threshold*. Measure bone volume fraction (BV/TV) with *Plugins*  $\Rightarrow$  Bone J  $\Rightarrow$  *Volume fraction*. Measure trabecular thickness (Tb, Th) and spacing (Tb.Sp) with Bone J  $\Rightarrow$  *Thickness*. Measure degree of anisotropy (DA) with *Plugin*  $\Rightarrow$  Bone j  $\Rightarrow$  *Anisotoropy*. All data are appended on a result table.

**Results** At this time, evaluate the relationship between (BV/TV), (Tb, Th) and (Tb.Sp) against DA. Correlation between DA and Volume fraction was 0.684, and DA and (Tb, Th) was 0.626. However, DA and (Tb, Sp) was -0.50. DA indicated positive correlation as Volume fraction and Tb, Th. On the other hand, concerning Tb, Sp. There was negative correlation.

**Conclusions** Morphological analysis for cancellous bone on MDCT by using Bone-J indicated a slight difference between total bone volume and morphometrics of trabecular bone and DA. It is recommended to use Bone-J analysis to evaluate 3D detail morphological trabecular bone information.



## Prevalence of Tonsilloliths and Other Calcifications in Panoramic Radiographs

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**Objectives** We aimed to investigate the prevalence of tonsilloliths detected via digital panoramic radiographs among dental patients, determine whether there is an association between their occurrence and the presence of other calcifications, and if it is related to age.

**Methods** The study data included 6000 panoramic radiographs of patients aged 40-90 visiting Vilnius University Hospital Zalgiris Clinic from 2014 to 2016. The presence and distribution of tonsilloliths and other calcifications were assessed using Planmeca Romexis Viewer software. The Chi-Square Test and Mann-Whitney U test on IBM SPSS Statistics 27.0 software were used to analyse the associations between the study variables. The significance level was set at p=0.05.

**Results** Tonsilloliths were observed in 329 (5.5%) of the 6000 panoramic radiographs. The mean age of patients was 61 years (SD10.4), of whom 170 were females (51.7%) and 159 were males (48.3%). 156 (47.4%) patients had tonsilloliths present bilaterally; for 84 cases, tonsilloliths (25.5%) were located on the left and 89 on the right side (27.1%), p=0.226. The mean quantity of identified tonsilloliths was equal to 4 (SD2.9). Furthermore, this measure was not associated with age, p=0.174. In patients aged 45-65, other calcifications, in addition to the presence of the tonsilloliths, were visible in 64 (19.5%) participants; in 66-75-year-olds, they were identified for 31 patients (9.4%) and in 76-90-year-olds - for 15 (4.6%), p=0.024.

**Conclusions** The prevalence of tonsilloliths in the tested population was 5.5%. In most cases, they were detected unilaterally, appearing in groups of four. Although tonsilloliths were not related to age, the occurrence of other radiographically visible calcifications together with tonsilloliths decreased with age. These findings underscore the need for future studies with a larger sample and randomized design to validate and expand upon these results.

## 0304

## Periodontal Biomarker and Diagnosis With Machine Learning and Causal Inference

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**Objectives** Periodontal disease arises from the complex multifaceted interplay of genetic, environmental, and particularly dysbiotic microbial activity. This imbalance in the oral microbiome triggers the disease, emphasizing the need for nuanced understanding and approaches in management. The capacity of Causal Inference to dissect the intricate cause-and-effect relationships among these varied factors offers a deeper understanding of disease. Machine Learning's ability to analyse extensive datasets unveils patterns crucial for predicting disease trajectories with heightened accuracy.

Our study aims to use Causal Inference and Machine Learning to link clinical parameters and microbial biomarkers in periodontal disease, developing a novel parameter to enhance diagnosis and enable personalised treatment strategies.

**Methods** In our study of 324 individuals, we explored the link between microbial markers (Lipopolysaccharides and Lipoteichoic acid) and clinical parameters of periodontal disease. Through



Causal Inference, we established a connection between these biomarkers and disease categorizations, leading to the development of a novel biomarker. This was then evaluated in Machine Learning models (Random Forest, SVM, XGBoost, Lasso Regression) to refine disease progression prediction, aiming to improve diagnostic accuracy and personalize treatment approaches.

**Results** Our causal analysis identified a strong correlation between our newly synthesized biomarker and the progression of periodontal disease effectively capturing dysbiotic activity. Applying this biomarker across ML models—Random Forest, SVM, XGBoost, Lasso Regression—enhanced disease severity prediction accuracy. This uniform improvement across models highlights their diagnostic effectiveness, marking a step forward in periodontal diagnostics.

**Conclusions** This study marks the first application of a combined ML and CI approach to analyse periodontal biomarkers. By employing CI algorithms, we effectively integrated Endotoxin Activity (EA) and Lipoteichoic Acid (LTA) to demonstrate periodontal disease development. Furthermore, we compared multiple ML models for disease diagnosis. This innovative approach enhances our understanding of periodontal disease dynamics, offering the potential for more accurate diagnostics and personalised periodontal care.

## 0305

# Improving Oral Oncology Optical Diagnosis: Site-Targeted Optical Coherence Tomography Approach

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**Objectives** Optical Coherence Tomography (OCT) is an imaging method used also in oral carcinogenesis investigations. However, very few research are available on OCT standardized procedures. This study aims to assess if a protocol combining *in vivo* OCT and a site-targeted punch biopsy technique can enhance optical diagnostic accuracy for Oral Squamous Cell Carcinoma (OSCC).

**Methods** Adult patients with clinically diagnosed OSCC were consecutively enrolled. OCT evaluations before and after site-targeted registration preceding the diagnostic biopsy were performed using standardized OCT diagnostic patterns for OSCC. Scans were evaluated by blinded observers for OCT-based supposed diagnoses. Statistical analysis determined the sensitivity, specificity, positive and negative predictive value of OCT-based diagnoses compared to histopathology.

**Results** From 7 enrolled patients, a total of 70 selected representative images of OSCC were obtained for each session (pre- and post-target OCT site evaluation). Site post-target OCT scans showed a statistically significant improvement in diagnostic accuracy for OSCC (p < 0.001) compared to site pre-target OCT scans. Post-target OCT scan sensitivity values were 98.57, and specificity values were 100.00, with strong inter-observer agreement (Cohen's kappa = 0.84). Positive predictive values for both operators were 100.00, and negative predictive values were 99.29.

Conclusions This pilot study advocates the improvement of diagnostic potential accuracy of in vivo OCT



for OSCC, using specific OCT patterns and site-targeted procedures. The findings underscore the importance of developing standardized and reproducible protocols for OCT applications in early detection and accurate management of oral oncology.

## 0306

# Oral Conditions and Alzheimer's Disease: Neuropsychological Evaluations and PET Study

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**Objectives** Worsening the oral conditions, including tooth loss and periodontal disease have been suggested as factors predisposing to the development of dementia in the past cohort studies. However, the association between the oral environment and Alzheimer's disease (AD) pathogenesis in humans remains equivocal. We aimed to investigate the associations of oral conditions and neuropsychological evaluations, amyloid- $\beta$  (A $\beta$ ) and tau pathologies in human participants.

**Methods** We examined occlusal force, the number of remaining teeth and the biofilm–gingival interface (BGI) index in 24 AD-spectrum patients and 19 age-matched healthy controls (HCs). They also underwent a battery of neuropsychological evaluations, positron emission tomography (PET) imaging of Aβ and tau with specific radiotracers, <sup>11</sup>C-PiB and Florzolotau (18F) (<sup>18</sup>F-PM-PBB3), respectively. All AD-spectrum patients were Aβ-positive, and all HCs were Aβ-negative. We analyzed the correlations between the data of oral conditions and them.

**Results** Occlusal force showed a significant correlation with the score in Trail Making Test (p < 0.01) whereas did not correlated with the ones in the Mini-Mental State Examination or Frontal Assessment Battery. The number of remaining teeth and the BGI index showed no correlation with <sup>11</sup>C-PiB retentions in amyloid PET in either group. In AD-spectrum patients, Florzolotau (18F) retentions in tau PET negatively correlated with the remaining teeth and revealed the correlation of tau deposits in the locus coeruleus (p < 0.05) primarily with the hippocampal and neighboring areas. The tau deposition in none of the brain regions was associated with the periodontal status.

**Conclusions** This study suggested that occlusal force was correlated with working memory, and the number of remaining teeth associated with AD tau pathogenesis. Oral care may be useful to deceleration AD progression.

# 0315

## Influence of Toothpastes on Probiotic Effectiveness in Enhancing Oral Health

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**Objectives** Dental biofilms are associated with oral diseases such as periodontitis, peri-implantitis, halitosis, and tooth decay. These diseases are characterized by dysbiosis, an imbalance between the host and microbiome. Current treatments rely on the mechanical removal of the biofilm and killing the microbiome with antimicrobials. However, rising antimicrobial resistance necessitates alternatives. Pro-microbial strategies, notably probiotics, hold promise for rebalancing the oral microbiome towards a symbiotic state. However, uncertainties persist, particularly regarding the impact of toothpaste on probiotic efficacy.

**Methods** In the *in-vitro* part, we assessed the inhibition of selected toothpastes on probiotic viability, probiotic adhesion to toothpaste pre-treated hydroxyapatite discs, the effect of probiotic strains on *in-vitro* oral biofilms that were pre-treated with brushing with selected toothpastes, and the anti-inflammatory effects of probiotics. In the *ex-vivo* part, ten volunteers brushed with selected toothpastes, and saliva samples were collected at different intervals for probiotic survival evaluation.

**Results** The antimicrobial efficacy of the selected toothpastes varied with concentration and probiotic strain. The adhesion of probiotics to hydroxyapatite discs is influenced by both the toothpaste product and the probiotic strain. The survival, colonization, and effect of the probiotics on the biofilm model are antiseptic and species-dependent. The ecology and composition of the biofilms were influenced by the toothpastes as well as by the applied probiotics. The probiotics anti-inflammatory activity varies between different pro-inflammatory genes and different toothpastes. Brushing with selected toothpastes did not decrease probiotic survival across different toothpastes and timepoints.

**Conclusions** Depending on the probiotic strain, colonization and effect of the probiotics are at least *invitro* dependent on the toothpaste used. The survival of the probiotic in saliva is not affected by the toothpaste *ex-vivo*.

#### 0316

## Prediction of Long-Term Oral Health in a Dutch Military Population

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**Objectives** To develop a prediction model for substantial deterioration of oral health defined as tooth loss (either  $\geq 1$  or  $\geq 2$ ), alveolar bone loss (either  $\geq 1$  or  $\geq 2$ ) and a combination of tooth loss and alveolar bone loss using long-term clinical data from a selection of the Dutch military population.

Methods Dental records with data and radiographs available over a period >20 years from patients serving in the Dutch Military were selected resulting in 198 patient files (192 male; 6 female, year of birth between 1958 and 1973; observation time 29-42 years). Bitewing radiographs were assessed for caries activity (CA) and alveolar bone loss (BL) by 2 experienced clinicians. CA was determined as lesions progressing into dentin. BL was determined by assessing sites with ≥ 6mm BL in PM region. 13 predictors were selected: year of birth, sex, military rank, general health (ASA), Diabetes Mellitus type 2, number of medications, smoking, sum CA-score, sum BL-score, maximum BL-score, D-T, M-T, F-T. Data were analyzed using a LASSO technique to select the main predictors. ROC-curves with corresponding AUC-values were calculated corrected for optimism by 500 fold bootstrapping for defined outcome measures. **Results** Predicting ≥1 BL resulted in AUC 0.775 with predictors: year of birth, sex, rank, number of





medication, smoking, caries activity, sum BL, maximum BL-score, D-T, and F-T. Predicting  $\geq$ 2 BL resulted in AUC 0.788 with predictors: rank, smoking, sum BL, maximum BL-score, and F-T. Predicting  $\geq$ 1 BL and  $\geq$ 1 missing teeth resulted in AUC 0.784 with predictors: year of birth, rank, smoking, sum BL, maximum BLscore, M-T, and F-T. Tooth loss was not predictable in our model.

**Conclusions** Our model shows a reasonable ability to predict alveolar bone loss > 6mm, also when combined with tooth loss.

# 0317

# In-Vitro Efficacy of Cleaning Splints Assisting Approximal Plaque Removal

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**Objectives** Cleaning splints (CS) can facilitate interdental brush (IDB) insertion and guide IDB during cleaning movement. This can be in particular beneficial for patients with impaired manual skills and cleaning deficits on tooth surfaces next to wide gaps or on terminal teeth. In this in-vitro study, cleaning efficacy with and without CS was assessed for a fully dentate (FD) and a partially edentulous (PE) situation.

**Methods** A typodont model was used either as FD (all teeth inserted) or as PE (every second tooth missing). For both situations, suitable IDBs were selected and cleaning splints were designed and fabricated (n=10/group) by 3D printing (Freeprint Splint 2.0, Detax). Before and after the standardized cleaning with/without CS model teeth were removed and photographed (Smartzoom 5, Zeiss) at three timepoints: T1) clean surface, T2) plaque simulation (Artificial Plaque, Nissin Dental Products), and T3) after cleaning. For each of the four test groups differing in dental status and use of CS, n=10 tests were performed. After alignment of corresponding photos, the quotient (T2-T3)/(T2-T1) of color differences (Matlab R2022a, Mathworks) was calculated. Cleaning efficacy was set as the mean value over predefined regions of interest. Effects of CS use and dental status were analyzed with two-way ANOVA ( $\alpha$ =0.05). **Results** With FD models, no significant differences were found irrespective of the use of cleaning splints. In contrast, the cleaning efficacy of approximal tooth surfaces in PE models was significantly improved by the use of cleaning splints.

**Conclusions** Cleaning splints can be recommended for clinical application. The results showed no negative effects on approximal plaque removal. For patients with manual impairment or tooth situations that are difficult to clean, cleaning splints might have the potential to improve interproximal hygiene. Clinical studies have to clarify if such an improvement can also be seen for patients with restricted manual skills.



# Oral Inflammation and Cardiovascular-Related Outcomes in a Nordic Population

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**Objectives** Bleeding gums can be an indication of ongoing inflammation in the oral cavity and may develop into periodontitis if left untreated. Inflammatory bacteria from the oral cavity have been found in cardiovascular plaque and poor periodontal health has been associated with cardiovascular events. We aimed to explore in a general population-sample whether self-reported gum-bleeding and periodontitis were associated with cardiovascular-related conditions.

Methods The Respiratory health in Northern Europe (RHINE) study had data om self-reported gumbleeding frequency from baseline in 2010-12 (RHINE III) and periodontitis status and cardiovascular outcomes reported 10 years later (RHINE IV) for 9622 participants (median age 62 years). Associations were explored with logistic regression, adjusted for sex, age, smoking, BMI, and study centre. Results Reporting to "always" or "often" bleed from the gums during toothbrushing at baseline was associated with doctor-diagnosed atrial fibrillation (7.6%): aOR=1.32 (95% CI: 1.21, 1.45) and leg oedema (18.9%): aOR=1.82 (1.37, 2.41) 10 years later. No associations were seen for stroke or angina. Overall, 44% and 31% of those reporting "always or often" (n=339) or "sometimes" (n=1601) gum-bleeding at baseline reported dentist-diagnosed periodontitis at follow-up in RHINE IV. Periodontitis was reported by 20.1% of the participants in RHINE IV, similar for men (20.7%) and women (19.6%). A cross-sectional exploration of RHINE IV data, found periodontitis to be associated with diagnoses of hypertension (36.8%) aOR=1.07 (1.00, 1.14), atrial fibrillation aOR=1.16 (1.01, 1.32) and leg oedema aOR=1.17 (1.02, 1.35). Conclusions Frequent gum-bleeding (as a marker of gingival inflammation), was associated with increased risk of atrial fibrillation and leg oedema 10 years later. Self-reported gum-bleeding at baseline was a strong predictor for periodontitis at follow-up 10 years later. Poor oral hygiene is an easily modifiable risk factor and therefore crucial for public health. Our results support a major preventive potential for improved dental care.

## 0319

## Evaluation of Periodontal Status in Metastatic/Nonmetastatic Breast Cancer Patients

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**Objectives** Previous studies have indicated a positive association between various types of cancer and periodontal disease. While definitive mechanism are not clearly elucidated, some evidence suggest that cumulative, chronic circulating inflammatory mediators involved in the host response from periodontal disease may participate in cancer progression. The purpose of this study is to evaluate periodontal status in patients with breast cancer and to explore if there is an association between severity of periodontal disease and the metastatic status of the breast cancer patients.

**Methods** Thirty voluntary individuals who diagnosed with breast cancer in the Department of Medical Oncology were enrolled in the study.Medical history,oncological records of the patients and the results of positron emission tomography-computed tomography scans were evaluated.Type of the cancer,pathology results and metastatic status were enumerated.Before chemotherapy,oral and periodontal examination of the patient were performed and clinical periodontal parameters including probing pocket depth (PPD),clinical attachment level (CAL),gingival index (GI),periodontal index (PI),DMFT index and periodontal inflammatory surface area (PISA) were recorded.

**Results** The study included 30 patients with ages ranging from 34 to 67 years, with a mean age of 48.07(SD: 8.99).Patient periodontal diagnostic information included:20 periodontitis,6 gingivitis,2 periodontal health,2 peri-implant mucositis.The results of clinical parameters were as follows: PPD 2.95  $\pm$  1.04(1.67 – 6.88),CAL 2,27  $\pm$  1,68(0 - 7,03),Gl 1.61  $\pm$  0.76(0.25 – 3),Pl 1.68  $\pm$  0.77(0.32 – 3), DMFT 9.63  $\pm$  6.86 (2 – 28).PISA was determined to be 564.86  $\pm$  515.80.Metastases were detected in 13 out of the 30 patients (43.3%).Statistically no significant difference was noted in the patients with metastatic breast cancer when compared to non-metastatic breast cancer patients regarding periodontal parameters. **Conclusions** The results of this study show no significant difference in the periodontal parameters of the patients with metastatic and non-metastatic breast cancer.This study remains limited by sample size and future studies aim to address this through addition of more power in the study design.

## 0320

## Is Periodontitis Associated With Risk for Mild Cognitive Lmpairment?

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**Objectives** Evidence from the literature suggest that there is association of severe periodontitis and dementia. Together with increasing age, mild cognitive impairment (MCI) is considered a risk factor for dementia, but also a stage of the disease at which it is possible to act to mitigate and postpone the disease. The aim of this study was to determine whether the increased risk of developing MCI is associated with severe periodontitis in middle-aged patients.

**Methods** Patients diagnosed with periodontitis were included in the study. Patients with severe periodontitis (SP stage III, IV) were considered as cases and those with mild to moderate periodontitis (MP stage I, II) as controls. A detailed medical history and periodontal status were recorded. All patients underwent neuropsychological assessment of cognitive functions: mental flexibility, psychomotor speed and working memory using the Symbol Digit Modalities Test (SDMT; a lower score indicates a higher risk of MCI), Digit Span and Reverse Test, Trial Making Test A, B, BA (TMT) and Attention Matrices Test.



**Results** Of the 102 participants, 71 were SP and 61 were women (59.8%). The average age was 45 years (IQR 8.62). Patients with SP were significantly older and had worse oral, periodontal, and neuropsychological status. A stepwise logistic regression with statistically significant variables was performed to evaluate the relationship between neuropsychological assessment and periodontitis severity: Age, gender, total number of teeth, total number of sound teeth, the Decayed, Missing, and Filled Teeth (DFMT) index and SDMT as predictors. Lower SDMT scores, a lower number of teeth, a lower number of sound teeth and a higher DFMT index predicted SP and explained about 60% of the variance (Nagelkirke R2=0.616).

**Conclusions** This study suggests that in addition to the traditional risk factors for SP, the risk of MCI is also associated with SP in middle-aged patients.

0321

# RCT Comparing Two Intraoral Appliances to Reduce Oral Sequelae Post-Radiotherapy

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**Objectives** To assess oral health outcomes associated with the use of two different intraoral appliances thermoplastic dental splints and 3D-printed tissue retraction devices (TRDs)—following head and neck radiotherapy (RT).

**Methods** In this pilot randomized controlled trial, 29 patients diagnosed with head and neck cancer were randomly assigned to use either a conventional splint (n=14) or a TRD (n=15) during their radiotherapy sessions. The former serves as an active control by shielding against backscatter radiation from dental restorations, while the latter, designed to conform semi-individually to patients' anatomy, aims to further minimize radiation exposure to healthy tissues. Assessments of saliva quality and quantity (Saliva-Check, GC), taste perception (Taste strips, Burghart-Messtechnik), and oral function (JFLS-8, OHIP-14, and maximum mouth opening) were conducted at baseline and three months post-RT. Treatment specifics such as RT target volume, modality, total dose, fractionation, and imaging guidance were tailored to individual cases. Intra-group changes over time were analyzed using Wilcoxon tests, differences between groups using Mann-Whitney-U tests.

**Results** Three months post-RT, taste perception remained unchanged in both groups. Although oral function showed no significant alterations, saliva production under stimulation notably decreased with conventional splints (median reduction: 4 mL, p=0.016) compared to an insignificant reduction with TRDs (median reduction: 2 mL, p=0.07). Dropout rates were higher in TRD group (6/15) than in control group (1/14). While inter-group differences were not statistically significant, trends (p < .1) suggested improved outcomes in terms of functional disability and saliva quality in the TRD group.

**Conclusions** The limited size and variability of the patient cohort necessitate cautious interpretation of these findings. Nonetheless, the initial favorable results for TRDs, particularly in reducing negative oral health impacts, warrant further investigation. The likelihood of adverse effects from TRD use appears low, underscoring the potential of this novel technology in enhancing radiotherapy outcomes.



0338

#### Endodontic Treatment Modifies Circulatory Inflammatory Mediator Levels: a Systematic Review

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**Objectives** Apical periodontitis (AP) represents persistent inflammation within the periapical tissues mostly caused by a range of microorganisms of endodontic origin. Locally produced mediators and microbial virulence factors may enter the bloodstream and potentially sustain a persistent low-grade systemic inflammation, exerting an impact on the general health of the patient. This investigation aimed to systematically review and critically evaluate the evidence on reducing circulatory inflammatory mediators in patients with AP after successful endodontic nonsurgical and surgical treatment.

Methods This systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA) statement, and the protocol of the review was registered a priori with the PROSPERO. A literature search was conducted across the following electronic databases: Web of Science, Scopus, and PubMed from inception to March 2024, with no language restriction. The Gray literature was additionally searched to ensure study inclusivity. Observational studies with prospective or retrospective designs were included. Articles with duplicate or overlapping results, abstract-only papers, case reports, case series, animal studies, and reviews were excluded. All phases were completed by two independent researchers while disagreements were resolved by a third reviewer. The Newcastle–Ottawa Scale (NOS) was used to assess the quality of included studies. Results Sixteen studies were included in the final review following full-text evaluation. As the included studies reported different outcomes, the heterogeneity of data prevented a meta-analysis being undertaken. The included studies were published between 1990 and 2024, with a total of 957 participating individuals with an approximate age range of 18 to 70 years. Although different inflammatory mediators were assessed, most of the studies investigated the change in the serum levels of C-reactive protein before and after endodontic treatment. The overall quality of the evidence for the most included studies was 'Fair', while five studies were categorized as 'Good'.

**Conclusions** Based on 'Fair' and 'Good' quality of evidence it has been shown that successful endodontic treatment reduces the level of circulatory inflammatory mediators in patients with AP.



# Water Presence Impacts the Fracture Behavior of Lithium Disilicate

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**Objectives** To investigate the influence of water storage and presence during mechanical testing on the flexural strength and fatigue behavior of a lithium disilicate glass-ceramic.

**Methods** Ninety bar-shaped specimens (1.0 mm x 1.0 mm x 12.0 mm) were cut from Advanced Lithium Disilicate (CEREC Tessera; Dentsply Sirona) under water cooling using a precision cutting machine. They were subsequently polished and fired according to the manufacturer-recommended protocol. Half of the specimens were stored in deionized water (W) at 37 °C for 30 days, while the other specimens stayed dry (D) for the same period. A 3-point bending test (n=15) was carried out in a dry (d) or wet (w) testing environment to determine flexural strength. A stepwise fatigue test was conducted using the same bending set-up for dry-stored specimens in a dry environment (Dd) and wet-stored specimens in a wet environment (Ww).

**Results** Results: For flexural strength, two-way analyses of variance showed a significant influence of the testing environment (P<0.001), while there was no significant effect for the storage environment (P=0.054) and the interaction of factors (P=0.140). Regardless of storage, testing in water generated a lower flexural strength (Dw:  $242.52 \pm 35.18^{\text{B}}$  MPa; Ww:  $249.53 \pm 57.30^{\text{B}}$  MPa) than in dry environment (Dd:  $323.75 \pm 73.87^{\text{A}}$  MPa; Wd:  $375.87 \pm 60.04^{\text{A}}$  MPa). However, wet storage combined with a wet testing environment exhibited similar fatigue strength (Ww:  $151.78 \pm 38.75$  MPa) to the group without water intervention (Dd:  $148.14 \pm 35.57$  MPa).

**Conclusions** Conclusion: Storage in 37 °C water for 30 days does not decrease the flexural strength of the evaluated lithium disilicate, while the wet testing environment degraded around 30% of the material's strength. The fatigue protocol in this study resulted in about 50% of the initial strength, whereas the wet storage and testing environment did not affect the fatigue strength.

## 0323

## Effect of Repeated Firings on Bond Strength of CAD-CAM Ceramic

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**Objectives** The aim of this in vitro study was to investigate the effect of repeated firing on shear bond strength of lithium disilicate glass ceramic.

**Methods** Fourty rectangular specimens (14 mm x 16 mm, 1.2 mm thickness) were cut from pre-crystalize computer-aided design-computer-aided manufacturing (CAD-CAM) block (IPS e.max CAD, Ivoclar Vivadent, Liechtenstein). These specimens were divided into four groups according to the numbers of firings (control group, 2F, 3F and 5F). After finishing firing cycles for each group, all specimens ultrasonically cleaned. Then, specimens were etched with 9.5% hydrofluoric (HF) acid gel (Royalry Acid



Gel, Imicryl, Turkey) for 20 s, rinsed for 1 min, air dried, and conditioned by a silane coupling agent (Ceramica Silane Activator, Imicryl, Turkey) for 30 s and dried. Polyethylene mold having a tube were positioned over the disc surface, then cement (Nova Resin, Imicryl, Turkey) was injected into the tube through the mixing tip. Light curing was done through the tube for 40 s. The prepared test specimens were stored in incubator for 24 h at 37 °C. The shear bond strength (SBS) of the ceramic discs was evaluated using a universal testing machine with a crosshead speed of 1 mm/min. The value at which the ceramic disc and the resin material ruptured was recorded. Data were analyzed by Kolmogorov-Smirnov, Kruskal-Wallis and Mann-Whitney U test (p<0,05).

**Results** No significant difference was found between the values of different groups (p=0,598). The highest SBS (MPa) value was found in control group (20,7 ±1,4), while the lowest value was found in 5F firing specimens (19,2 ± 0,82).

**Conclusions** Repeated firing did not affect the SBS of the lithium disilicate ceramic. However, clinician should away unnecessary firing process. All occlusal adjustments and characterization must be completed before final firing.

# 0324

# Mechanical Properties and Machinability Assessment of Four CAD/CAM Block Materials

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**Objectives** This study aimed to assess the machinability and characterize the mechanical properties of three composite based blocks as compared to a ceramic block.

Methods Cerasmart (CS), Lava Ultimate (LU), Grandio Blocs (GR), and Initial<sup>™</sup> LRF (IR) blocks were investigated. Flexural strength and modulus, fracture toughness and Vickers hardness were evaluated using the corresponding ISO norms (ISO 6872:2015, ISO6872:2015, and ISO10477:2020 respectively). Merlon fracture test (Machinability) was performed according to ISO18675.2018 and scanning electron microscopy was used to examine sample borders. Finally, statistical analysis was performed using One-Way ANOVA at P=0.05.

**Results** GR had significantly higher flexural strength values than other blocks. IR had significantly highest flexural modulus values. Fracture toughness values showed significantly lower values for CS. While IR had significantly higher Vickers hardness values. The brittleness index for the tested blocks was calculated and showed significantly higher brittleness index for the IR block. The machinability data revealed no fractured walls for all tested blocks. However, the bottom of the IR block hollow part was perforated. Scanning electron microscopy images revealed differences regarding the machined walls.

**Conclusions** The mechanical properties of the CAD-CAM block materials tested were within the acceptable range according to the ISO standard for ceramics (ISO 6872:2015). The machinability of the four tested materials were satisfactory according to the ISO standards (ISO 18675), while the ceramic based block showed lesser edge quality in comparison to the resin based blocks. From a clinical perspective, the corresponding properties should be taken in consideration for specific indications.



# Choosing Biomaterials for Bruxism Patients: in Vitro Pilot Study

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**Objectives** This study is meant to provide data for selecting the right biomaterials for a clinical study of the survival of fixed dental-supported prosthesis in bruxism patients. The objective is to compare the biaxial flexural strenght of diverse CAD/CAM biomaterials, before and after a mechanical fatigue, similar to bruxism.

**Methods** A composite CAD/CAM bloc Cerasmart 270 (C270), a polymer-infriltrated composite network bloc Enamic (ENA) and a lithium disilicate ceramic bloc (EMX) were studied. 12x0.2mm discs of each material were prepared. The samples have been soaked in water for 10 days prior to testing. The biaxial flexural strenght (piston on 3 balls, P3B) was measured (n=3). A fatigue test simulating 457 day of bruxism, using variable loads between 20N and 130N, at 37°C and 95% humidity was performed (n=3). The main outcome was the survival of the sample - absence of fracture. After the fatigue test, the surviving samples were studied under optical microscope looking for cracks and fissures. A post-fatigue biaxial flexure test was also performed. The results were analysed with a non-parametric Kruskal-Wallis test, then a Dunn test, p= 0.05. The survival test was analysed with a Log-Rank test.

**Results** The biaxial flexural strenght (MPa) of the biomaterials prior to any fatigue was: ENA 152.64±5.64, C270 288,80±4,55 and EMX 468,14±13,82. Only in EMX and C270 groups, all samples have survived the bruxism simulation. A loss of up to 27% (77MPa, C270) of the biaxial flexure resistance was registered after fatigue.

**Conclusions** The studied biomaterials have a different resistance to fatigue simulating bruxism. C270 can be proposed for a clinical study on the survival of fixed prosthesis in bruxism patients, where it should be compared to the disilicate vitro-ceramic, EMX.

## 0326

## Performance Assessment of Speed-Sintered Multigrade Monolithic Zirconia Ceramics

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**Objectives** To evaluate the performance of speed-sintered multigrade monolithic zirconia through a comprehensive analysis of its microstructure, optical and mechanical properties. **Methods** Speed-sintered multigrade 4Y/5Y-PSZ ZirCAD MT Multi (Ivoclar) (total thermal cycle: 60 min) was compared to 4Y-PSZ Katana HT (total thermal cycle/sintering time/dwell temperature: 90min/30min/1515 °C) and 5Y-PSZ Katana STML (Kuraray Noritake) (90min/30 min/1560 °C). Density was determined according to the Archimedes principle; chemical composition was determined using X-ray fluorescence; phase composition was characterized using X-ray diffraction; grain size was measured using scanning



electron microscopy; Translucency Parameter was measured with a spectrophotometer. Vickers hardness, indentation fracture toughness and biaxial strength were also assessed. Layers of polychromatic zirconia was evaluated by light microscopy and nanoSEM-EDX. Statistical analysis involved one-way ANOVA and post-hoc Tukey's HSD test (α=0.05).

**Results** All zirconia grades showed similar density ( $\approx$ 6.02±0.01 g/cm<sup>3</sup>). ZirCAD MT Multi was characterized by three distinct layers, each with different phase compositions. 5Y-PSZ layer contained the highest amount of Y<sub>2</sub>O<sub>3</sub> in the remaining tetragonal ZrO<sub>2</sub> phases (5.4 mol%) compared the transition and the 4Y-PSZ layer (4.6 mol% and 3.5 mol%, respectively). The grain size between the 4Y-PSZ layer and Katana HT was similar ( $\approx$ 0.3 µm), while the 5Y-PSZ layer had a smaller grain size (0.9 µm) compared to Katana STML (1.2 µm). Transition layer revealed the presence of agglomerates consisting of small grains, higher Y<sub>2</sub>O<sub>3</sub> content and presence of Er. No statistical difference in hardness was observed. Toughness of 4Y-PSZ layer (3.7 MPa m<sup>1/2</sup>) was significantly higher compared to Katana HT (3.2 MPa m<sup>1/2</sup>). There was no statistical difference in TP between 4Y-PSZ and 5Y-PSZ layers and Katana HT and STML, respectively. ZirCAD Multi MT showed significantly lower biaxial strength compared to Katana HT (548.6±63.9), but demonstrated the highest mechanical reliability (m=11).

**Conclusions** Multigrade 4Y/5Y-PSZ zirconia showed similar density, microstructure, translucency and hardness compared to monograde zirconia. However, further studies should focus on improvement of flexural strength of speed-sintered multigrade zirconia.

## 0327

# Evaluation of Thermoplastic 3D Printing for Zirconia-Based Dental Applications

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**Objectives** Threedimensional printing is transforming manufacturing of prosthetic restorations by allowing for precise creation of custom-tailored zirconia ceramics with minimal waste. While vat photopolymerization (VPP) stands out for its precision, thermoplastic material extrusion (MEX) introduces possibility of multi-material fabrication, though it faces challenges in achieving necessary dimensional accuracy. This study aims to assess potential of MEX in production of clinically viable zirconia dental structures, comparing its dimensional accuracy and mechanical properties with those achieved through VPP and traditional CAD-CAM milling.

**Methods** Zirconia dental bars (approx. 15×4×8 mm) were manufactured using MEX (Prusa i3 MK3S, Prusa, Czech Republic), VPP (CeraFab 7500, Lithoz, Austria), and CAD-CAM milling as a control (n=10/group). Bars were scanned by nano-computed tomography (Xradia Versa 620, Zeiss, Germany). 3D deviation was analyzed using root mean square values (RMS). Additionally, disk-shaped specimens (n=30/group) were fabricated to assess surface roughness (Sa), density, porosity, grain size analysis (SEM), and biaxial flexural strength. Statistical analysis was conducted using ANOVA with Tukey's HSD post hoc and Weibull analysis coupled with fractography for mechanical properties (P<0.05).

**Results** CAD-CAM milling and VPP showed superior dimensional accuracy over MEX, with RMS values within clinically acceptable margins (below 150  $\mu$ m). MEX exhibited the highest surface roughness (Sa=0.83±0.02  $\mu$ m) and porosity, while Sa values of VPP (0.33±0.01  $\mu$ m) and CAD-CAM milling (0.34±0.08



μm) were comparable. Mechanical testing revealed that while CAD-CAM milling exhibited the highest characteristic strength (1240 MPa) and reliability, followed by VPP (1120 MPa) and MEX (960 MPa), all groups reached clinically acceptable strength levels. Critical flaws observed in VPP and MEX specimens were predominantly process-related.

**Conclusions** Despite its current challenges in dimensional accuracy and mechanical strength relative to traditional CAD-CAM milling and VPP, MEX's capability to fabricate multi-material dental prostheses remains promising. The findings suggest further optimization of MEX parameters to enhance its application in the dental field.

## 0328

## Effects of Vacuum Sintering on 3Y, 4Y and 5Y Zirconias

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**Objectives** This study aims to investigate the mechanical and aesthetic properties of 3Y, 4Y and 5Y zirconia in A3 shade using traditional and vacuum sintering furnaces.

**Methods** A total 135 samples of 3Y, 4Y and 5Y zirconia in A3 shade (Explore Esthetic, Upcera, China) (n=45) were sectioned in size of ~Ø20mm ×1.3mm. Then, these samples were cleaned and polished with 200- and 1000-grits SiC abrasive water under deionised water. After 1 day of drying, 15 samples of each zirconia were randomly allocated to two sintering furnances, traditional (Zyrcomat 6000MS, VITA) and vacuum (CS6, Ivoclar) using three sintering programme: S1) 64 mins for vacuum sintering heated to 1560°C; S2) 74 mins for vacuum sintering heated to 1560°C; and S3) 7h 29 mins heated to 1550°C for traditional sintering. Colour parameters of  $\Delta E$ ,  $\Delta L$ ,  $\Delta a$ ,  $\Delta b$  (Colourimeter, Nix Pro 2), surface roughess (AFM, Bruker's EDGE), surface gloss (Glossmeter, WG45) and biaxial axial strength  $\sigma_{BFS}$  (Universal Testing Maching, Instron E3000, following ISO 6872:2015) were evaluated on all sintered samples. The significant level was pre-set as 0.05 for all statistical tests.

**Results** In terms of colour parameters, two-way ANOVA revealed that, while  $\triangle E$ ,  $\triangle L$ ,  $\triangle a$  and  $\triangle b$  are significantly differnet on zirconia types (p<0.001), sintering programmes are significantly different on a (p=0.002),  $\triangle E$  and L (p<0.001) but not b (p=0.071). Compared to S3, all  $\triangle E$ ,  $\triangle L$ ,  $\triangle a$  and  $\triangle b$  are significantly higher in S1 than S2 for all zirconias, except for  $\triangle L$  for 4Y that has no difference (p=0.50). In terms of glossiness, the type of zirconia (5Y>4Y>3Y, p<0.001) and sintering programme (S3>S2>S1, p<0.001) have a significant difference. In terms of roughness, only sintering program (S1<S2=S3, p<0.001) has shown a significance. For  $\sigma_{BFS}$ , both zirconia (3Y>4Y=5Y, p=0.01) and sintering programme (S3>S2=S1, p<0.001) have shown a statistical significance.

**Conclusions** Vacuum sintering S1 and S2 have substantial impact on the mechanical and aesthetics properties on 3Y, 4Y and 5Y zirconia.



# 20-Year Results of Cast Gold and CAD/CAM Partial Ceramic Crowns

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**Objectives** To investigate the long-term clinical performance of cast gold partial crowns (CGPCs) compared to CAD/CAM partial ceramic crowns (PCCs) after up to 20 years. The null-hypothesis was that CGPCs and PCCs reveal similar survival and performance.

**Methods** In this controlled, prospective, clinical split-mouth study, initially, 29 patients received one CGPC (Degulor-C) and one PCC (Vita Mark II/Cerec3). The follow-up examination after 20 years was performed by two independent investigators using both, modified USPHS- and FDI-criteria. Kaplan-Meier survival rates were calculated. Non-parametrical statistical procedures ( $\chi^2$ , log-rank (Mantel-Cox),  $\alpha$ =0.05) were applied.

**Results** Out of the initially 29 patients, 11 patients with 19 restorations could be recruited for a recall after a median (25-75%) observation period of 238 (236; 242) months (19.9 years). Within these 11 patients, 10 CGPC and 9 PCCs were still in service.

Kaplan-Meier analysis showed cumulative survival of 73.3 % for CGPC and of 55.6 % for PCC, without statistically significant differences. All available restorations showed ratings within the acceptable range in all criteria (USPHS: Alpha or Bravo except for secondary caries, FDI-ratings 1-3). For USPHS-criteria surface lustre ( $p \le 0.002$ ) and marginal discoloration ( $p \le 0.02$ ), both, CGPCs and PCCs, revealed a significant deterioration over time. Additionally, marginal adaptation of PCCs deteriorated over time (p < 0.001), whereas GCPCs revealed significantly better results (p = 0.003). In FDI criteria, CGPCs performed significantly better in criteria surface staining (A2a; p = 0.047) and marginal adaptation (B6; p = 0.01) compared to PCCs.

**Conclusions** All posterior gold and ceramic partial crowns available for evaluation showed acceptable results after up to 20 years, with slight advantages for gold partial crowns in singular criteria. The findings of the present study suggest that gold cast partial crowns and CAD/CAM ceramic partial crowns can both be confidently recommended for long-term clinical application.

0331

## Development of Chlorhexidine-Loaded Lipid Nanoparticles Incorporated Into Endodontic Sealers

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**Objectives** This study aimed to assess several bioceramic sealers (BCS) incorporating liposomal chlorhexidine digluconate (CHX) for its antibacterial activity, drug release capacity, and physicochemical properties.

**Methods** Drug release of CHX liposomal formulations in combination with BCS was evaluated spectrophotometrically and through mathematical release models for 30 days. A selected combination was evaluated for antimicrobial properties against *Enterococcus. faecalis (E. faecalis)* biofilm growth on human dentin. Cytotoxicity was assessed following the ISO 10993-5:2019 standard on days 1, 3, and 7. Physicochemical properties were evaluated through setting time, Fourier transform infrared spectroscopy (FTIR), solubility, contact angle, and film thickness.

**Results** From BR, liposomal CHX released up to 7-fold higher CHX than CHX solution (p<0.05), following a triphasic drug release pattern compared to the CHX solution, which followed a quasi-Fickian diffusion. BCS combined with a selected liposomal CHX completely inhibited *E. faecalis* biofilm growth compared to the combination of BCS with CHX solution and the control group (p<0.05). Liposomal CHX decreased the contact angle (p<0.05) and solubility but increased cytotoxicity (p<0.05) of BCS, staying above the ISO threshold. None of the other physicochemical characteristics tested differed from BR (p>0.05). **Conclusions** This liposomal formulation improved CHX release from BCS, enhancing the antibacterial effectiveness. It presents a promising approach for local anti-biofilm therapy in endodontics without substantially altering the physicochemical characteristics of BCS.

#### 0332

# Biocompatibility of Experimental Fluoride-Doped Calcium Phosphates as Promising Remineralizing Materials

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**Objectives** Innovative fluoride-doped calcium phosphates (FDCP) may be used as "bioactive" materials for dental applications. This in vitro study aimed at assessing the biocompatibility and osteoinductive potential of the tested FDC and experimental adhesives containing FDCP fillers on Human Dental Pulp Stem Cells (hDPSCs).

**Methods** Five specimens of FDCP doped with different concentration of fluoride (0, 5, 10 and 20 %), as well as adhesives containing 0, 5, 10 and 20% of fluoride on hDPSCs were tested at different dilutions (undiluted, from 1:5 to 1:100) and the eluates were prepared according to ISO 10993-12. Viability assays were conducted using the MTT test. Furthermore, self-renewal and migration activity evaluations were carried out. Osteogenic differentiation potential was tested by Alkaline Phosphatase Activity and Alizarin Red Staining.

**Results** Our results demonstrated that the powders with greatest toxicity on hDPSCs were those without 0 and 20% fluoride when diluted at 1:1. The undiluted adhesives showed a reduction in viability after 24 hours, while at 1:50 and 1:100 diluted adhesives containing the filler FDCP 20% fluoride caused an increase in cell proliferation after 48 hours. The FDCP powder containing 20% fluoride caused a significant decrease in clonogenic capacity, while the adhesive had the opposite effect. The scratch test did not highlight significant differences in terms of the migratory capacity of the cells. The FDCP powder



with 20% fluoride showed an osteoinductive effect, while the adhesives seemed not to affect the osteogenic differentiation.

**Conclusions** The experimental fluoride-doped calcium phosphates are not cytotoxic on hDPSCs at specific dilutions, which can also promote cell proliferation, stem proprieties and osteoinductive potential. Hence, our future studies will now focus on the most appropriate concentrations of FDCP to be used in order to obtain experimental materials for preventive and operative dentistry.

0333

# Effects of Plant-Based Agents on Root Canal Dentin Mineralization.

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**Objectives** Natural irrigation agents can create different effects on the mineral contents of root dentin, so it is important to know what effects each solution will have on root dentin before its clinical use. Various natural-based irrigants have been recently proposed due to their antimicrobial activity and fewer side effects. Bromelain is a natural cysteine protease enzyme, obtained from the stems and fruits of pineapple plants. Phytic acid is the source of phosphorus found in plant seeds. This *in-vitro* study aims to provide alternative uses by comparing traditional irrigation solutions and natural-based irrigants in terms of their effects on the mineral content of root dentin.

**Methods** Extracted human mandibular premolar roots were prepared and divided into groups according to the following irrigation protocols: 17% ethylenediaminetetraacetic acid; 1% phytic acid; %5.25 sodium hypochlorite; %0.05 Bromelain; and deionized water (control). Dentin chips were obtained. The levels of different minerals were analyzed with the use of Inductively coupled plasma - optical emission spectrometry.(ICP-OES)

**Results** The effect of different solutions on minerals was statistically significant, except calcium (p<0.01). Phytic acid and EDTA have been shown to increase the calcium ratio, while bromelain and NaOCl have decreased it; however, this decrease was not found to be statistically significant(p<0.01).When it comes to the Ca/P ratio, all solutions have exhibited a decreasing trend compared to the control group; however, no statistically significant difference could be found.Bromelain solution increased K, S, Fe, and Cu levels compared to NaOCl, while NaOCl increased B levels (p<0.01).PA and EDTA affected minerals differently. PA showed higher levels of Mg, K, B, and Cu minerals compared to EDTA.

**Conclusions** According to the results of this in-vitro study, natural agents may be an alternative to traditional solutions regarding their effects on dentin mineralization. Even if the solutions we use are natural, their potential to affect dentin should be taken into account, and the ideal application percentage and duration should be determined for each solution to be used.

0334

## Cytotoxicity and Biomineralization Effects of a Novel Calcium-Silicate-Based Cement

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**Objectives** The objective of this *in vitro* study was to assess the biocompatibility and biomineralization effects of a novel calcium-silicate-based cement BIOfactor MTA (Imicryl Dental, Konya, Turkey) using human-derived dental pulp stem cells (DPSCs), comparing the results with those for BIO MTA+ (Cerkamed, Pawlowski, Poland), and Angelus MTA (Angelus, Londrina, Brazil).

**Methods** Discs (8-mm diameter, 2-mm thickness) were fabricated using sterile silicon molds. After a 48hour setting period, each disc was immersed in cell culture media and 24-hour extracts were obtained. DPSCs were seeded at a density of 10<sup>4</sup> cells per well in 12-well plates and cultured with pure extract or 1:2, 1:4 or 1:8 dilutions of the extracts. Cell viability was evaluated by WST-8 assay after 24 hours of extract treatment. DMSO served as the positive control, while the culture medium served as the negative control. The alkaline phosphatase (ALP) activity of DPSCs was assessed after 7 days of treatment. Cytotoxicity data were statistically analyzed using Kruskal-Wallis and post hoc Games-Howell tests, while ALP data were statistically analyzed using one-way ANOVA and post hoc Tukey's tests.

**Results** Angelus MTA (Undiluted: 38.66±12.70% and 1/8 concentration: 56.76±36.86%) were found to exhibit cytotoxicity, as their viability percentages were below the threshold of 70% set by the ISO 10993. ALP activity of DPSCs demonstrated a significant decrease by exposure to BIO MTA+ extract (p<0.05), whereas no significant difference was observed for Angelus MTA and BIOfactor MTA compared with the negative control (p>0.05).

**Conclusions** The novel calcium-silicate-based cement BIOfactor MTA showed no cytotoxicity and its biomineralization effects were greater than BIO MTA+, demonstrating favorable biological properties on DPSCs viability and hard tissue formation ability.

## 0335

# Antibacterial Efficacy and Characterisation of Single Syringe Hydraulic Calcium Sealers

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**Objectives** To characterise the physical and antimicrobial properties of single syringe hydraulic calcium silicate sealers.

**Methods** Single syringe hydraulic cement sealers, AH Plus Bioceramic (Dentsply) and BioRoot Flow (Septodont) were compared with hand mixed sealers - AH Plus and BioRoot RCS. The microstructure and composition of the sealers were assessed using scanning electron microscopy (SEM) and energy dispersive spectroscopy. Crystalline phases and compositional changes were assessed by X-ray diffraction analysis and Fourier transform infrared spectroscopy. The pH was also monitored. Antimicrobial properties of the materials were assessed using a direct contact assay with *Enterococcus faecalis* and *Fusobacterium nucleatum*. All tests were performed at 0, 28 and 90 days (n=3). ANOVA followed by Tukey post-hoc tests were applied to parametric data, and Kruskal-Wallis applied to non-parametric data.

Results All sealers exhibited the presence of zirconium, calcium, and silicon. SEM images revealed



porosity and cracks in all sealers after 28 and 90 days. BioRoot RCS displayed calcium hydroxide peaks at later time points. No significant changes were observed in single-syringe hydraulic sealers and AH Plus. BioRoot Flow had a significantly higher pH than AH Plus at 28 days (p=0.01) and 90 days (p<0.05). BioRoot RCS demonstrated the highest calcium release (p<0.05), followed by single-syringe hydraulic sealers. AH Plus displayed the lowest calcium release and showed increased bacterial attachment compared to single syringe TCS sealers however, BioRoot RCS displayed significant (p<0.05) antimicrobial properties against *E. faecalis* and *F. nucleatum* growth. AH Plus resulted in the least bacterial colony reduction. **Conclusions** Single syringe hydraulic sealers exhibited slower hydration, reduced release of calcium hydroxide compared to BioRoot RCS resulting in lower antimicrobial activity. BioRoot RCS emerges as the most effective antimicrobial sealer, while AH Plus displays the least efficacy. These findings underscore the importance of considering both physical and antimicrobial characteristics when selecting endodontic sealers.

## 0336

# "Is Dead Really Dead?" Membrane-Potential and Intracellular-pH Affect Viability Staining

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**Objectives** The uptake of propidium iodide (PI) in bacterial cells during viability staining correlates with both membrane potential (Dψ) and intracellular pH (pH<sub>i</sub>) distribution. A boosted Dψ or pH<sub>i</sub> decrease enables increased accumulation of PI and can yield falsely positive results for viable bacterial cells. **Methods** In the present study, the uptake of PI across intact cell membranes for facultative and obligate anaerobic oral microorganisms was examined. The aerobic *Micrococcus lylae* was used as a reference to enable comparison. The tested bacterial cells were screened during anoxic (aerobic, facultative and anaerobic; 1 h anoxia, 37°C), oxic (all anaerobic; 1 h aeration in CO<sub>2</sub>, 37°C) and oxic-anoxic (all aerobic and anaerobic; 1 h aeration in CO<sub>2</sub> followed by 1 h anoxia or conversely, 37°C) transitions. Untreated cells in exponential growth phase served as negative control. To visualize changes in membrane potential the carbocyanine dye DiOC<sub>2</sub> (3; 3,30-Diethyloxacarbocyanine lodide) was applied, whereas BCECF-AM (2',7'-Bis-(2-Carboxyethyl)-5-(and-6)-carboxyfluorescein) acetoxymethyl ester) was used as intracellular ratiometric pH indicator. The Live/Dead\* BacLight™ Kit (Syto 9/PI) combined with confocal laser scanning microscopy (CLSM) was applied to monitor bacterial viability. Finally, image quantification and statistical analysis (Kruskal-Wallis test) were conducted.

**Results** Short-term changes in oxygen supply induced bidirectional changes in D $\psi$  and pH<sub>i</sub>. The anaerobic preincubation of facultative anaerobic microorganisms resulted in high PI uptake and thus, the presence of falsely marked "dead" cells in the untreated controls. In *Streptococcus mutans* an aeration-related decrease in D $\psi$  and increase in pH<sub>i</sub> led to a lower PI uptake in the streptococcal cells compared to the untreated control.

**Conclusions** Overall,  $D\psi$  and  $pH_i$  seem to contribute actively to ATP regeneration and thus, PI uptake in aerobic and anaerobic oral bacterial cells. New alternatives to PI should aim at reducing falsely positive cells marked as dead during viability staining.



# A New Potential Solution for Cell Viability in Avulsed Teeth

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**Objectives** The objective of this study was to determine a developed propolis hydrogel's capacity to maintain viability of human gingival fibroblasts cells (HGF-1) and evaluate its potential as avulsed teeth storage media before replantation.

**Methods** Two hydrogel samples (water and ethanol-based propolis extracts) were developed, and two different concentrations, 50% and 25%, of both samples were investigated. 100% phosphate buffered saline (PBS) served as a negative control. HGF-1 cells were treated with the hydrogels or PBS mixed with cell growth media (DMEM+10% FBS +1% antibiotics) for 1h and 6h. HGF-1 cells viability was measured fluorimetrically using the PrestoBlue reagent (Thermo Fisher Scientific).

**Results** The HGF-1 viability after 1 hour storing in different hydrogel samples were as follows: 66.12% and 88.93% in water-based 50% and 25% propolis extract, respectively; 118.86% and 102.71%, in ethanolbased 50% and 25% propolis extract, respectively. PBS-immersed HGF-1 viability after 1 hour was 94.93%. After 6 hours measurements were repeated and revealed 90.26% and 91.99% of HGF-1 viability in water-based 50% and 25% propolis hydrogel while the corresponding figures for ethanol-based 50% and 25% propolis hydrogel were 114.7% and 83.22%, respectively. After 6 hours in PBS, only 71.84% HGF-1 remained viable.

**Conclusions** Hydrogels containing propolis extracts can effectively preserve HGF-1 cells viability for at least 6 hours and could be considered a valuable option of avulsed teeth storage media prior to replantation.

## 0339

## Enhancing Implant Prosthodontics: in Vitro Accuracy of Coded Healing Abutments

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**Objectives** The aim of this study was to investigate the accuracy of conventional and digital impression-taking and cast-fabrication using coded healing abutments under in vitro conditions.

**Methods** Our study investigated the accuracy of the On1 Concept (Nobel Biocare; Kloten, Switzerland) coded healing abutment system using conventional and digital workflows. The control group was the Conical Connection (Nobel Biocare; Kloten, Switzerland) system.

An edentulous mandibular typodont with four implant analogs positioned as an all-on-4 status was used as reference.

10-10 open-tray impressions and intraoral scans were taken from the reference model with each system. Models built from intraoral scans were additively fabricated, whereas open-tray impressions were poured with type-4 dental stone.

The prepared models were digitized with an industrial-grade scanner (Maestro MDS500; Pisa, Italy), and then both the intraoral scan files and the digitized models were examined, thus allowing us to measure the accuracy of the impression-taking and cast-fabrication separately. Four linear distance and RMS deviations were calculated using Geomagic Control X (3DSystem; Rock Hill, USA).

**Results** For preliminary results, five intraoral scan files and digitized open-tray impressions were superimposed on the reference model to measure four linear deviations and RMS deviations.

The average linear deviation in the On1 group was 30,93µm±68,58µm using the open-tray impression method, whereas using optical impression, it was -14,05µm±-97,25µm.

The RMS deviation was 40,17  $\mu$ m±-14,91  $\mu$ m for open-tray impression-taking and 85,44  $\mu$ m±-13,09  $\mu$ m for intraoral scanning.

In the Conical Connection group, the average linear deviation was 14,98µm±62,78µm using conventional impression and -32,05µm±78,13µm using optical scanning.

The RMS deviation for open-tray impressions was 45,90µm±25,02µm, while it was 120,84µm±10,25µm for using an intraoral scanner.

**Conclusions** Based on the preliminary data in three out of four outcomes, the On1 system showed better accuracy compared to the Conical Connection system. However, all the measured values are clinically acceptable.

## 0340

## Occlusal Wear in Milled Dental Prostheses: a Clinical Pilot Study

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**Objectives** The study aims to evaluate occlusal changes in CAD/CAM milled complete removable dental prostheses (CRDP) at 6- and 12-months follow-up.

**Methods** Edentulous patients aged 60 years or more received either maxillary and mandibular conventional CRDPs or a maxillary conventional CRDP and a mandibular implant-overdenture (IOD). All protheses were CAD/CAM fabricated by subtractive milling. The prosthetic teeth were either milled from a monolithic two-colored shell-geometry PMMA disk (IM) or milled from a tooth-colored multi-layer disk (IO) prior to bonding to the denture base. The occlusal surfaces were scanned at 2 weeks post insertion (baseline) and compared to the scans at 6- and 12-months follow-up with a software using a best-fit algorithm (Geomagic Control<sup>®</sup>). Additional comparative analysis of multiple points on the buccal and



lingual cusps of the posterior teeth was conducted. Outcome parameters were root mean square (RMS) accounting for all deviations and average negative deviations (AVG-). Non-parametric tests were conducted to compare different time points and type of prostheses with a significance level set at P<0.05. **Results** Twelve patients were included (mean age: 74±11.5 years). Six patients received conventional CRDPs while another 6 had a maxillary conventional CRDP and a mandibular IOD. 8 patients had their CRDP fabricated from IM, the remaining 4 patients from IO disks. RMS increased at the 6- and 12-months follow-up (50.3±20.92 µm, and 69.6±25.25 µm; p=0.038). The AVG- increased in the maxilla from - 36.6±15.55 µm at 6 months to -57.7±22.64 µm at 12-months (p=0.008), and in the mandible from - 35.6±12.60 µm to -56.3±20.08 µm (p=0.017). The comparative analysis of the selected reference points revealed negative deviations. No significant variations were found between the two tooth materials or CRDP versus IOD prosthesis.

**Conclusions** The findings indicate a pattern of material loss consistent with wear, underscoring the importance of long-term monitoring of milled CRDPs for maintaining occlusal integrity and function.

## 0341

# Effect of Wall-Thickness on Fracture Resistance of 3D-Printed Zirconia Teeth

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**Objectives** The purpose of this study was to analyze how the wall thickness of 3D-printed hollow zirconia teeth affects the fracture resistance.

**Methods** Data sets for the different artificial teeth resembling a mandibular right first molar were created (Geomagic design X, 3D systems) with internal structure as hollow. The outer geometry was identical, and wall thicknesses of artificial teeth were 0.30 mm, 0.50 mm, 0.75 mm, and 1.00 mm, respectively. Twenty zirconia teeth were fabricated using a 3D printer (CeraFab 7500 Dental, Lithoz) for each group, and sintered before support removal. The artificial teeth were divided into subgroups of teeth which remained hollow (hollow teeth) or were filled with PMMA (filled teeth). After fracture load tests were performed, each artificial tooth was examined using a digital microscope and a SEM. ANOVA was used to compare the fracture resistance of the zirconia artificial teeth among the conditions, followed by pairwise Tukey tests. To compare fracture resistance between hollow and filled teeth within each wall thickness, t-test were applied. The significance level was  $\alpha$ = 0.05.

**Results** Fracture resistance of artificial zirconia teeth decreased significantly (P<0.001) with decreasing wall thickness. Mean fracture loads reached 500 N or higher values only for wall thicknesses of 0.75 mm and 1.00 mm. A resin filling of the crowns did only lead to a significantly improved fracture load for very thin walls. The microscopy and SEM observation showed that most of the occlusal surfaces of the hollow teeth were completely fractured, whereas all the fracture surfaces of the filled teeth were incompletely fractured.

**Conclusions** The wall thickness of 3D-printed hollow zirconia teeth affects the fracture resistance, and zirconia artificial teeth had sufficient fracture resistance for clinical use when the wall thickness is 0.75 mm or greater regardless of the presence of filling with resin.



# Effect of Mouthwashes on Optical Properties of Novel Zirconia Ceramics

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**Objectives** Mouth rinses can lead to adverse effects such as discoloration of restorative materials. The purpose of this study was to investigate the effect of mouth rinses on the color and translucency of two new generation CAD/CAM zirconia ceramic materials.

**Methods** Forty specimens were fabricated from each zirconia ceramic (totally 80 specimens): monolithic zirconia (VITA YZ HT) and multilayered zirconia (IPS emax ZirCAD Prime). Each subgroup (n=10) was immersed in one of the following four solutions: distilled water, chlorhexidine (%0.2), Listerine Mouthwash (advanced white) and Glimo Care mouthwash for 180 hours. The baseline color values were recorded according to the CIElab system with a spectrophotometer (Vita Easyshade 4.0). The color coordinates (L\*, a\*, b\*) of the specimens were measured before and after immersion and TP (translucency parameter),  $\Delta E$  (color difference) values were calculated by using the CIEDE2000 color difference formula. The data were analyzed by two-way ANOVA followed by Tukey's post-hoc tests ( $\alpha = 0.05$ ).

**Results** Color changes occurred in the experimental groups . The  $\Delta E^*ab$  values were significantly greater in IPS Emax ZirCAD PRIME compared to VITA YZ HT (p<0.001). Mouthrinse type also significantly affected the  $\Delta E$  value(p=0.004). In post hoc comparisons, the difference was found to be due to the lower  $\Delta E$  value of ceramics immersed in chlorhexidine (0.97±0.63), compared to Glimo Care (1.36±0.91) and Distilled water (1.11±0.68). The ceramic type had an impact on TP values difference , but the change over the immersion time was not statistically significant. It was found that the mouthwash type did not have a significant effect on TP change (p=0.144).

**Conclusions** In both novel zirconia types, color change was observed after immersion in mouthrinses. The color change was greater in the multilayered zirconia ceramic. Chlorhexidine caused less discoloration in both ceramic types. Glimo Care reduced the translucency, while Listerine increased.

BLOCS	MOUTHRINSE	TP BEFORE	TP AFTER	ΔΕ
ТҮРЕ	TYPE	(Mean±SS)	(Mean±SS)	(Mean±SS)
IPS emax ZirCAD PRIME	Distilled Water	2,60±0,87	2,25±0,56	1,64±0,56
IPS emax ZirCAD PRIME	Chlorhexidine	2,16±0,70	2,27±1,05	1,45±0,56
IPS emax ZirCAD PRIME	Glimo Care	3,05±0,54	1,92±0,32	2,17±0,45
IPS emax ZirCAD PRIME	Listerine	1,92±0,67	2,23±0,38	1,91±0,46
VITA YZ HT	Distilled Water	3,01±0,62	2,83±0,31	0,58±0,19
VITA YZ HT	Chlorhexidine	3,27±0,46	3,26±0,38	0,49±0,17
VITA YZ HT	Glimo Care	2,88±0,47	2,87±0,55	0,55±0,32

Translucency parameters of 4 different mouthwash types in two different blocks



VITA YZ HT	Listerine	2,64±0,41	2,78±0,40	0,85±0,28

# Preferred Chewing Side and Hemispheric Body Laterality

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**Objectives** The aim of this study is to examine if a person's preferred chewing side (PCS) corresponds to his/her hemispheric body laterality (HBL) or is dominated by the dental state.

**Methods** After ethical approval, eighty-two volunteers were recruited for this experimental study. In a clinical examination, the number and location of natural teeth and prostheses were noted. The PCS was evaluated using an asymmetry index (ASI) and a visual analog scale (VAS). Both tests were repeated. As for the HBL, participants underwent 4 different tests. First they were asked to stir liquid in a glass (HAND). Afterwards, they were asked to stamp on a piece of paper placed on the ground (FOOT). We then observed into which ear the participant placed one single ear phone (EAR). Finally, we registered which eye the participant used for looking into a dark bottle (EYE). The tests were performed in a randomized sequence per PCS or HBL, respectively. Statistical analysis comprised kappa agreement for HBL tests as well as paired Wilcoxon tests for number of posterior teeth.

**Results** HAND, EYE and EAR showed a substantial reproducibility, while FOOT produced moderate agreement (Kappa=0.58, p<0.001). The 4 different tests of HBL were only in slight to fair agreement with each other, with the highest Kappa value observed at 0.24 (p=0.03). No correlation was found between a participant's PCS and HBL, with the exception of EAR with VAS (Kappa=0.29, p=0.001). The results revealed a significantly higher number of natural posterior teeth, including missing teeth replaced by fixed bridges, on the participant's PCS (for VAS p<.0001; ASI p<003).

**Conclusions** In the present cohort, masticatory laterality does not correspond to body hemispheric laterality. Rather than HBL, the number of natural teeth seems to determine on which side a person prefers to chew.

0344

## Zirconia Bars Implant Overdentures: 3-Year Prospective Clinical and Radiographical Cohort

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**Objectives** To assess the clinical and radiographic outcomes of CAD-CAM zirconia bars supporting mandibular IODs after a 3-year follow-up.

**Methods** A prospective observational single-center study involving 30 edentulous patients rehabilitated with two mandibular implants and a mandibular implant overdenture supported by a computer-aided design - computer-assisted manufacturing zirconia bar with distal extensions was performed assessing clinical and radiographic parameters.

**Results** From an initial sample of 30 patients, 25 were assessed after a 12-month follow-up, and 14 were included after a follow-up of 36 months. Implant and prosthetic success and survival rates were 100%. No implant biological complications were reported, a generalized mucosa hyperplasia around the zirconia bar was reported in one patient after 12 months, and no prosthodontic complications were observed. A mean marginal bone level (MBL) of -1.22 mm (SD  $\pm$  0.32) after the initial 12-month follow-up and -1.31 mm (SD  $\pm$  0.35) were recorded at the present follow-up. The MBL difference between the follow-ups was not statistically significant (*p*=0,529).

**Conclusions** Zirconia bars with distal extensions for mandibular implant overdentures appear to be a reliable option for rehabilitating edentulous patients, showing favorable outcomes after 3-years of follow-up. An implant and prosthodontic survival rate of 100% and stable MBL were observed.

0345

## Influence of Scan Pattern on Full-Arch Scans With Three Digital Scanners

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**Objectives** Digital imaging has become one of the standard procedures in dental practice. A variety of different intraoral scanners are available for this purpose. A universally valid and accepted procedure for digitizing a specific anatomical situation is not yet available. This makes it difficult to obtain an accurate and reproducible result. The aim of the study was to develop a standardized workflow that improves quality and guarantees precise results regardless of the scanner type. The deviations between the data record and the original should be as small as possibles.

**Methods** The data sets were collected from eight different scan protocols and compared with a master scan (laboratory scanner). The protocols were applied five times to a test jaw. The data were collected with three different intraoral scanners in a light box with identical lighting conditions. To quantify the deviations, the scans were superimposed and the deviations *in regio* 41 and 47 were compared. The statistical analysis was carried out by an ANOVA and a Tukey-HSD post-hoc test.

**Results** None of the strategies proved to be superior overall. The deviations were on average 0.57mm (SD ± 0.13mm) in the anterior region and 0.72mm (± 0.3mm) in the posterior region. Strategy 3 (swiping movements from 37 to 47 along the dental arch) was able to generate the most accurate data for the anterior region with mean deviations of 0.52mm (± 0.117mm) and strategy 5 (lingual from 37 to 47 - occlusal from 47 to 37 - vestibular from 37 to 47) for the posterior region with mean deviations of 0.61mm (± 0.3mm). Differences between the different scanners were also detected.

**Conclusions** Depending on the target or size of the digital impression, choosing the right scanning strategy can increase the "accuracy and precision" of the data set. Not only the target region, but also the scanner used should be considered. The available results cannot identify a generally superior strategy



currently. This is of particular importance, as deviations in the digital impression can affect the fit accuracy of dental restorations. Nevertheless, the aim of further comparative studies should be to develop a universal scanning method that delivers consistently realistic, accurate and precise results regardless of the scanner.

#### 0346

## Deep Learning-Based Workflow of Removable Denture Base and Teeth Arrangement

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**Objectives** To introduce a novel digital design workflow powered by deep learning (DL) to arrange artificial teeth and design removable partial denture base.

**Methods** The proposed workflow is about an automated design process of removable partial denture base and arrangement of artificial teeth powered by DL. A total of 15 partially edentulous cases were deidentified and collected as test scan data. In brief, an DL-based design software (Dentbird Crown) generated artificial teeth in missing regions of each scan data, considering adjacent and antagonistic teeth. The software was powered by the models composed of pixel2style2pixel (pSp) encoder and StyleGAN generator, and trained with a modern image-to-image translation schema. The software automatically removed undercut area along the optimal insertion paths and generated denture bases according to user-defined border. It can produce voxel-based signed distance fields (SDF) of desired bases by considering the SDF of artificial teeth and edentulous area. This utilizes a U-shape network to achieve consistent mapping between the SDF, addressing its task as a regression problem. For each step, average working time was measured. All designed denture bases and artificial teeth were fabricated with dental resins by using digital light processing for their physical evaluation.

**Results** Average working time was measured as 6.1 seconds for artificial teeth arrangement, 25.5 seconds for undercut area removal, and 1.4 seconds for denture base generation. Based on this workflow, the virtual outcome is shown in Figure 1 and physical outcome in Figure 2.

**Conclusions** This pilot study introduced a novel DL-based workflow to arrange artificial teeth and design removable partial denture base. This automated process can be useful to simplify the workflow.



# Utilization of Dental Visits in Emergency Departments - Role of Distance

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**Objectives** An important predictor of utilization of non-urgent Emergency Department (ED) services is access. The main objectives of our study were to estimate: *i*) the influence of geographic proximity to the nearest ED on utilization of NTDCs and *ii*) variations in the use of ED service for NTDCs as a combined function of distances to the nearest ED, private dental clinics, and urgent care clinics.

**Methods** We used the State Emergency Department Database and The American Dental Association Data Files for 2017-2021 for the state of Maryland, USA. Using the Dental Quality Alliance (DQA) guidelines, we extracted NTDC visits using ICD-10 diagnoses codes. Using negative binomial regression models, we estimated the ED utilization rate for the overall as well as subsets of populations, specifically racial-ethnic minorities and age-groups. Our main explanatory variable was nearest distance (mean straight line distance) between the zip code and an ED along with that from a dental clinic or urgent care facility. **Results** For the overall population, as the distance to the nearest ED increased, the average NTDC utilization rate declined ( $\beta$ =-0.29; 95% CI: -0.39, -0.18), while distance to a dental clinic was seen to have a positive effect on ED utilization rate ( $\beta$ =0.33; 95% CI: 0.22, 0.43). When compared across racial and agegroups, Non-Hispanic Blacks ( $\beta$ =-0.40; 95% CI: -0.51, -0.29) and 19-64 year olds ( $\beta$ =-0.32; 95% CI: -0.45, -0.19) as compared to Whites ( $\beta$ =-0.15; 95% CI: -0.28, -0.02) and older adults>=65 year olds ( $\beta$ =-0.22; 95% CI: -0.31, -0.13) respectively reported a more pronounced negative effect of distance from a nearest ED on the utilization rate. No significant effects were seen with respect to the distance from urgent care clinics. **Conclusions** Our findings support the presence of a negative effect of distance on the utilization of the ED for NTDC visits, while also showing a positive effect of distance from dental clinics.

#### 0348

## Cultural Influences on Adolescents and Caregivers' Perception of Their OHRQoL

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**Objectives** This study aims to understand the impact of cultural differences on the Oral Health-Related Quality of Life (OHRQoL) of Belgian and Italian adolescents seeking orthodontic treatment, as well as on the perception of their parents/caregivers of their children's OHRQoL.

**Methods** 791 Belgian adolescents (aged 11-17 years) and 101 Italian adolescents (aged 10-17 years), alongside their parents/caregivers, were included. OHRQoL was assessed with the Child Perception Questionnaire-16 and Parental Perception Questionnaire-16. Objective orthodontic treatment need was determined with the dental health component of the Index of Orthodontic Treatment Need. The demographic and clinical characteristics of both cohorts were compared using the Mann-Whitney, Chi-



square, and Fisher's exact test. Mann-Whitney test was used to analyze the differences in OHRQoL between the adolescents of both samples. The correlation between parents/caregivers and adolescents was determined by the intraclass correlation coefficient and non-parametric Spearman correlation. Wilcoxon matched-pairs signed rank test was used to detect statistically significant differences between the responses of parents and adolescents.

**Results** Italian adolescents presented significantly lower overall OHRQoL and social and emotional wellbeing compared to their Belgian counterparts. Italian parents/caregivers perceived their children's overall OHRQoL to be lower than Belgian parents, except for the 'eating disturbances' domain. The childrenparent responses were positively correlated, overall, and in all subdomains both in Belgium and Italy. Parents of both countries underestimated their children's overall and emotional well-being related OHRQoL.

**Conclusions** The different results of self-perceived OHRQoL of adolescents seeking orthodontic treatment as well as the different perceptions of parents/caregivers between Belgium and Italy underscore the impact of cultural factors, such as socioeconomic status, healthcare systems, and cultural norms on OHRQoL. Parents/caregiver perception can be used to supplement (but not to replace) the children's own OHRQoL report. However, the cultural context in which the children are being examined should be taken into account.

## 0350

# Parental Impact on Children's Caries Risk Following Oral Health Intervention

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**Objectives** To assess the influence of immigrant parents' oral health behaviours on their children's feeding-oral hygiene habits, and risk of Early Childhood Caries (ECC) following oral health intervention. **Methods** Immigrant parents (N=345) with newborns from 7 health centres in Bergen, Norway, were cluster-randomized into intervention (n=4) and control (n=3) groups. Intervention group received oral health educational program, while control group received standard healthcare information. Structured Questionnaires on parental oral hygiene behaviours (POH) and parental dietary habits (PDH) were collected at baseline and follow-up (after 18-24 months). Child feeding habits (CFH) (night-time breastfeeding, sweetened bottles), oral hygiene practices (CBH) (brushing, fluoride toothpaste use), and clinical examination of primary teeth were assessed at follow-up. Multiple logistic regression models estimating odds ratios (OR) with 95%CI were used to assess the association of parental behaviours (POH, PDH) on their children's feeding and hygiene habits (CFH, CBH) and ECC risk. Structural equation modelling (SEM) was used to investigate the association between the parental behaviours, children's oral hygiene-feeding habits and ECC risk.

**Results** No significant differences were found between intervention and control groups regarding parental hygiene-dietary behaviours, children's oral health habits, or ECC. Consequently, the groups were merged into a single cohort for comprehensive assessment of parental behaviours' impact on children's oral health habits and ECC risk. POH, unlike PDH, was associated with CFH (OR 0.5, 95%CI: 0.3,0.9). Negative CFH increased ECC risk (OR 3.7, 95%CI:1.6,8.4). CBH and POH slightly reduced the ECC risk with ORs 0.55 (95%CI: 0.25,1.24) and 0.6 (95%CI: 0.29,1.26) respectively, nevertheless, PDH showed no significant



impact. SEM analysis confirmed earlier findings, identifying CFH as the sole factor influencing ECC risk. **Conclusions** The oral health intervention had no impact on parental hygiene-dietary behaviours, children's oral health habits, or ECC risk. Child feeding habits are the key determinant influencing ECC risk.

## 0351

# Caries Management in France – Evolution Between 2002 and 2023

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**Objectives** The aim was to assess variations in restorative management of approximal and occlusal carious lesions in permanent teeth between 2002 and 2023.

**Methods** A cross-sectional, online questionnaire survey was carried out amongst 688 dentists, members of the dental practice-based research network in France (ReCOL). Bivariate comparisons were made using Chi2 or Fisher's exact tests to assess the association of the respondents' characteristics (age, gender, clinical experience, continuing education in cariology) with the management decisions. The results were compared to those obtained in 2002 and 2012 using the same questionnaire.

**Results** The response rate was 36,2% (n=249); 41 respondents were excluded from the analysis (specific practices, missing data).

For approximal lesions, the vast majority of the respondents (76.4%) would postpone their restorative decisions until the lesion is at the enamel-dentin junction or deeper. When comparing with the 2002 and 2012 responses, it appears that the threshold has been delayed to later stages of carious progression (p<0.001). The same tendency was found for occlusal lesions with 88.4% of the respondents indicating restorative options until the lesion was in the dentin in 2023 and a delayed threshold compared to earlier results (p<0.001).

Amalgam is no longer indicated neither for occlusal lesions nor for approximal (only one respondent amongst 208 for both sites). Moreover, questions related to two clinical cases show that early occlusal diagnosis is still subject to a wide variability. Management decisions were not significantly related to respondents' characteristics, except for occlusal restorative threshold and participation to continuing education in cariology in the past five years (p = 0.001).

**Conclusions** Management concepts for both approximal and occlusal carious lesions have changed dramatically during the last 21 years for more preservative options in accordance with the concept of minimum intervention in cariology. Nevertheless, early occlusal diagnosis is still a matter of controversy.



## Investigating Dental Biomedical Waste Management at Semmelweis University

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**Objectives** Dental biomedical waste (BMW) generation and disposal contribute significantly to the environmental burden of healthcare systems. The aim of this study was to assess and compare the composition of daily generated BMW and waste segregation awareness among clinical specialists' (STR) and clinical educational treatment rooms (ETR) at the dental clinic of Semmelweis University Faculty of Dentistry.

**Methods** Three waste audits were conducted in 2023 with two-week intervals between each audit to quantify and analyze the complete daily production of BMW generated during dental care. Collected clinical waste has been analyzed and separated into 49 categories and each fraction was weighed using kitchen scales. Measurement data of the three audits were summarized and averaged. Independent samples t-test (significance level: p<0.05) was used to compare the measured waste quantities among STRs and ETRs.

**Results** The average daily amount of generated BMW in the dental centre weighed 59596 g in total and 93 g per patient, whereas the total weight of the waste collection bags was 14310 g. The heaviest waste fractions were medical gloves, paper towels and disposable patient bibs (22197g, 12107g and 5673g, respectively). Discarded single-use personal protective elements (PPE) and single-use plastics (SUP) used in patient care were responsible for 57% (34154 g) of the total BMW weight, and the ratio of mismanaged municipal solid waste was 3% (1997 g). Significantly more BMW is produced per patient in ETRs compared to STRs (p=0.007). ETRs use 7 pairs, while STRs use 3-4 pairs of medical gloves per patient on average (p=0.010), whereas more sterilization pouches were discarded as clinical waste in STRs compared to ETRs (p=0.03).

**Conclusions** Excessive use of SUP and PPE in dentistry, together with overproduction, inappropriate collection and/or mismanagement of dental BMW has negative economic and planetary health consequences. Switching to reusable, sterilizable utensils, implementing sustainable procurement and circular economy strategies, and educating staff members and dental students about proper waste disposal may help mitigate these effects.

0353

## Antibiotic Prescription Attitude and Antibiotic Resistance Awareness Among European Dentists.

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**Objectives** Antimicrobial resistance has become an alarming global public health concern, threatening the effective treatment of common infections. This phenomenon has been fostered by the improper prescription of antibiotics by general dentists and specialists. This study aimed to elucidate the patterns of antibiotic prescription mainly during dental implant placement and treatment of peri-implantitis among European dentists and their awareness of antibiotic resistance.

**Methods** A validated anonymous online questionnaire was distributed via e-mail through the European Association for Osseointegration to dentists based in Europe. The questionnaire comprised of 17 structured questions investigating demographic variables, working environment, experience, attitude towards antibiotic prescription, in particular in relation to implant dentistry and to COVID-19 pandemic, and awareness about antibiotic resistance. Data were collected in April-May 2023.

**Results** 281 dentists from 33 European countries completed the survey. Amoxicillin, alone or in combination with clavulanic acid, resulted the most common antibiotic for dental implant placement, despite high awareness among respondents of penicillin resistance. Almost 80% affirmed to routinely prescribe antibiotics as prophylaxis as well as after implant placement, especially in medically compromised patients or in cases of bone grafting. For peri-implantitis treatment, more than half use systemic antibiotics. The large majority (95%) did not prescribe more antibiotics since the beginning of COVID-19 pandemic and less than 40% declared to follow national guidelines for antibiotics prescription. **Conclusions** This survey revealed a high prescription rate of antibiotics in implant dentistry, despite the awareness about antibiotic resistance among the respondents. The development and adherence to European guidelines have been identified as a potential strategy for improving antimicrobial stewardship.

## 0354

# Accuracy of Dental Procedures in Microgravity Is Comparable to Earth Conditions

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**Objectives** As humanity transitions towards long-duration spaceflight and extraterrestrial habitation, the long-term effects of microgravity become a significant concern. These effects can have deleterious impacts on the human body, including the oral cavity. The study aimed to build a simulated dental operatory for a microgravity environment and use it to evaluate the accuracy of dental procedures. **Methods** 

Within SpaceDent project, three parabolic flights (Airbus-A310 Zero-G, Novespace, European Space Agency) were conducted with 90 microgravity intervals (duration=22s). A simulated dental operatory (Fig. 1), conforming to standards for a microgravity environment was constructed, enabling simulated caries preparation and composite restoration placement in standardized cavities in artificial teeth of the phantom head. Senior dentistry student operators (n=2) performed preparations (n=72) and composite restoration (n=36) in different environments (n=3), namely ground (GND), microgravity (MIG), and steady flight (STF). The accuracy of preparation was evaluated by relative under- and over-preparation in relation to the area of simulated caries by computer-aided evaluation of 2D images. The accuracy of restoration was evaluated by volume of under- and over-fill in relation to original anatomy by computer-aided evaluation of 3D scans. Two-way ANOVA was used for statistical analysis.



**Results** No unexpected events occurred during experiments in all environments and all planned preparations and restorations were successfully completed as planned. For preparation accuracy, a significant difference was observed between operators, while there was no significant difference for environmental conditions (p =.623) or interaction (p=.072). For restoration accuracy, there was no statistically significant between operator (p = .897), environment (p=.139), and interaction (p=.791). **Conclusions** Within the study's limitations, our simulated dental operatory facilitates the performance of dental procedures in various environments. The results indicate that varying gravitational conditions do not significantly affect the accuracy of preparation and restoration procedures. However, differences between operators might be expected.

# 0356

# Microbiological Variations and Salivary pH Values of Mouthguards

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**Objectives** To evaluate the oral changes caused by sporting activity in boys who practiced boxing, to test the efficacy of an antacid product and to motivate athletes to the correct habits of home oral care and mouthguards.

**Methods** 37 children were divided into Test group, who wore mouthguards both in training and competition, and Control group, who did not wear mouthguards. The mouthguards used were of the boil and bite type. The study design included: medical history and dental examination, microbiological samples on mouthguards, determination of salivary pH and application of CarieX, oral hygiene and mouthguard hygiene instructions and participation survey.

**Results** The young athletes adapted differently to the cleaning instructions and can be distinguished into: following, partially following, no following. In the group following, it is possible to note a statistically significant decrease in the total bacterial load. In the control group, the training resulted in non significant pH change.

Pre and post training pH values were below the required value for the saliva.

CarieX, in the Control group, increased the pH values, not significantly compared to the pre training but significantly compared to the post training.

CarieX, applied in the mouthguard in the Test group, significantly increased pH values compared to both pre and post training.

**Conclusions** Wearing a boil and bite mouthguard during the training involves a greater reduction in salivary pH. Therefore, the mouthguard, despite its importance in the prevention of traumatic damage, is an additional risk factor for the balance of the athlete's oral ecosystem, if the right preventive measures are not adopted. CarieX, applied during training, significantly increased salivary pH, and therefore its use can be recommended to offer a certain level of prevention against oral diseases, as caries, that can affect the athlete's mouth.



## Trends in the Prevalence of MIH in Tepatitlán de Morelos

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**Objectives** *Objectives:* The aim of this study was to compare the prevalence of MIH in children of elementary schools in Tepatitlán de Morelos (Jalisco, Mexico) between 2018 and 2023. Furthermore, the association of MIH with other variables was investigated.

**Methods** *Methods:* The study population consisted of children aged between 5-13 years old, enrolled in elementary schools in Tepatitlán de Morelos. The intra-oral examination was performed on schoolgrounds by two calibrated examiners. In both patient cohorts, the presence and characteristics of MIH and Hypomineralised Second Primary Molar (HSPM) were scored according to the standardised scoring system formulated by the European Academy of Paediatric Dentistry (EAPD). Also, the severity of MIH was determined either mild or severe based on the criteria of Lygidakis et al. (2021). In 2023, dental plaque and dental caries were additionally scored according to the ICDAS-II criteria. Statistical analysis was applied on the data sets of 2018 and 2023 separately ( $\alpha$ =5%, 95%CI).

**Results** *Results:* A total of 959 schoolchildren were evaluated, 436 in 2018 and 523 in 2023. The prevalence of MIH was 35.78% in the first patient cohort, and 26.58% in the second patient cohort (p=0.002). Also, the tooth level prevalence of MIH decreased significantly from 12.71% to 8.00% when comparing the two patient cohorts (p<0.001). Higher prevalence of HSPM were observed in patients with MIH in both patient cohorts (p<0.001). Neither the number of teeth presenting cavitated caries lesions (p=0.193), nor the plaque score (p=0.061) was associated with the presence of MIH in 2023. Though, patients with severe MIH had a higher likelihood to present cavitated caries lesions compared to patients with mild MIH (p=0.001).

**Conclusions** *Conclusions:* The findings in the present study portray a significant decrease in the MIH prevalence at both patient and tooth level in the period 2018-2023.

## 0358

## Pediatric Denstists' Knowledge, Atitudes and Practices of Silver Diamine Fluoride

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**Objectives** Silver Diamine Fluoride (SDF) is a minimally invasive treatment approach for arresting carious lesions. The aim of this study was to evaluate the educational experiences, attitudes and behaviours of pediatric dentists(PD) towards SDF, one of the current treatment approaches among.

**Methods** For the cross-sectional survey, a 24-question questionnaire was sent via email to pediatric dentists who are among the 950 members of the Turkish Pedodontic Association (TPA) between March 2023 and November 2023.

Results Responses were received from 201 members (175 women and 26 men) (response rate 22.2%).



The mean age of the most of participants (51%) was between 20-29. All respondents reported that they were familiar with SDF prior to participating in the survey. The majority, 145(72.1%) of PD, had not previously applied SDF. 163(81%)PD agreed/strongly agreed that SDF could be implemented in a short time. 176(87.5%) PD agreed or strongly agreed that SDF may be a good treatment option for patients with severe dental anxiety. 88(43%) PD agreed or strongly agreed that SDF a good treatment alternative for patients needing general anesthesia for dental treatment. 172(85.5%) PD were considering using SDF in the future. 163(81%) PD believed that they needed more training on SDF.

**Conclusions** These findings indicate that PD perceive SDF therapy as effective, simple, painless, and non-invasive. However, these results suggest a need for expanded education on the proper use and benefits of SDF. Such education may increase the likelihood of PD utilizing SDF.

# 0360

# Evaluation of Different Pulpotomy Techniques in Primary-Teeth: a Randomized Controlled-Trial

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**Objectives** Primary teeth play roles in the development of permanent teeth and jaws, the provision of functions such as feeding and speaking and the maintenance of aesthetics; therefore, they contribute to the physical and psychological development of the child. The primary teeth and mouth should be healthily maintained until their physiological resorption occurs and permanent teeth erupt. The purpose of this randomized controlled clinical trial is the clinical, radiographic and restorative evaluation of different pulpotomy techniques for primary teeth with deep dentin carries lesions.

**Methods** 170 lower first and second primary molar teeth in 81 volunteers with an age between 5-9 years, which had pulp perforation during the removal of dental carries, were evaluated in the first phase of this two-phase study. The teeth were divided into a total of five groups, including one control (ferric sulphate) and four study groups (Biodentine<sup>\*</sup>, laser, low level laser therapy and atmospheric pressure cold plasma) and the restoration procedures were completed. Follow-up was continued for 24 months at intervals of six months. The resulting data was statistically evaluated. Statistical significance range was accepted as α <0.05 for all data.

**Results** After 24 months of follow-up, clinical and restorative success rate was 100% in all groups. The highest radiographic success rate was 100% in the Biodentine<sup>®</sup> group, while the lowest radiographic success rate was found in the ferric sulphate group with 79.4%. In the radiographic evaluation, it was seen that there was a statistically significant difference between study groups (p <0.05).

**Conclusions** Within the limitations of this study, Biodentine<sup>\*</sup>, low dose laser, and ABSP applications are preferable methods for pulpotomy treatments. The effect of the pulpotomy method should be considered in the selection of the restorative material to be applied after pulpotomy treatment.


# Assessing Italian Dentists' Knowledge of Developmental Enamel Defects

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**Objectives** Developmental Defects of Enamel (DDEs) are a heterogeneous set of structural abnormalities of varying severity that can occur during the formation and mineralization of dental enamel, influenced by genetic, environmental, and systemic factors. DDEs pose challenges to dental practitioners due to their impact on aesthetics and oral health. Accurate diagnosis and appropriate management are essential for optimal patient care. To assess Italian dentists' knowledge and diagnostic skills regarding DDEs and to evaluate the factors influencing diagnostic accuracy a cross-sectional study was performed. **Methods** A nationwide survey was planned based on a questionnaire including 27 closed-ended questions, with four clinical pictures, Molar Incisor Hypomineralization (MIH), Amelogenesis Imperfecta (AI), Dental Fluorosis (DF) and an initial caries lesion (ICL). Data were collected from January 2022 to December 2022. Discrete variables were expressed as absolute and relative frequencies (%). A multivariate analysis was performed to assess whether socio-demographic variables were correlated with the answers' truthfulness.

**Results** 5017 questionnaires were included and analyzed. Although 90.19% of the sample stated that they had received information on DDEs, a significant proportion failed to identify DDEs accurately. High share of the sample did not recognize MIH (36.36%), AI (48.34%), DF (71.50%) and ICL (46.62%). Only 57.07% correctly classified enamel hypomineralization as a qualitative defect, and even fewer, 54.45%, classified enamel hypoplasia as a quantitative defect. Demographic characteristics and training on DDEs influenced diagnostic accuracy. According to the logistic regressions, female dentists, dentists who treat mainly children and received information about DDEs, were more likely to recognize the four clinical pictures (p<0.01).

**Conclusions** Italian dentists have varying levels of knowledge and diagnostic skills regarding DDEs, indicating a need for enhanced education and training. Continuous education and standardized diagnostic criteria are essential to address the challenges posed by DDEs in dental practice and improve patient care.

0362

## **Cytotoxicity of Silver Fluoride Treatments**

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CED/NOF-IADR 2024 Oral Health Research Congress 12—14 Sept 2024 Geneva, Switzerland

**Objectives** Silver fluoride treatments have shown significant efficacy in arresting caries progression. This study aims to investigate the cytotoxicity of silver diamine fluoride or aqueous silver fluoride using dentinbarrier test and direct cell viability assays.

**Methods** Deep dentin discs (n=8/group) (400 $\mu$ m thick/10mm diameter) were prepared and distributed based on permeability measurements. 3-D cultures of odontoblast-like cells (SV40 transfected pulp-derived cells) transferred to the pulpal aspect of dentin slices inside individual perfusion split chambers designed for dentin barrier test according to ISO 7405 standards. An experimental glass ionomer cement served as the positive control (50% cell viability), while a polyvinylsiloxane impression material (Express, 3M-ESPE) served as the negative control (100% cell viability). The tested groups included (1) 38% silver diamine fluoride=SDF (Riva Star, SDI), (2) SDF+potassium iodide=KI (Riva Star, SDI), (3) 38% aqueous silver fluoride=AgF (Riva Star Aqua, SDI) and (4) AgF+KI (Riva Star Aqua, SDI). Materials were applied to the coronal section of the dentin discs for 1min and dried. After 24h, cell viability (%) was assessed by MTT assay. Additionally, direct dilutions (10<sup>-3</sup>, 10<sup>-4</sup>, and 10<sup>-5</sup>) of the test solutions were evaluated at a well-plate, using the same cell line. Data were analysed using Kruskal-Wallis and Mann–Whitney U test ( $\alpha$ =0.05). **Results** Silver fluoride treatments significantly reduced cell viability compared to other treatments (p<0.05). AgF treatment resulted in significantly higher cell viability compared to other treatments (p<0.05). In direct exposure tests, all groups showed moderate cytotoxicity with 10<sup>-3</sup> dilutions, while AgF treatment exhibited no cytotoxicity with 10<sup>-4</sup> and 10<sup>-5</sup> dilutions.

**Conclusions** Silver fluoride treatments, particularly in deep cavities, should be applied with caution due to potential cytotoxicity. AgF treatment resulted in lower cyctotoxicity compared to SDF in both dentin barrier test and direct dilution assays. Furthermore, the addition of KI increased cytotoxicity when combined with SDF and AgF.

0370

# CAD-CAM Resin-Based Crown Materials Bond Strength to Polyetheretherketone and Titanium

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**Objectives** To evaluate the effect of additively or subtractively manufactured restorative material type on the shear bond strength (SBS) to different abutment materials and failure modes.

**Methods** One hundred and ten disk-shaped specimens (Ø3 mm×3 mm) were fabricated by using 3 additively (AM\_CT, AM\_FP, and AM\_VS) and 2 subtractively (SM\_GC and SM\_BC) manufactured resinbased materials. After allocating 2 specimens from each group for scanning electron microscope evaluation, the specimens were divided according the abutment material (polyetheretherketone [PEEK] and titanium [Ti]) (n=10). All specimens were abraded with 50 µm aluminum oxide. After applying a resin primer to PEEK and an adhesive primer to Ti specimens, a self-adhesive resin cement was used for cementation. All specimens were stored in distilled water (24 hours, 37°C) and a universal testing device was used for the SBS test. SBS data were analyzed with 2-way analysis of variance and Tukey honestly significant difference tests were, while the homogeneity of failure modes was assessed with chi-square test. Pearson's correlation test was used to investigate the correlation between the SBS values and failure modes ( $\alpha$ =.05).



**Results** Material type, abutment type, and their interaction affected the SBS (*P*<.001). When PEEK was used, SM\_GC and SM\_BC had the lowest and AM\_VS had the highest SBS (*P*<.001). When Ti was used, SM\_GC had the lowest SBS followed by SM\_BC (*P*<.001). AM\_VS had higher SBS when cemented onto PEEK and SM\_BC had higher SBS when cemented onto Ti (*P*<.001). There was a weak positive correlation (*r*=.380, *P*<.001) between the SBS values and failure modes, which were mostly adhesive. **Conclusions** Regardless of the abutment material, additively manufactured specimens had higher bond strength and one of the subtractively manufactured materials (SM\_GC) mostly had lower bond strength. The abutment material had a small effect on the bond strength. Adhesive failures were observed more frequently.

# 0371

# Composite-Cement, Abutment-Chimney-Height and Surface-Treatment Affect the Bond-Strength of the Polyetheretherketone-Abutment-Interface

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**Objectives** The aim of the present study was to investigate whether (i) the brand of composite-cement, (ii) the chimney height and (iii) different surface-treatments of the polyetheretherketone crowns affect the bond-strength of the polyetheretherketone crown-abutment interfaces.

**Methods** 480 screw-fixed polyetheretherketone (PEEK) crowns with different chimney heights (3.5 mm and 5.5 mm) were fabricated by CAD/CAM technology and attached to the titanium abutments with three composite-cement brands (DTK-adhesive/visio.link-Primer for PEEK, MKZ-Primer for abutment [DTK], Bredent; PanaviaV5/Clearfil-Ceramic-Primer-Plus [Panavia], Kuraray Dental; G-Cem-LinkForce/G-Multi Primer [G-Cem], GC). Surfaces of the PEEK crowns were pretreated with 4 different methods (1) aluminium oxide (250µ, 4 bar) [Al<sub>2</sub>O<sub>3</sub>], (2) aluminium oxide (250µ, 4 bar) and macro-retentions [Al<sub>2</sub>O<sub>3</sub>+MR], (3) aluminium oxide (250µ, 4 bar) and Dialog bonding fluid (Schütz Dental) [Al<sub>2</sub>O<sub>3</sub>+DBF] instead of the primers belonging to the composite-cement brands or (4) Rocatec plus (110µ, 2,5 bar) [ROC]. This resulted in a total of 24 groups of 20 test specimens each. Before measurements test specimens were stored in distilled water at 37°C for at least 24 hours. Bond strength (tensile test) was determined with a universal testing machine (Zwick/Roell). Data were analysed using ANOVA statistics.

**Results** The composite-cement brands had a significant effect on the bond-strength of the PEEKabutment interface (DTK: 192±103 N; G-Cem: 166±90 N; Panavia: 75±72 N; p<0.001, Figure 1). The influence of the different chimney heights on the bond-strength (5.5mm: 168±111 N; 3.5mm: 122±86 N; p<0.001, Figure2) was also significant as well as the surface treatment (Al<sub>2</sub>O<sub>3</sub>+MR: 202±99 N; ROC: 149±118 N; Al<sub>2</sub>O<sub>3</sub>: 124±94 N; p<0.001, Figure 3). Al<sub>2</sub>O<sub>3</sub>+DBF was not significantly different from Al<sub>2</sub>O<sub>3</sub> alone.

**Conclusions** Increasing the bonding area (i.e. increasing the chimney height from 3.5mm to 5.5mm) increased the bond strength of the PEEK crown-abutment interface. PEEK test specimens with macroretentions achieved the highest bond strengths in combination with the cements DTK followed by G-Cem.



# Mechanical Properties of Additively Manufactured Zirconia Depending on Build Orientation, Post-Processing, and Thermocycling

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**Objectives** The study aimed to evaluate the effect of build orientation, post-processing, and thermocycling (TC) on the mechanical properties of additively manufactured (AM) zirconia compared with those of subtractively manufactured (SM) zirconia.

**Methods** Bar- (17×4×1.5 mm) and disc-shaped (10×2 mm) STL files were used to fabricate AM (3-YTZP) and SM (3-YTZP and 4-YTZP) zirconia specimens. AM specimens were printed using 3 different build orientations (horizontal, tilted, and vertical), and the specimens were post-processed either using 1-stage (debinding combined with sintering) or 2-stage processes (debinding, cooling, and sintering) (n=24 bars/12 discs per subgroup). The discs were polished. Half of the bars and all discs were subjected to thermocycling (10.000 cycles, 5-55°C). Flexural strength (FS) was measured before and after TC, and VH was measured before and after polishing, and after TC.

**Results** A significant interaction was found between material type and thermocycling for the FS and VH (p<.001). Before TC, SM-3YTZP had a higher FS than other groups (p<.001), except for SM-4YTZ (p=.084). Before TC, tilted 1- and 2-stage AM zirconia had lower FS than vertical 1-stage AM zirconia ( $p\leq.016$ ), whereas there was no difference among other pairs (p>.054). After TC, vertical 2-stage AM zirconia had lower FS than other groups (p<.003), except for vertical 1-stage AM zirconia (p>.99). After polishing, the VH of tilted and vertical AM zirconia increased (p<.012). All groups had similar VH after polishing (p>.108) and after TC (p>.818).

**Conclusions** All groups had FS higher than that required for single-unit monolithic ceramic prostheses (ISO6872:2015; 300 MPa), regardless of TC. The effect of TC on FS varied depending on the material type, build orientation, and post-processing. Before TC, all AM zirconia groups had lower FS than SM-3YTZP. Polishing increased the VH of vertical and tilted samples. After polishing, build orientation, material type, and TC had no significant effect on the VH.



## Mechanical Stability of Abutment-Free Monolithic Zirconia Fixed Dental Prostheses

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**Objectives** To test initial (Fi) and final failure (Ff) load of three-unit abutment-free monolithic zirconia CAD-CAM fixed dental prostheses (FDPs) compared to titanium three-unit FDPs on different implant abutment assemblies.

Methods Three-unit FDPs and associated tissue-level implants were divided in groups (n=10) based on implant's connection to abutment and material of the supra-structure: (1) novel internal implant connection with abutment-free full-contour CAD-CAM zirconia FDP (Abut-Free-Zr), (2) full-contour zirconia FDPs on prefabricated titanium base abutments (Zr-Ti-Base), (3) full-contour zirconia FDPs on prefabricated multi-unit abutment (MU-Zr), (4) novel internal implant connection with abutment-free veneered titanium FDPs (Abut-Free-Ti), (5) veneered titanium FDP on prefabricated multi-unit abutment (MU-Ti). Specimens were subjected to thermomechanical aging (1'200'000 cycles, 49N, 1.67Hz, 5°-50°C, dwelling time 120s). Torque of the screws was measured, and static loading performed in universal testing machine. Mean failure load values and torque changes were statistically analyzed (p<0.05). Results All specimens survived thermomechanical aging. All screws showed reduced torque with reduction of 66.7 - 72.7% in mesial and 50.45 - 80.11% in distal screw, Ti-MU having significantly more reduction compared to Abut-Free-Ti (p=0.0046). Titanium groups showed significantly lower Fi values (p=0.0001) and significantly higher Ff (p<0.0001) values than zirconia groups (Table 1). Conclusions Three-unit abutment-free monolithic zirconia CAD-CAM FPDs show similar failure loads compared to other zirconia groups, while the titanium groups exhibited superior final failure loads. Different implant-abutment assemblies did not seem to affect to failure loads.

Group	Fi N (SD)	Ff N (SD)		
Abut-Free-Zr	1272.17 (191.3) <sup>1</sup>	1272.17 (191.3)ª		
Zr-Ti-Base	1358.24 (224.2) <sup>1</sup>	1358.24 (224.2)ª		
Zr-MU	1347.84 (318.0) <sup>1</sup>	1347.84 (318.0)ª		
Abut-Free-Ti	230.87 (209.8) <sup>2</sup>	3028.84 (946.4) <sup>b</sup>		
<b>Ti-MU</b> 171.42 (26.7) <sup>2</sup>		2912.85 (1054.6) <sup>b</sup>		

Table 1: Mean initial (Fi) and final failure (Ff) loads in N (SD) of study groups.

\*Superscript numbers show statistical differences between the groups for Fi. Superscript letters show statistical differences between the groups for Ff.



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## 0374

## Effect of Experimental-Acid Solutions on Bond Strength of Resin Cement

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**Objectives** To evaluate and compare the effects of experimental-acid solutions, hydrofluoric acid (HF), and sandblasting on the shear bond strength (SBS) between leucite-reinforced glass-ceramic and dualcure resin cement.

## Methods

Sixty ceramic specimens were prepared and randomly divided into six groups according to surface treatments (n=10): group C (control, no treatment); group SB (sandblasting with 50-µm aluminum oxide particles at 10-mm distance and 2.5-bar pressure for 15 s); group HF1(etched with 4.5% HF for 60 s followed by washing and drying); group HF2 (etched with 9.5% HF for 60 s followed by washing and drying); group Exp1 (treated with  $H_2O$ :HF: $H_2O_2$  (20:1:1) solution for 60 s followed by washing and drying); and group Exp2 (treated with  $H_2O$ :HF:HNO<sub>3</sub> (50:1:1) solution for 60 s followed by washing and drying). Dual-cure resin cement (Multilink N) with 3-mm diameter was applied to all specimens. After 24 h of distilled water storage, the specimens were tested for SBS using a universal testing machine at a crosshead speed of 1 mm/min. Data were analyzed using one-way ANOVA and Tukey's HSD test (a=0.05). **Results** Significant differences were observed in the mean SBS values among the tested groups (F(5)=7.057, P<0.001). Groups C (10.83 ±4.04 MPa) and SB (12.72 ±5.90 MPa) showed significantly lower mean SBS values than the acid-treated groups (P<0.05), while there was no significant difference between Groups C and SB (P>0.05). There were no differences among the acid-treated groups (P>0.05). Groups Exp1 (19.28 ±3.93 MPa) and Exp2 (19.46 ±6.62 MPa) exhibited similar mean SBS values to the HF1 (19.10 ±3.0 MPa) and HF2 (20.01 ±4.29 MPa) groups (P>0.05).

**Conclusions** Experimental-acid solutions enhanced the bond strength of the resin cement to a level comparable to that of the HF solutions. Sandblasting application did not significantly increase the bond strength of the resin cement to the glass-ceramic material.

## 0375

# Repair Bond Strength of Aged Ceramics With Various Surface Treatments

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**Objectives** To investigate the effects of different surface treatments on repair bond strength (RBS) between two types of aged glass ceramics and a composite resin.

**Methods** Eighty specimens were prepared from leucite-reinforced (G-Ceram) and lithium disilicate glassceramics (IPS E-max CAD). These specimens underwent thermocycling (between 5°C and 55°C for 5500 cycles) and were divided into five subgroups (n=8) based on the surface treatment: Group C (control), Group A (air abrasion with 50-µm glass bead particles), Group CP (Clearfil Ceramic Primer Plus application), Group MEP (Monobond Etch&Prime application), and Group MN (Monobond N application). A universal bonding agent (Nova Compo B Plus) was applied, followed by the application of nanohybrid composite resin (Clearfil Majesty Esthetic). All the specimens were stored in distilled water at 37°C for 24



h. RBS was measured by means of shear bond strength testing using a universal testing machine (1 mm/min). Data was statistically analyzed using two-way ANOVA, Tukey and Bonferroni post-hoc tests (α=0.05).

**Results** Surface treatment and its interaction with the material significantly affected RBS values (P<0.05). However, there was no significant difference between the glass-ceramic materials (P>0.05). Regardless of the ceramic used, the mean RBS values of Groups C and A were significantly lower than those of Groups CP, MEP, and MN. Although there was a significant difference between the MEP and MN groups (P<0.05), the CP group had similar SBS values (P>0.05). The surface treatments had a similar effect on the ceramics used; however, the bond strength of the lithium disilicate ceramics in the CP group was higher than that of the leucite ceramics (P<0.05).

**Conclusions** The application of ceramic primers enhanced the SBS between glass-ceramics and the composite resin material. Clinically, using these agents instead of glass bead abrasion alone may improve the bond strength of composite resins for repairing glass-ceramics.

## 0376

# Color Stability of Prosthodontic Tooth Polymers Stored in Chromogenic Solutions.

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**Objectives** Numerous additive polymers have been introduced in just the last few years, but little research is available on their color stability. This study evaluated the color stability (stainability) of additive and subtractive computer assisted manufacturing (CAM) polymers compared to a manufactured denture tooth control when immersed in chromogenic staining solutions of wine, coffee and water control, and measured periodically over an extended time period.

**Methods** Nine removable and fixed prosthodontic tooth materials with different chemical compositions/fabrication processes were evaluated. Materials tested: FLX-Flexera(DeskTop Dental), ONX-OnX(SprintRay), VARVarseoSmileCrownPlus(Bego), TRS-Trusana(Myerson), TDS-TrueDent(Stratasys), TRG-TrueDentGlossy (printed with a glossy surface), DNT-DentureTeeth(Dentca), IVO-Ivotion(Ivoclar), VIV-SR-Vivodent(Ivoclar), IPN-Portrait-IPN Denture Teeth (DentsplySirona) as control. Total of 270 tiles were fabricated according to manufacturers' systems n=10/group measuring 10x15x1.5+/-0.1mm thickness approximating ADA specification #12. IPN teeth were ground flat and specimen groups polished per protocol. Specimens were immersed into 3 standardized solutions of COFFEE, Syrah WINE, and distilled WATER (control) at 40+/-1 $\odot$ C with constant stirring dark chamber. The degree of color change was monitored over time with measurements made at 0,2,4,6,8,10,14,24 weeks. A portable color measured CIELAB values of each specimen and color differences ( $\Delta$ E) calculated. Two-Way ANOVA and Tukey posthoc tests were used for comparisons (p<.05).

**Results** PMMA materials VIV and IVO demonstrated the lowest overall  $\Delta E$  values while FLX and DNT had the highest. In WATER (Graph1), mean  $\Delta E$  of DNT was significantly higher than the control. For COFFEE (Graph2)- FLX, ONX, and DNT exhibited significantly higher mean  $\Delta E$  than the control. In WINE (Graph3), the mean  $\Delta E$  of FLX and DNT were significantly higher while VIV was significantly lower than the control. **Conclusions** For measured color changes, only the subtractive PMMA VIV was significantly lower than the control. For all material groups the mean  $\Delta E$  was significantly greatest for wine followed by coffee



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compared to water control. The additive materials TRD, TRG, ONX, TRU, VAR were similar in mean  $\Delta E$  compared to the control denture tooth.

## 0377

# Clinical Evaluation of Novel Stud Attachment Wear Using Micro-Computerized Tomography

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**Objectives** The study aimed to evaluate the surface wear of novel stud attachments for the retention of mandibular implant-supported prosthesis using a micro-computerized tomography (m-CT). **Methods** A prospective randomized controlled study compared the wear properties of a novel Novaloc attachment system to the conventional Locator system. Twenty edentulous patients requiring overdentures were included, and 20 implant-supported mandibular prostheses were randomized into two groups: Locator (n=9) or Novaloc (n=11). At annual follow-ups, the abutments were unscrewed and extraorally recorded using m-CT. After the image reconstruction and segmentation, mesh surface models of the abutment at each time point were obtained. The root mean squared error (RMSE), maximum distance, volume change, and percentage of worn surface (Spct) in the region of interest (ROI) were measured for each model at the initial and subsequent time points. To evaluate the wear pattern, the Shape Index (SI) – a measure of local curvature – was calculated for each mesh point. The Mann-Whitney U test was used to analyze the differences in m-CT measurements between both experimental groups (P<0.05).

**Results** After 2 years, both groups exhibited minimal surface changes. In the Novaloc group, the wear of one abutment was clinically observed. However, no significant differences were found between the groups. The RMSE was between 2 and 4  $\mu$ m for most specimens, while for the abutment with clinically observed wear, the RMSE exceeded 8  $\mu$ m, with a maximum deviation of 28  $\mu$ m. The Spct of the ROI ranged from 0 to 3% and increased to 7% with a volume loss of 0.079 mm3 in the case of clinically observed abutment wear. In addition, the minimum SI decreased from 0.65 to 0.57, indicating a loss of convexity of the abutment head.

**Conclusions** After 2-years of clinical service, the Novaloc attachment system showed comparable wear properties to the conventional Locator system.

## 0380

## Transcriptomic Changes of Human Dental Pulp After Orthodontic Force

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**Objectives** To analyze the gene expression profile of the human dental pulp (DP) tissue after the application of 7 and 28 days of orthodontic force (OF) by using RNA-sequencing. The maxillary and mandibular DP were additionally compared.

**Methods** Healthy patients requiring orthodontic premolar extractions were randomly assigned to one of three groups: control group, 7-days and 28-days, where premolars were extracted either 7 or 28 days after a 50-100g OF application. Total RNA was extracted from the DP tissue and analyzed via RNA-seq. Differentially expressed genes (DEGs) were identified using a false discovery rate and fold change threshold of <0.05 and  $\geq$ 1.5 respectively. Functional analysis was performed.

Results After 7-days OF, pulp reaction indicates immune response (upregulation

of CHI3L2 and Complement activation, Mature B cell differentiation, Positive regulation of interleukin-12 production, Th1 and Th2 Cell Differentiation pathways), hypoxia (CAVIN4), DNA damage and epigenetic regulation (downregulation of Histones, RBBP8, snoRNAs, hub genes CENPT, RUVBL1 and PRKDC). After 28-days cell adhesion, migration and tissue repair (upregulation of LAMC2, COL17A1, hub genes PKP1, PKP3) and dentin formation (MMP13) are evident. The maxillary and mandibular pulp tissues react differently to OF. The maxilla exhibits minimal alterations, mostly related to immune response at 7days (hub genes IFI44L, RSAD2, PSMB9, PSMB1) and tissue repair at 28-days (ASIC3, TNFRSF1B, E2F1), while the mandible shows mostly DNA damage and epigenetic regulation at 7-days (downregulation of Histones, snoRNAs, hubgenes RUVBL1, PRKDC, SF3B1, TAF1C, PCGF2) and no DEGs at 28-days. **Conclusions** This study demonstrates that DP reaction to 7-days OF is marked by immune response, hypoxia and DNA damage. After 28-days, cell adhesion, migration, organization, tissue repair and dentin formation are observed. Maxillary and mandibular premolars react differently to OF: while the maxilla exhibit minimal alterations at both time points, the mandible mostly shows DNA damage, epigenetic regulation, and immune response at 7-days. This disparities could stem from different blood supplies or lower maxillary bone density, potentially triggering faster biological changes. Our findings provide insights into the gene regulatory networks modulating DP response to OF.

## 0381

# **Comparison of RPE and MARPE Effects on Facial Soft Tissues**

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**Objectives** To evaluate the soft-tissue changes after maxillary expansion with tooth-borne (RPE) and tooth-bone-borne (MARPE) appliances, compared with a matched control group using stereophotogrammetry.

**Methods** The study comprised subjects aged 10 to 16 years, consisting of 22 patients treated with RPE, 21 treated with MARPE, and 31 individuals in the control group, matched by age and gender.

Facial surface scans were acquired with 3dMD imaging system at 2-time points: pretreatment (T0) and postretention (T1). Median time between T0-T1 was 6.34 (IQR 5.79 – 6.99) months. Landmark-based analysis was performed with linear and angular measurements.

Linear regression was employed to compare face parameters between groups after controlling for the effects of age and gender.

**Results** Both study groups showed statistically significant increase in the morphological nose width, compared to the controls with respective marginal means 1.3 mm (95% CI 0.9-1.6) and 0.8 mm (CI 0.4-



1.1) for MARPE and RPE. There was a statistically significant difference in the effects produced by the appliances (p = 0.043). These appliances produced no effect on the anatomical nose width.
Treatment with RPE resulted in the increase in the mouth width by the marginal mean 2.9 mm (CI 0.5-1.9), and with MARPE by 2.3 mm (CI 0.4-1.4) compared to the controls (0.8 mm, CI 0-1.6). The appliances produced similar increase in the nostrils, ranging from 0.6 (CI 0.3-1) to 0.9 mm (CI 0.6-1.2).
Only the MARPE group had statistically significant increase in the nasal tip angle by 0.7 degrees (CI -0.1 – 1.5) compared to the controls.

The changes in the intercanthal width, anatomical nose width, nostrils widths and nose height between T0 and T1 were influenced by age, while the changes in the morphological nose width and mouth width were gender related.

**Conclusions** RPE and MARPE produces similar facial soft tissue changes, except the morphological nose width. The facial soft tissue changes are age and gender dependent, emphasizing the importance of including a control group, particularly for growing individuals.

# 0382

# Impact of Pain Intensity on Oral Hygiene During Orthodontic Treatment

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**Objectives** To assess the impact of pain intensity on oral hygiene during orthodontic treatment with fixed appliances.

**Methods** Eighty patients (mean age 22.03 years) were selected from the Department of Orthodontics in Pomeranian Medical University in Szczecin who were beginning orthodontic treatment. Patients were randomly divided into three groups:

Control group - Fourty patients without pain therapy.

LLLT (Low-level laser therapy) group - Twenty patients who received daily laser biostimulation therapy for five consecutive days after the fixed appliance was installed.

VT (Vibration therapy) group – Twenty patients who received daily low-frequency vibration therapy for five consecutive days after the fixed appliance was installed.

Pain levels were evaluated using a Visual Analogue Scale (VAS).

Oral hygiene level was measured using the Approximal Plaque Index (API) on the day of installation and on the fifth day after installation.

All patients were subjected to an anonymous survey regarding the level of discomfort during oral hygiene on the day of installation of the fixed appliance, before and after its installation and on the following four days.

The results were subjected to statistical analysis.

**Results** Approximal Plaque Index measurements indicated higher values in the fifth day than at the beginning of the treatment in most of patients. The survey showed, that most respondents in the control group felt mild or moderate discomfort during daily hygiene, from the first day until the fifth day after the installation of fixed appliances. The vast majority of respondents reporting no discomfort came from the LLLT and VT groups. The only patients who declared great discomfort that prevented proper oral hygiene were from the control group.

**Conclusions** The intensity of pain experienced by patients undergoing orthodontic treatment influences the discomfort during hygiene procedures and is strongly reflected in the condition of oral hygiene.



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## 0383

# Biomimetic-Engineered Hydrogels Prevent Orthodontic Root Resorption

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**Objectives** To explore the effects of a novel application of a biomimetic-engineered hydrogel in a rat model of orthodontically-induced inflammatory root resorption (OIIRR).

Methods In vitro, human periodontal ligament stem cells (PDLSCs) were isolated from extracted healthy premolars and identified as mesenchymal stem cells. Simultaneously, gold nanocomplexes were produced, characterized and loaded into type I collagen hydrogels, where PDLSCs were later embedded. Cytotoxicity assay, ALP and ARS staining, PCR, TEM and immunocytochemical analysis (biomarkers of bone metabolism, inflammation, stress resistance and autophagy) were performed. In vivo, the biomimetic-engineered hydrogel, mimicking the native physiological niche of PDLSCs was then transplanted into an orthodontic rat model. Thirty-six twelve-week-old male Wistar rats were divided into 6 groups: (1) no orthodontic force (OF), (2) OF, (3) OF + Sham injection, (4) OF + hydrogel injection without PDLSCs, (5) OF+PDLSCs injection without hydrogel, (6) OF+ hydrogel injection with PDLSCs. OIIRR was longitudinally evaluated for 31 days with micro-CT and immunohistochemistry was performed. **Results** In vitro, the hydrogel-embedded 0.05 mg/mL 40nm AuNCs significantly promoted PDLSCs viability and osteogenic differentiation. In vivo, micro-CT showed that Groups 2, 3. 4 and 5 presented obvious OIIRR (p<0.05), without significant difference between groups (p=0.81). In contrast, OIIRR was effectively prevented in Group 6 (p > 0.05). Changed immunoreactivity of autophagy biomarkers suggests that the underlying mechanism can be linked to the autophagy-induced osteogenesis triggered by the biomimetic-engineered hydrogel injection.

**Conclusions** The biomimetic-engineered hydrogel could effectively promote osteogenesis and prevent OIIRR, without altering orthodontic tooth movement rate.

## 0384

## Orbicularis Oris Muscle Electromyographic Activity in Children With Lip Incompetence

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**Objectives** To assess the electromyographic (EMG) activity of the superior (SOO) and inferior (IOO) orbicularis oris muscles in children with lip incompetence and children with competent lips. **Methods** The sample comprised 30 children with lip incompetence (mean age 9.46 ± 1.76 years) and 30 subjects with lip competence (mean age 8.85 ± 1.52 years). EMG recordings were made with a DAB-Bluetooth Instrument (Zebris Medical GmbH, Germany) at clinical rest, and during saliva swallowing, lip protrusion and reciprocal compression of the lips, as well as while speaking the phonemes such as /p/, /b/, and /m/ combined with the vowel /a/. Statistical analyses were carried out using Stata 11.0 software. The level of significance was set at *p* < .05.



**Results** EMG activity of the SOO and IOO muscles during saliva swallowing and lip compression was significantly higher in children with lip incompetence compared to subjects with competent lips. Similar EMG activity at rest and during speaking was observed in children with and without lip competence. The differences in the EMG activity of the SOO and IOO muscles with regard to all functional tasks between boys and girls were not statistically significant for either group.

**Conclusions** Higher EMG activity of the SOO and IOO muscles in subjects without lip competence during saliva swallowing and compressing the lips may suggest greater muscular effort due to the need to seal the lips during these functional conditions. This may affect the balance of muscular forces which is required to ensure a proper growth and development of the maxillofacial structures and a stable occlusion.

# 0385

# Prevalence and Risk Factors of Wire Syndrome: a Cross-Sectional Study

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**Objectives** The Wire Syndrome problem refers to dental displacements that can be described as aberrant, inaccurate, unexplained, or excessive on teeth still contained by an intact orthodontic wire, without detachment or fracture, leading to evolving dental and periodontal, aesthetic and/or functional consequences. The objective of this study was to define the prevalence of mandibular wire syndrome and the associated risk factors.

**Methods** Students attending the last 3 years of Dental school, who have undergone orthodontic treatment and were wearing an intact fixed mandibular retainer, were included. All participants were asked to complete a questionnaire of 20 questions about orthodontic history, habits, tics, or parafunctions. Furthermore, an extraoral and intraoral clinical examination along with photographic records was carried out. Finally, two practitioners independently assigned each participant to one of 2 different groups, the non-wire syndrome group (NWS group: no Wire Syndrome detected at the mandible) and the wire syndrome group (WS group: a Wire Syndrome detected at the mandible). The association of potential risk factors with Wire Syndrome was studied using univariate logistic regression models. **Results** A total of 59 students with a mean age of 23.4 years (± 1.7 years) were included. Out of these 59 students, 9 presented with mandibular wire syndrome, leading to a prevalence of 15.25% (95% Cl: 6.08% – 24.43%). In univariate analysis, a deep labio-mental fold (vs normal), a concave profile (vs normal) and a multi-strand round wire (vs other wire retainers) were significantly associated with an excess risk of Wire Syndrome. The odds ratios were 16.5 (95% Cl: 1.9 – 146.8, p=0.012), 6.4 (95% Cl: 1.0 - 41.0, p=0.05), and 9.0 (95% Cl: 1.7 – 48.7, p=0.041), respectively.

**Conclusions** Under the conditions of this study, a prevalence of 15.25% was found for the wire syndrome. Three risk factors were identified: a deep labio-mental fold, a concave profile, and the presence of a multistrand round wire. Further analyses are needed to confirm these results on a wider population.



## Healthy and Inflamed Gingival Fibroblasts' Role in Osteogenesis and Osteoclastogenesis

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**Objectives** Due to chronic inflammation in periodontitis, gingival fibroblasts (GFs) retrieved from inflamed sites have been exposed to bacterial products, activated leukocytes and pro-inflammatory cytokines and might be primed differently to modulate bone biology compared to GFs from healthy sites. Aim: to explore the biological characteristics of GFs obtained from biopsies from inflamed and non-inflamed (i.e. healthy) periodontal tissues from periodontitis patients.

**Methods** After 21 days of co-culture of GFs with leukocytes, osteoclasts were counted, inflammatory cytokines were measured and osteoclastogenesis and osteogenesis-related gene expression was quantified.

**Results** GFs from inflamed and healthy tissues exhibited a similar osteoclast inducing capacity, similar levels of TRAcP enzyme activity and secretion of the pro-inflammatory cytokines TNF-α and IL-1β. Expression of osteoclastogenesis-related genes (IL-1β, TNF-α, RANKL and OPG) as well as the osteogenesis-related parameter alkaline phosphatase (ALP) activity did not differ between the two groups. Notably, the cellular responses displayed a time-dependency for cytokines and their gene expression; TNF-α reached its peak on day 6 but decreased by day 14, while TRAcP enzyme continued to be highly expressed until day 21. Gene expression of TRAcP, TNF-α, and RANKL progressively increased over time, while the expression of OPG decreased.

**Conclusions** Both inflamed and healthy GFs show an early response of inflammatory markers during osteoclast formation (as disclosed by the increased expression of TNF- $\alpha$  and TRAcP on day 6). There were no differences in the capacities of GFs from inflamed and healthy sites from periodontitis patients to modulate osteoclastogenesis and osteogenesis. This suggests that the in vitro cultured GFs have intrinsic capacities irrespective of inflammatory state and do not seem specifically primed by the in vivo inflammation. Further research is needed to investigate whether GFs from non-periodontitis patients have differential activities regarding osteoclastogenesis and osteogenesis than GFs from periodontitis patients.

#### 0387

## Distinct Salivary Inflammatory Profiles in Patients With Periodontitis and Peri-Implantitis

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**Objectives** Periodontitis (PD) and peri-implantitis (PI) are characterized by an inflammatory response and immune reaction initiated by pathogenic bacteria and biofilm. The chronic inflammation in turn can cause the degradation of connective tissue and tooth-supporting bone leading to PD and PI, respectively. This study aimed to compare the salivary inflammatory mediator profile in patients with periodontitis, peri-implantitis and healthy controls.

**Methods** Samples of stimulated whole saliva were collected from patients (n=138), with a mean age of 63.2 ± 11.6 years. Healthy individuals (n=41) and individuals with periodontitis and/or peri-implantitis (n=97) who had implants installed for a minimum of 10 years were included. Samples were analyzed using



a multiplex-immunoassay panel including the tumor necrosis factor (TNF), interferon (IFN), and interleukin (IL) superfamily (Bio-Rad Laboratories).

**Results** The levels of BAFF (belonging to the TNF ligand family), sIL6R $\beta$ , IFN- $\beta$ , and sIL6R $\alpha$  were significantly (p < 0.05) higher in saliva samples of patients with PD and/or PI compared to healthy subjects without periodontal disease. Using the diagnosis periodontitis and/or peri-implantitis as the dependent variables and salivary inflammatory mediators, sex and smoking as independent variables demonstrated that smoking and sIL6R $\beta$  were significantly (p < 0.05) correlated (OR=4.69 and OR=52.77 respectively) with PD and/or PI diagnosis.

**Conclusions** Within the limits of this cross-sectional study, our findings suggest a potential difference in salivary cytokine levels between patients according to periodontal and peri-implant diagnosis. Moreover, our study suggests that slL6R $\beta$  shows promise as a candidate biomarker for salivary diagnostics of periodontitis and/or peri-implantitis. Using the detection of salivary inflammatory mediator levels might serve as an adjunctive diagnostic method for early detection of signs of disease. Additional investigation with a larger sample size is needed to further determine the role of salivary cytokines in the pathogenesis and progression of PD and PI.

0388

# Tertiary Lymphoid Structures in Severe Periodontitis Patients: Preliminary Results

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**Objectives** Tertiary lymphoid structures (TLSs) are ectopically organized lymphoid tissues that drive immune responses in chronical inflammation. They develop in perivascular areas comprising of high endothelial venules (HEVs) and lymphatic vessels, together with cell aggregates of B and T-cells. The presumed influence of TLSs on the disease course has led to widespread interest in understanding their biology and function. We aimed to investigate the presence of TLSs in severe periodontitis lesions. **Methods** Gingival tissues were obtained from periodontitis patients referred to the specialist clinic at Oral Health Centre of Expertise, Western Norway. The study was approved by the Regional Committee for Medical Research Ethics in Norway, 2017/1650/REK.

The patients included in this study were four males (1 smoker, 3 non-smokers) and one female (smoker), aged 19-73 years. All participants had completed a hygienic phase of therapy with a remaining pocket depth ≥ 5mm, before surgical treatment. Gingival tissue excised during surgery was formalin fixed and immunohistochemical analysis was performed on serial paraffin sections. Antibodies used were rabbit anti-CD3 (T-cells), mouse anti-CD20 (B-cells), rat anti-MECA-79 (HEVs) and mouse anti-Podoplanin D2-40 (lymphatic endothelium (LEC)). Triple-enzymatic immunohistochemistry staining was used, in addition to single staining of LEC in neighbor sections.

**Results** TLSs were found in gingival tissue sections of 3 participants (2 males, nonsmokers and one female, smoker). Podoplanin<sup>+</sup> lymphatic vessels were found within and in the periphery of the immune cell aggregates along with HEVs. In 2 patients (1 smoker, 1 non-smoker) no TLSs were identified. **Conclusions** This study revealed the presence of TLSs in severe periodontitis cases. Analysis of more



patients and the comparison with healthy controls are needed to identify the prevalence of TLSs in periodontitis patients and to understand the association of TLSs and periodontitis treatment outcomes.

## 0389

# Paracrine- and Cell-Contact-Mediated Immunomodulatory Effects of Human Periodontal Ligament-Derived MSCs

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**Objectives** Human periodontal ligament-derived mesenchymal stromal cells (hPDL-MSCs) have a high therapeutic potential, largely dependent on their immunomodulatory properties. The mechanisms of this immunomodulatory activity are versatile and regulated by various inflammatory cytokines produced by the immune cells. In this study, we directly compare the contribution of various mechanisms on the reciprocal interaction of hPDL-MSCs and allogeneic CD4<sup>+</sup> T lymphocytes using different *in vitro* co-culture models at different inflammatory milieus.

**Methods** The reciprocal interaction between hPDL-MSCs and CD4<sup>+</sup> T lymphocytes was investigated in three different co-culture models: direct with or without insert and indirect with 0.4mm-pored insert. Co-culture was performed with untreated, interleukin (IL)-1b, or tumor necrosis factor (TNF)-a - treated hPDL-MSCs, and CD4<sup>+</sup> T lymphocyte proliferation was activated by phytohemagglutinin. In CD4<sup>+</sup> T lymphocytes, proliferation, viability, and cytokine secretion were investigated. The gene expression of soluble and membrane-bound immunomediators was investigated in the co-culture dhPDL-MSCs.

**Results** CD4<sup>+</sup> T lymphocyte proliferation and viability were inhibited by hPDL-MSCs. In untreated hPDL-MSCs, this effect was more pronounced in the direct co-culture model. Co-culture of CD4<sup>+</sup> T lymphocytes with hPDL-MSCs in the direct co-culture model without inserts resulted in a strikingly higher CD4<sup>+</sup> T lymphocyte cell death rate. Adding IL-1b to the co-culture models resulted in substantial CD4<sup>+</sup> T lymphocyte response alterations. In contrast, adding TNF- $\alpha$  had only moderate effects. The changes in CD4<sup>+</sup> T lymphocyte parameters upon adding IL-1 $\beta$  or TNF- $\alpha$  in a direct co-culture model without insertion were qualitatively different from those observed in two other models. The immunomediator gene expression in untreated and cytokine-triggered hPDL-MSCs also showed some variability depending on the model.

**Conclusions** The inflammatory environment affects both paracrine and cell-to-cell contact interaction between hPDL-MSCs and CD4<sup>+</sup> T lymphocytes. This fact should be considered by comparing the outcomes of the different models.

## 0391

# Linking Periodontal Diseases and Ulcerative Colitis Through Subgingival-Gut Mucosal Microbiome

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**Objectives** To characterize the subgingival and gut mucosal microbiome compositions in ulcerative colitis (UC) patients with different periodontal statuses by comparing them with age- and gender-matched non-UC controls and explore the subgingival-gut mucosal microbial signatures in this relationship. **Methods** Thirty newly-diagnosed active UC patients and 30 non-UC controls from the Gastroenterology Department at Gazi University Hospital were included. Patients were categorized based on their periodontal status as healthy (n=10), gingivitis (n=10), and periodontitis (n=10). Multiple colonic mucosa biopsies were obtained from inflamed areas, and simultaneously, subgingival plaque samples were collected from the teeth with the deepest probing depths before any medication or therapy related to UC. All samples underwent analysis using 16S ribosomal RNA gene amplicon sequencing. Periodontal parameters were assessed on the same day as sample collection.

**Results** There was no statistical difference found in periodontal parameters between UC patients and non-UC controls. In subgingival plaque samples, the non-UC group showed significantly higher bacterial abundance and diversity than the UC group, as demonstrated by alpha-diversity indicated by the Shannon index. In gut mucosal biopsy samples, periodontal health exhibited significantly higher bacterial abundance and diversity than gingivitis and periodontitis in the non-UC group, as indicated by alpha-diversity (Chao index) (p<0.05). In UC patients, a higher abundance of *Streptobacillus* for periodontal health, *Campylobacter rectus*, and *Prevotella stercorea* for gingivitis, and *Streptococcus anginosus* and *Bifidobacterium* for periodontitis were identified in subgingival plaque samples. A significant association of *Bacteroides vulgatus*, *Prevotella copri*, *Bacteroides fragilis*, and *Parabacteroides merdae* was found in both colonic mucosal and subgingival plaque samples of UC patients (p<0.05). **Conclusions** In both subgingival and gut mucosal biopsy samples, UC patients diagnosed with gingivitis presented the highest abundance and diversity of microbial compositions. In UC patients, subgingival and gut microbiome profiles share some common microorganisms, such as *Prevotella copri* and *Bacteroides fragilis*.

# 0392

# Effect of Collagen Matrix and Platelet-Rich Fibrin on Periodontal Regeneration

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**Objectives** To histologically evaluate the effect of a volume-stable collagen matrix (VCMX) and liquid platelet-rich fibrin (PRF) on periodontal regeneration.

**Methods** One-wall intrabony defects were surgically created in six beagle dogs and randomly assigned to one of the following four treatment modalities: empty defect (group 1, control), liquid PRF (group 2), VCMX (group 3), VCMX + liquid PRF (group 4). Liquid PRF was prepared from venous blood using a low-speed centrifugation concept (600 rpm; 44 g; 8 min). After 12 weeks, the dogs were euthanized, and the specimens were scanned by micro-CT followed by histological processing. Micro-CT, histologic evaluation, and statistical analysis were then performed.

**Results** Healing was uneventful in all animals and all 48 defects (12 defects per group) were available for evaluation. Histologically, periodontal regeneration occurred to varying degrees in all groups. Residual VCMX was still present in groups 3 and 4 and showed integration into new bone and soft connective tissue. Degradation of VCMX appeared to be more advanced in group 4 compared to group 3. Cementum formation was not always continuous from the apical to the coronal end of the defects. Consequently, measurements were differentiated between highest point of continuous and interrupted cementum. The highest point of cementum was located more coronally in groups 2, 3, and 4 (4.23±0.26mm,

4.35±0.58mm, and 4.29±0.67mm) compared to group 1 (3.49±0.48mm). The difference between group 1 and group 2 reached statistical significance (p=0.03). Regarding continuous cementum formation, groups 2, 3, and 4 (2.92±1.14mm, 2.40±1.09mm, and 3.96±0.67mm) showed higher values compared to group 1 (1.08±0.76mm). Group 4 was statistically significantly better than group 1 (p=0.01). New bone formation was higher in groups 2, 3, and 4 (3.19mm, 3.24mm, and 3.22mm, respectively) compared with group 1 (2.68 mm) but did not reach statistical significance.

**Conclusions** The groups treated with liquid PRF and/or VCMX showed more favorable results in terms of periodontal regeneration compared to the empty control. Liquid PRF with or without VCMX appears to represent a viable treatment modality for intrabony defects and warrant further preclinical and clinical investigations.

## 0452

## **Staining Analysis of Resin Cements and Effects on Veneer Restorations**

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**Objectives** To determine and analyse color and translucency changes of resin cements and lithium disilicate veneer restorations, as well as sorption and solubility of cements following staining. **Methods** Ten cylindrical specimens (10x2mm) were prepared of G-Cem One (GC), RelyX Universal (3M), Panavia V5 (Kuraray), Variolink Esthetic (Ivoclar). Another set of LiSi veneers were cemented to G-aenial Universal Injectable composite as dentine base (GC) (N=10/group). Color and translucency parameter (TP) were determined initially and after staining in black tea for 72h using a spectrophotometer and calculated using CIEDE2000 formula. Sorption and solubility of resin cements (N=5/group) was tested following the same conditions and calculated using the mass/volume formulae. Data were analysed using one-way ANOVA and Tukey's post-hoc test, correlation and regression analyses (a=0.05). **Results**  $\Delta E_{00}$  of cements ranged between 9.1±2.9 (G-Cem) and 15.4±1.5 (Panavia). G-Cem and RelyX showed lower  $\Delta E_{00}$  than Variolink and Panavia (p<0.001). Comparable  $\Delta TP_{00}$  was observed for G-Cem,



Variolink and Panavia (range -2.1±0.9 and -3.6±1.6)(p>0.05), whilst  $\Delta TP_{00}$  of RelyX significantly increased (2.6±2.1, p<0.001).  $\Delta E_{00}$  of veneer restorations cemented with different cements ranged from 2.7±0.5 (G-Cem) to 3.9±0.7 (Panavia)(p<0.05). TP decreased after staining with no significant differences between groups (p>0.05). Initial TP positively correlated with  $\Delta E_{00}$  of cements (Pearson r=0.67, regression equation Y=0.8398\*X+4.101) and  $\Delta E_{00}$  of cemented veneer restorations (Pearson r=0.41, regression equation Y=0.1360\*X+1.844)(p<0.05).  $\Delta E_{00}$  of cements positively correlated with  $\Delta E_{00}$  of cemented veneer restorations (Pearson r=0.41, regression equation Y=0.1360\*X+1.844)(p<0.05).  $\Delta E_{00}$  of cements positively correlated with  $\Delta E_{00}$  of cemented veneer restorations (Pearson r=0.41, regression equation Y=0.1360\*X+1.844)(p<0.05).  $\Delta E_{00}$  of cements positively correlated with  $\Delta E_{00}$  of cemented veneer restorations (Pearson r=0.41, regression equation Y=0.1360\*X+1.844)(p<0.05).  $\Delta E_{00}$  of cements positively correlated with  $\Delta E_{00}$  of cemented veneer restorations (Pearson r=0.48, p=0.0016, regression equation Y=0.1284\*X+1.592). Highest sorption was observed for RelyX (0.0336±0.0024mg/mm3) and highest solubility for Variolink (0.0117±0.0028mg/mm3). No significant correlation was established between sorption or solubility and  $\Delta E_{00}$  of cements and veneer restorations (p>0.05).

**Conclusions** Resin cements affected color and translucency differences of cemented veneer restorations after staining. Color differences of cements and veneer restorations depended on initial translucency of the tested cements but not on their sorption and solubility.

# 0453

# Effect of Polishing on Color and Roughness of Aged Composites

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**Objectives** This in vitro study aimed to assess the surface roughness and color stability of different composite resins after polishing with different polishing systems following exposure to coffee and thermal cycling aging.

**Methods** In our study, the surface roughness and color values of FiltekUltimate Universal(Enamel,FUU), ClearfillMajestyES-2(CME), PalfiqueEstelitePaste(PEP), G-ænialUniversalInjectable(GUI), TetricPowerFill(TPF) composite resins were analyzed. Two hundred samples were polished with 4 polishing systems (OneGloss(OG), ZenitFlex(ZF), ClearfillTwistDia(CTD), NovaTwist(NT)). Measurements made without any surface treatment were accepted as the control group. After the samples were polished with polishing systems, roughness and color change values were measured. Then, after exposure to coffee and thermal cycle aging, and after polishing with polishing systems after aging, the roughness and color changes of all samples were measured. Statistical analyses were performed using One-way ANOVA and Post Hoc tests.

**Results** When color change was compared with the control group after exposure in coffee and thermal cycling; FUU showed the most color change in other polishing systems except ZF, and PEP showed the most color change in the ZF group(p<0.05). When the surface roughness of each composite was compared in the 4 polishing systems, significant differences were observed in OG polished FUU, CME, TPF(p<0.05). When the roughness changes between the polishing systems and the composites were compared, a higher roughness change was found only in CME polished with OG(p<0.05). When the composite groups(p<0.05). In all composite resins polished after aging, the color change showed statistically significant variations according to the polishing systems(p<0.05). **Conclusions** The study highlighted the variability in the impact of polishing aged composites on roughness and color change based on the composite type and polishing systems.



## Post-Bleaching Polishing Effects on Composite Resins: Surface & Color Analysis

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**Objectives** The aim of this study is to evaluate the effect of polishing following bleaching treatment on the color stability and surface roughness of colored composite-resins.

**Methods** Discs (10mm\*2mm) were fabricated from Clearfil-Majesty-ES-2 (CME), Palfique-Estelite-Paste (PEP), Filtek-Z250 (Z250), Parafil (PF), Ruby-Comp-Nano (RC) composites (n=20) were polished with Kerr-Identoflex. Samples underwent initial roughness and color measurements (control), followed by immersion in coffee for 7 days. 40% Hydrogen Peroxide gel (Opalescence Boost PF) was applied for bleaching. Half of the samples in each group (n=10) were polished after bleaching. Then, the samples were immersed in coffee again for 7 days and third color and roughness measurements were made. Data were analyzed using one-way ANOVA and Tukey tests (p=0.05).

**Results** Following bleaching, only the polished CME samples showed significantly lower surface roughness compared to the non-polished group. Among the polished composite resin groups, CME samples exhibited significantly higher roughness than other composites, except for Z250. No significant differences were found among the other composite resin groups. Non-polished samples in all composite-resins displayed higher surface roughness than polished ones, with no significant difference in color change. While non-polished samples showed no significant differences in color change, polished PF and Z250 samples demonstrated more discoloration compared to PEP and RC.

**Conclusions** While polishing after bleaching was observed to reduce the surface roughness of composite-resins, no significant effect on color change was detected. However, surface roughness and color change varied depending on the content of the composite-resins.

0455

## Does Exposure to Daylight Affect the Coloration of the Composite?

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**Objectives** This study aims to investigate the color change of a composite material exposed to daylight. The objective is to simulate the clinical scenario where the lid of the composite box remains open during application. Additionally, the study aims to assess the impact of the polishing process on color change after composite discoloration in coffee immersion.

**Methods** Disk shaped composite samples were prepared after exposure to daylight in a clear sunny day for 2, 4 and 6 minutes. Also a control group was utilized. A total of twenty-eight disc-shaped composite samples (NeoSpectra ST, Dentsply Sirona, Germany) were prepared. All samples were hydrated in distilled water at 37°C for 24 hours, and initial color measurements were recorded (T0) with a spectrophotometer. The control group remained in water, while the other groups were immersed in a coffee solution to simulate staining. After seven days, color measurements were repeated (T1), and color differences (ΔΕ



using CIEDE2000) were calculated. Sof-Lex discs (3M ESPE, USA) were then used to polish all colored samples following the manufacturer's recommendations. Color measurements were repeated again (T2). Data were analyzed using Shapiro-Wilk and One-Way ANOVA with Tukey Post-Hoc Tests. **Results** All test samples showed a statistically significant color change compared to the control group after staining. However, no statistically significant color change was observed between the daylight exposure groups. The polishing process significantly reduced discoloration (p<0.001). After polishing, no statistically significant color difference was observed between the groups, although the polishing process was least effective in the 6-minute group.

**Conclusions** Daylight exposure for tested periods before polymerization did not significantly affect the degree of coffee staining. The polishing process effectively removed composite discolorations **however** all groups except the control exhibited clinically unacceptable color changes compared to their initial state.

# 0456

# Aging-Dependent Color Changes in Different Restorative Materials

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**Objectives** To evaluate artificial accelerated aging (AAA)-dependent color stability of different restorative materials.

**Methods** Disc shaped samples (D=10mm, 2-mm thick, n=5) were fabricated using 9 different restorative materials: Tetric N-ceram (Ivoclar Vivadent), Beautifil II (Shofu), Admira Fusion (Voco), Admira Fusion Xtra (Voco), Estelite  $\Sigma$  Quick (Tokuyama), Charisma Topaz (Kulzer) Charisma Diamond One (Kulzer), GrandioSO (VOCO), GrandioSO x-tra (VOCO) were polymerized using a curing light was through a Mylar strip and 1mm glass slide for 40 seconds. Specimens were polished using PoGO disk-shaped polishers (PoGo, Dentsply) for 40 seconds. A spectrophotometer (X-Rite Ci7600 Series, Xrite,) was used for color measurements at baseline, and after AAA (SUNTEST XXL, Atlas Material Testing Technology): exposure to controlled irradiance of 150 kJ/m2. CIEDE2000 color differences ( $\Delta$ E00) were calculated. Means and standard deviations were determined, and data was analyzed by One-way ANOVA. Tukey's tests were used for post hoc comparisons. In addition, a 50:50% acceptability threshold (AT) of  $\Delta$ E00=1.8 was used in result interpretation.

**Results** CIEDE2000 color differences of different restorative materials before and after accelerated aging are listed in the Table. Charisma Topaz exhibited the best color stability after artificial aging. Statistically significant differences were recorded among materials (p<0.001).

Conclusions Artificial aging-dependent color differences were material-dependent.



# Mean ΔE00 (s.d.) after Artificial Aging

MATERIALS	ΔΕ		
Tetric N-ceram	2.3 (0.3)		
Beautifil II	1.6 (0.7)		
Admira Fusion	1.8 (0.4)		
Admira Fusion X-tra	3.0 (0.2)		
Estelite ∑ Quick	2.0 (0.5)		
Charisma Topaz	0.6 (0.2)		
Charisma Diamond One	0.9 (0.4)		
GrandioSO	2.1 (1.2)		
GrandioSO X-tra	1.2 (0.4)		

#### 0457

# Three Different Matrix Systems' Contact Tightness in Class-II Cavities

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**Objectives** The purpose of this study was to evaluate the contact tightness of restorations applied to cavity three different matrix systems and two different composite resin materials utilized in the posterior region.

**Methods** In the present study, 144 acrylic molar teeth were used, and standardized Class-II MO cavities with the same features were prepared on acrylic jaw for phantom head. The entire procedure was performed by a single operator. Teeth were divided into three groups as two different sectional matrix systems (lvory and Palodent) and one circumferential matrix (Tofflemire) system. Depends on the composite resin, which microhybrid and bulkfill composite, each group divided two subgroups. Groups were as follows; Group 1: Tofflemire matrix-microhybrid composite; Group 2: Tofflemire matrix-bulkfill composite; Group 3: lvory matrix-microhybrid composite; Group 4 :lvory matrix-bulkfill composite; Group 5 :Palodent matrix-microhybrid composite; Group 6 :Palodent matrix-bulkfill composites were applied in single layer. Before the restoration pre-contact tightness and after the restoration post-contact tightness were measured on the teeth according to the World Dental Federation (FDI) criteria by both the operating physician and a specialist who had no knowledge of the procedures. Data were evaluated with Kruskall-Wallis and Tamhane tests. Cohen's Kappa coefficient was illustrated for inter-rater.



**Results** The initial contact tightness agreement between the two observers was substantial (0.638) and the final contact tightness agreement was fair (0.344). There was no significant difference in the contact tightness between the palodent matrix and the ivory matrix (p>0.05), but significant difference was found between them and the tofflermire matrix (respectively, p<0.001, p<0.001).

**Conclusions** Using a sectional matrix system might be provides superior contact tightness compared to using a circumferential matrix system. Due to our results are in vitro and may not be possible to compare with under clinical conditions.

0458

# Developing 'Atiya' a Virtual Patient to Practice Patient Counselling Skills.

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**Objectives** Virtual patients (VPs) are a safe and standardised method of simulating clinical environments, but few studies have explored oral health care professional's experiences of learning via a VP. This study aimed to create a VP through generative conversational Artificial Intelligence (AI) which can enhance oral health education delivery skills among dental students.

**Methods** The study was carried out among dental students, interns and junior residents to assess their satisfaction after interaction with a Virtual Patient (VP) named 'Atiya' for enhancing their oral health education delivery skills. A 'no-code' generative conversational AI platform, was used to construct a VP with whom the study participants can interact with. Three Public Health Dentists as subject experts formed a working group to start the conceptualization process. This VP actively engaged the participants by asking pertinent questions mirroring those of a real patient who is going to receive oral health education. The VP was then integrated with an instant messaging application frequently used by the trainees giving them the possibility of interacting with it at any time.

**Results** Participants were enthusiastic about virtual patients as a novel training tool which provided an opportunity for learners to practice realistic scenarios in a safe environment. Participants reported liking the concept and delivery of the VP. They also reported finding it usable, and simulated VP assisted oral health education to be effective as compared to traditional methods. Amendments that were suggested included changing some of the contents.

**Conclusions** The VP offered an educational use as experiential learning. It appeared to be functional and usable and the dental students reported positively about the use of VP's for enhancing and increasing overall preparedness of their oral health counselling sessions. They reported that the VP had value as an adjunct to other education and training resources.



# New Effective Material for Translucent Teeth Preparation for Dental Education

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**Objectives** Endodontic teaching models do not reflect natural tooth root canal shaping perceptions. As a result, alternative methods for dental education were developed, specifically the use of natural extracted teeth. However, the traditional approach of using methyl salicylate to prepare translucent teeth raises safety concerns due to its high toxicity. The objective of this study was to assess the effectiveness of benzyl alcohol and benzyl benzoate (BABB) solution in clearing extracted teeth.

**Methods** Freshly extracted 32 single-rooted teeth were immersed in 10% formalin for 24 hours. They were then processed following a standard protocol, which included alternating immersion in 5.25% sodium hypochlorite, demineralization in 5% nitric acid, dehydration in a series of alcohol solutions, and finally placement in xylene. The teeth were then divided into two groups: the first (control) group, consisting of 20 teeth, underwent the traditional protocol, which involved soaking the teeth in 99% methyl salicylate for 24 hours; the second group, consisting of 12 teeth, was immersed into the BABB solution for 24 hours. Optical properties of the processed teeth translucency were evaluated by transluminant light imaging using collimated light source and digital camera C-P8 (Optika, Italy). Image processing algorithms in the MatLab computational environment were used to evaluate the colour and intensity of the translucent light at the apical area of the root in each tooth.

**Results** The optical properties of selected anatomical locations were the same across both groups of teeth evaluating Hue, Saturation and Value of pixels (independent samples Mann-Whitney U test, p > 0.2). **Conclusions** Benzyl alcohol and benzyl benzoate solution is equally effective compared to traditional methyl salicylate for preparing translucent teeth in dental education.

## 0460

## KAP Questionnaire in Anxiety, Pain and Emergencies Among Dental Students

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**Objectives** The aims of this study was to assess the current state of Italian dental students' preparation, attitude, and perception regarding emergency management, anxiety, and pain.

**Methods** A cross-sectional study was conducted on Italian dental students with the collaboration of the Italian Association of Dentistry Students. The Google Link questionnaire consisted of: Part I: demographic information; Part II: comprised 22 questions (12 for <u>Knowledge</u>, 8 for <u>Attitude</u> and 2 for <u>Practice</u>), relating to three domains: treatment of anxiety, pain, and medical emergencies management. The Knowledge and attitude questions had five answer options. The total score range were 0-12 and 0-32 respectively. In Practice section, A 0-2 score was adopted for the evaluation. The total score ranges from 0-4.



**Results** 232 questionnaires were acceptable with an average of 6.11 questionnaires per University. <u>Knowledge section</u>: the average score was  $3.51 \pm 1.79$  points with out geographical differences (Anova: 0.476). About Anxiety Domain, the mean total score was  $0.54 \pm 0.66$  points. A geographical difference (Anova: 0.049) was observed between the North ( $0.41 \pm 0.59$ ) and the South ( $0.65 \pm 0.67$ ). About Pain Domain, mean result was  $1.31 \pm 0.98$  points. About Medical Emergency Domain, mean result was  $1.65 \pm 1.01$  points. No Geografical differences were found in Pain (Anova: 0.743) and emergency (0.522) domains.

<u>Attitude section</u>: the mean total score was 17.45 ± 3.68 without geographical differences (Anova: 0.396). <u>Practice section</u>: 53.45% of students declare that they have never taken courses for anxiety. Regard to emergencies, 25.43% have never attended any BLS courses. No geographical differences were found (Anova: 0.267).

**Conclusions** In Italy, there is a clear need to improve the effectiveness of university training to guarantee the skills to identify/prevent medical complications related to anxiety and pain in clinical practice.

# 0461

# Evaluation of Tooth Preparations in Dental Education: a Collaborative Protocol

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**Objectives** Dental educators usually assess student preparations visually, using several indicators such as the conicity of the walls or the shape and finish of the cervical margin. However, this procedure creates problematic issues concerning time, precision and reproducibility for the evaluators. The aim of this work is to present the progress of an inter-university and collaborative project aiming to address this issue with an automated protocol.

**Methods** A 3-step collaborative workflow is defined between 5 universities: -Design and manufacturing of a multiple digitization base (24 preparations); -Comparative assessment of scanners used for preparations Digitization: a tabletop scanner (E4 3SHAPE®), an intraoral scanner (TRIOS 3SHAPE®) and a low-cost new generation scanner (REVOPOINT®); -Programming of an automated preparation measurement software. In the present abstract, results regarding the quality of the STL files will be presented. The three scanners are compared and evaluated with aim to estimate: -Their ability to scan the entire preparations on a base allowing multiple scanning; -Having sufficient precision to assess the quality of the cervical margin, tissue reduction thickness and the preparation walls conicity.

**Results** The E4 3SHAPE® laboratory scanner allow an overall better scanning, but REVOPOINT® also allow good reproduction of shapes and details, while the TRIOS 3SHAPE® scanner don't seem suitable for this protocol. A higher mesh density is observed in the laboratory scanner in comparison to the REVOPOINT®, which offered an easier analysis of the cervical limit. Additional parameters such as scan strategy, learning curve and cost of the device are also investigated in this study.

**Conclusions** Different scanning base designs could be adapted depending on the type of tooth and the manufacturer. This protocol offers standardized digitization of preparations. The REVOPOINT<sup>®</sup> represent an original alternative, being more accessible than a laboratory scanner for teaching staffs. A



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repositioning and measurement algorithms will be the next step of this project to enable rapid and automatic evaluation of preparations.

## 0462

## Youtube as a Source of Information on Composite Veneer

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Objectives The aim of present study was to evalute the accuracy and quality of YouTube videos related to composite veneers.

Methods In the current study, the initial 100 videos were obtained by searching for the keyword 'composite veneers' on YouTube. Videos were evaluated in terms of video demographic properties such as number of views, number of likes and dislikes, days since upload, number of comments and video length. Moreover, video power index and interaction index were calculated according to video demographic properties. Video contents were evaluated in 2 different categories such as educational purposes and learning techniques, and video sources were investigated in 4 different categories that are dental company, specialist, YouTube channel and dental clinic. While, Journal of American Medical Association Benchmark Criteria (JAMA) was employed to determine the accuracy of the videos, the Global Quality Score (GQS) with a 5-point scale was used to assess the quality of the videos. The analysis was conducted using the Kruskal-Wallis and Tamhane-T2 tests, while the Spearman correlation test was used for correlation analysis.

Results When evaluated in terms of source, there was a significant difference between the GQS value (p=0.039). In terms of content, there was a significant difference between the number of likes, dislikes, and comments (respectively, p=0.038; p=0.023; p=0.038). When evaluating due to the GQS values, a significant difference was found between JAMA (p=0.003), while the interpreting JAMA values, a significant difference was found between GQS (p=0.001). There was a strong positive correlation between JAMA and GQS scores.

Conclusions The overall accuracy of the videos is high level and the quality of the majority of the videos is high content. The role of professionals is critical in providing accurate and high-quality information about composite veneers to patients and dental students.

#### 0463

#### **Differences in Aesthetics Perception of Dentistry Students in Different Grades**

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**Objectives** The aim of present study was to evaluate how smile features are perceived by dental students and to reveal the more prominent changes in smile aesthetics.

**Methods** 299 dental students who agreed to take part in were participated in current study. A frontal photo of one patient was taken which has the most ideal smile we encountered in clinical conditions, after the consent form. Adjustments were made so that only the lips and teeth were visible. With the



Adobe Photoshop program, adjustments that would disrupt the aesthetic appearance of the teeth and surrounding tissues were made gradually. Gummy smile, diastema, tooth color change, midline shift, crown length and width, buccal corridor, peg lateral and lip appearance parameters were altered on the photographs. The photographs adjusted were directed to 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> grades dental students via a Google survey. They were asked to score the photographs that looked complicated, 'How beautiful do you find this smile?', using the VAS scale. Furthermore, our researcher (dentist), who knew which adjustment were made in the photographs, was asked to score the photographs.

**Results** Compared with answers given by the dentist, there is no significant difference between the students (p>0.05). A significant difference was found between grades for the photo with the ideal smile (p = 0.001). In terms of gender, while women selected those 1- and 4-mm gummy smile, 2-mm expanded central tooth, 4-mm extended central tooth, D2 colored teeth according to the vita scale, 1-mm small peg lateral were significantly unacceptable aesthetic (p<0.05), likewise, they thought that the 1-mm expanded central tooth, C1 colored teeth according to the vita scale, 3-mm buccal corridor and 1-mm midline shift had a significantly satisfactory aesthetic appearance (p<0.05).

**Conclusions** While dental students could notice some parameters in the adjustment made photographs, they could not distinguish most of them.

0465

# Alterations in Salivary Electrolytes in Oral Cancer or Lichen Planus

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**Objectives** To analyse electrolyte concentrations in stimulated whole saliva from patients with head and neck cancer and patients with lichen planus.

**Methods** Stimulated whole saliva was collected from 20 patients with head and neck cancer (HNC group) (63±9 years), 25 patients with either lichen planus (n=16) or oral lichen planus (n=11) (LP group) and 15 healthy controls. Saliva was stored at -80°C, thawed, centrifuged and lyophilized to a pellet (0.5-2 mg). The pellet was dissolved in water (3 ml), filtered (0.45 mm) and the concentrations of 6 positively (Li<sup>+</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>+</sup>, Ca<sub>2</sub><sup>+</sup>) and 8 negatively charged ions (F<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, HCO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, SCN<sup>-</sup>) simultaneously determined with ion chromatography using 200 ml of the filtered sample. **Results** Results: The HNC group had a significantly lower secretion rate (1.6±0.7 ml/min) compared with the healthy controls (2.8±0.8 ml/min) (p < 0.001). The mean secretion rate in the LP group was 2.5±1.4 ml/min. The concentrations of F<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup>, Na<sup>+</sup>, NH4<sup>+</sup>, K+ and Ca<sup>2+</sup> compared with the controls. The HNC group had significantly lower concentrations of HCO<sub>3</sub><sup>-</sup> and Na<sup>+</sup> and significantly higher concentrations of SCN<sup>-</sup> and Mg<sup>+</sup> compared with controls.

**Conclusions** The decreased levels of HCO<sub>3</sub><sup>-</sup> in both the LP group and the HNC group results in a lower buffer capacity. The increased concentration of HCN<sup>-</sup> might indicate a more active immune defense in HNC. The markedly decreased concentration of several electrolytes in the LP group needs further investigation. Ion chromatography constitutes a sensitive method, enabling complete and repeated analysis of electrolytes in low sample volumes.



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## 0467

# Use and Simplification of the Dry Mouth Severity Score

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**Objectives** We have previously proposed a Dry Mouth Severity Score, DMSS, for uniform characterization of patients in clinical studies. We have here used the DMSS in a pilot study to evaluate the effect of an innovative product to relieve the symptoms of dry mouth. As the product was not intended to increase the secretion of stimulated whole saliva, a simplification of our original DMSS was tested.

**Methods** Twenty patients who had been evaluated for Sjögren's syndrome were included. OHIP-14 sum scores were recorded. Initially, four parameters of DMSS were employed: The Standard Xerostomia Question (GXQ, range 0-3, 1 point (p) when  $\geq$ 2), the Shortened Xerostomia Inventory (SXI, range 5-15, 1 p when  $\geq$ 11), the Clinical Oral Dryness Score (CODS, range 0-10, 1 p when  $\geq$ 6), and secretion of unstimulated whole saliva (UWS, 1 p when  $\leq$ 0.01 ml/min). DMSS (range 0-3, 0p=0, 1-2p=1, 3p=2, 4-5p=3) was calculated according to these four parameters. Thereafter, stimulated saliva secretion (SWS, 1 p when  $\leq$ 0.07 ml/min) was evaluated, and DMSS was calculated using five parameters as in the original DMSS.

**Results** The mean age of the patients was 50.6 years, and their mean OHIP-14 sum score was 22.7. Mean GXQ was 2.7, mean SXI was 13.1, mean CODS was 6.5 and mean UWS was 0.07 ml/min. In the first round, patients scored 2-4 points, corresponding to DMSS 1-3, mean 2.5. Addition of SWS (mean 0.54 ml/min) led to an increase in points for most patients, but only four patients increased their DMSS, mean 2.7 (ns). **Conclusions** In this group of patients exhibiting low oral health-related quality of life and high DMSS, the score can be simplified as most patients received the same score in the presence and absence of SWS. The findings indicate that DMSS can be simplified according to patient groups and purpose of the clinical study.

## 0468

## Association of ESSDAI With Orofacial Sicca-Symptoms and Histopathology in SjöGren's-Syndrome

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**Objectives** Aim was to find association of the EULAR Sjögren's Syndrome Disease Activity Index (ESSDAI) with orofacial sicca symptoms and minor salivary gland histopathology results in patients with primary Sjögren's syndrome.

**Methods** 25 patients (24 females, 1 male; mean age: 58±15 years) were included, and were divided into 3 groups (G1-3) according to their ESSDAI scores. G1: ESSDAI Score 0 (n=15), G2: ESSDAI Score 1-8 (n=8),



G3: ESSDAI Score>8 (n=2). Grade of xerostomia (1-4 with no, mild, medium, severe), unstimulated whole saliva flow rate (UWS) and furthermore, alterations of the salivary ductal (normal/dilated) and acinar (normal/atrophic) tissue of minor the salivary glands were examined. Data were compared amongst the G1-3 patient groups and statistically analysed at a significance level of p<0.05.

**Results** UWS flow rates ± the standard deviation was as follows: G1: 0,17 ± 0,22ml/min, G2: 0,19 ± 0,16ml/min, and, G3: 0,25 ± 0,13 ml/min. In G1 26,66%, G2 12,5%, and G3:0 % of the patients had no xerostomia, while in G1:73,33%, G2:87,5%, G3:100% of the examined ones had severe burning mouth symptoms. Ductal morphology showed in G1: normal duct in 46,66%, dilated duct in 53,33%; in G2: normal duct in 62,5%, dilated duct in 37,5%; while, in G3 dilated duct were found in 100% of the examined minor salivary gland samples. Acinar morphology revealed in G1: normal in 53,33 %, atrophy in 46,66%; in G2 and G3 both: 50%-50% had normal and atrophic tissue. There were neither significant difference between the groups in the severity of xerostomia, nor in the flow rate of UWS nor in the histopathology of the minor salivary gland tissue.

**Conclusions** Data revealed that ESSDAI level was neither in correlation with the subjective nor with the objective orofacial sicca symptoms, nor with the histopathological morphological alterations of the minor salivary glands.

# 0469

# Oil-Based Salivary Substitutes Increase Candida Albicans Biofilm Growth

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**Objectives** Our main goal was to test the effect of different salivary substitutes, with various compositions, on *Candida albicans* biofilm growth.

**Methods** A simple method of *Candida albicans* biofilm growth test in 96 well plate has been modified to mimic the presence of salivary pellicle interface during the initial adhesion and further growth. Saliva from healthy donors was used either pristine or after filtration through a 0,22 µm filter to discard high molecular weight mucins. *Candida albicans* biofilm growth was evaluated after rinsing with different salivary substitutes, by spectrophotometry (OD600nm). Aside modification of salivary pellicle was recorded by QCM-D.

**Results** Among the 7 different salivary substitutes tested, two favored an increase in the *Candida albicans* biofilm growth while others did not modify *Candida*'s biofilm growth. These two salivary substitutes share a similar oil-based chemical composition. No difference was observed when high molecular weight mucins were filtered out. QCM-D analysis of the salivary pellicle showed an increase of the mass deposited after a rinsing step when testing oil-based salivary substitutes compared to water-based salivary substitutes. In addition, viscoelastic characteristics were also modified with a trend towards higher softness. In the absence of salivary pellicle, all salivary substitutes resulted in a decrease of *Candida albicans* biofilm growth. The degree of reduction correlating positively with the viscosity of the substitute.

Conclusions After Candida albicans adhesion on salivary pellicle, the use of oil-based salivary



substitutes can increase biofilm growth, mostly because they persist on the surface. Practitioner should take this into account when prescribing a salivary substitute to patients with a history of candidosis.

# 0471

# Impact of Smoking on Gingival Microbiome Composition

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**Objectives** The oral microbiome plays a crucial role in maintaining oral health and can be influenced by various factors, including smoking habits. This study aimed to investigate the differences in the gingival microbiome among never smokers, current smokers, and previous smokers.

**Methods** Subgingival plaque samples were collected from 1287 participants born in 1950-1951 participating in Hordaland Oral Health survey (2020-2022) and in the parent Hordaland Health Study (third wave occurring during 2018-2020) in Western Norway. Samples were obtained from individuals with periodontal pockets. Shotgun metagenomics analysis was conducted to assess the composition of the gingival microbiome.

**Results** Significant differences were revealed in the abundance of bacterial genera and species among current smokers, previous smokers, and never smokers. Current smokers exhibited significantly higher abundances of several bacteria, including Tannerella forsythia (p < 0.001), Fretibacterium fastidiosum (p < 0.001) and Prevotella intermedia (p < 0.01) compared to never smokers. Conversely, certain bacteria, such as Lautropia mirabilis (p < 0.001), Actinomyces naeslundii (p < 0.001), and Rothia aeria (p < 0.001), showed lower abundances compared to never smokers. Specific bacterial species displayed differential abundances between current and previous smokers.

**Conclusions** The findings underscore the importance of considering smoking status when assessing the gingival microbiome and its implications for oral health. The extensive alterations in bacterial composition observed in current smokers highlight the need for targeted interventions to mitigate the adverse effects of smoking on periodontal health. Further research is warranted to elucidate the mechanistic links between smoking, the oral microbiome, and periodontal disease. Furthermore, the potential reversibility of smoking effects on the gingival microbiome upon smoking cessation underscores the need for further research in this area.



# Periodontitis Dysregulates Oral MicroRNA Linked With Cardiovascular-Endothelial Risk Dysfunctions

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**Objectives** Recent studies have evidenced that micro-RNAs (miRNAs) are involved in a wide range of epigenetic processes linked with periodontitis, increased cardiovascular disease (CVD and endothelial dysfunctions. The present study evaluated the impact of periodontitis on gingival crevicular fluid (GCF) miRNAs associated with increased CVD risk and endothelial dysfunctions and evaluated their possible predictors.

**Methods** Healthy controls (n=15), patients with CVD (n=15), periodontitis (n=16) and periodontitis+CVD (n=16) were enrolled. Patients were clinically and periodontally evaluated. In addition, GCF miRNAs 7, 21, and 200 expression were analyzed using a real-time quantitative polymerase chain reaction (RT-PCR). **Results** In the analyzed sample, patients with periodontitis and periodontitis + CVD had higher -7 and 21-miRNAs expression in comparison with healthy controls. Moreover, compared to healthy controls, subjects with periodontitis and periodontitis + CVD had higher GCF miRNA -7, -21 and -200 expression, while there were no changes in miRNAs expression with CVD patients. The multivariate regression analysis evidenced that periodontitis (miRNA 21), full mouth bleeding score (FMBS) (miRNA -7) and periodontal inflamed surface area (PISA) (miRNA -7 and -200) were significant predictors of higher GCF miRNAs expression in the analyzed sample.

**Conclusions** The results of the study highlighted that patients with periodontitis and periodontitis with cardiovascular diseases exhibited high mi-RNAs GCF levels compared to healthy subjects. The multivariate regression models highlighted that periodontitis and its extent, as FMBS and PISA, were significant predictors of upregulated miRNAs.

## 0473

# The Effect of Periodontal Therapy on Social Anxiety Levels

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**Objectives** Social anxiety is a psychological disorder that causes individuals to feel highly uncomfortable in social situations. The aim of this study was to evaluate the effect of periodontal treatment on social anxiety levels in patients with periodontitis.

**Methods** Twenty-five patients with periodontitis (stage III-IV) were included in this study. Sociodemographic data and clinical periodontal parameters were recorded. The social anxiety levels were assessed at baseline, 1st month, and 3rd month after non-surgical periodontal treatment (NSPT) by the Liebowitz social anxiety scale (LSAS) in patients. The cut-off score was determined to be 50 for Liebowitz total anxiety score.

**Results** Plaque index (PI), gingival index (GI), clinical attachment loss (CAL), and missing tooth numbers values were lower in patients with low Liebowitz total anxiety score (p<0.005). After the periodontal treatment, Liebowitz total, total anxiety, performance anxiety, socially related anxiety, total avoidance,



performance avoidance, and socially related avoidance scores decreased from baseline to the 1st and 3rd months (p<0.001). There were positive correlations mostly between Liebowitz total scores and all subscores and plaque index, gingival index, probing pocket depths, and clinical attachment loss (p<0.005). **Conclusions** LSAS scores gradually decreased after NSPT. The findings of the study suggest that periodontitis can have a negative effect on social anxiety levels. NSPT contributes to improving social anxiety levels.

# 0474

# Minimally-Invasive Periodontal Treatment Impact on Endothelial Dysfunction and Arterial Stiffness

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**Objectives** Growing evidence suggests that the approach of periodontal treatment could differently influence the reduction of key cardiovascular risk and endothelial dysfunction ultrasound mediators in periodontitis patients. This randomized, controlled clinical trial compared the impact of minimally invasive non-surgical periodontal treatment (MINST) with quadrant-wise subgingival instrumentation (Q-SI) on Carotid Intima-Media Thickness (CIMT), pulse wave velocity (PWV), distensibility coefficient (DC), advanced glycated end-products (AGEs) and on clinical periodontal outcomes in patients with periodontitis as early indicators of cardiovascular disease risk and endothelial dysfunction. Moreover, it was evaluated if baseline DC levels impacted the efficacy of NSPT protocols.

**Methods** Forty-five periodontitis patients were enrolled and randomly treated by means of MINST (n=22) or Q-SI (n=23). The outcomes assessed were CIMT, PWV, DC, AGEs and periodontal parameters (probing depth, PD; clinical attachment level, CAL; full-mouth bleeding score, FMBS; full-mouth plaque score, FMPS), at baseline, 1-, 3-, 6-months, and at 1-year follow-up after treatment.

**Results** At 1 year, in comparison to Q-SI, MINST significantly reduced mean CIMT (p=0.024), DC (p=0.012) and periodontal outcomes mean PD (p=0.009), and the number of pockets >4 mm (p=0.012), >6 mm (p=0.033), and n° patients with FMBS <10% (p=0.004) and FMPS <10% (p=0.013). The generalized multivariate analysis evidenced that high baseline DC (p=0.019) and baseline AGEs (p=0.009) levels and treatment with MINST (p=0.024) were significant predictors of PD reduction at 1-year follow-up. Furthermore, the Jonckheere-Terpstra test showed that patients with high baseline median DC levels gained more benefits from MINST treatment at 1-year follow-up (p=0.032) than they did from Q-SI approach.

**Conclusions** Patients receiving MINST showed a greater reduction in CIMT and DC mean levels than patients with Q-SI after 1-year follow-up. Moreover, patients with high baseline levels of DC gained more benefits from the MINST approach at 1-year follow-up.



# **Exosomes the Missing Link in Peri-Implantitis**

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**Objectives** Exosomes are extracellular nano-vesicles ranging in size from 40 to 150 nm that are released from donor cells and internalized in recipient cells. They serve as cell-to-cell vehicles for the transfer of genetic components, proteins, metabolites, and more.

In previous human studies, exosomes were detected at elevated levels in peri-implantitis and periodontitis lesions.

Aim: to explore the influence of titanium particles on macrophages exosomes secretion and sequentially, the paracrine effect of exosomes on macrophages.

**Methods** Murine peritoneal macrophages were isolated and cultured. Afterward, macrophages were left untreated (M0) or treated with one of the following: LPS and IFN-γ (M1) or titanium particles (Titanium). Exosomes were isolated by serial centrifuges of the conditioned medium (Purified exosomes). Exosome quantification was done with a nanoparticle tracking analysis (NTA) (Nanosight NS300).

Purified exosomes were added to freshly isolate peritoneal macrophages. Exosome localization was determined by fluorescent confocal microscopy. The macrophage polarization state was determined by flow cytometry and compared to M1 and M0. RT-PCR was used to identify pro-inflammatory cytokines (IL1b and TNF-a).

**Results** Higher concentrations of exosomes were found in the presence of titanium particles compared with positive control (LPS and IFN- $\gamma$ ) or naive macrophages (M0<M1<<<Titanium).

Externally added purified exosomes internalized and reached macrophages cytoplasm (Fig 1). The addition of purified exosomes resulted in an elevation of IL1-b in macrophages compared to macrophages treated with LPS and IFN- $\gamma$  (M1) or untreated macrophages.

**Conclusions** Titanium particles lead to elevated exosome secretion. Exosomes cause macrophage polarization towards a pro-inflammatory profile through a paracrine effect.

## 0484

## Platelet Concentrates as Local Antibiotic Delivery System: Systematic Scoping Review

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**Objectives** In the field of modern medicine, the search for effective strategies to combat bacterial infections while minimizing systemic side effects, antimicrobial resistance and limited tissue penetration remains a critical effort. Consequently, there has been a growing interest in developing innovative approaches to deliver local antibiotics. Autologous platelet concentrates (APCs) offer promise in delivering antibiotics directly to infection sites. Despite interest, a comprehensive evaluation of APCs' effectiveness in antibiotic delivery is lacking. Therefore, this systematic scoping review aims to fill this gap to provide a global understanding of the efficacy of APCs in delivering antibiotic therapy **Methods** The protocol was adopted from the guidelines of the Joanna Briggs Institute on systematic scoping reviews. Three electronic databases (PubMed, Scopus, Web of Science) have been explored. Two



authors separately carried out the electronic literature search and data extraction. Articles addressing the use of APCs as local antibiotic delivery system were included. The results of the selected studies were classified under the following subheadings: antibiotic loading capacity of APC, release kinetics of antibiotic and antibacterial effects of loaded APCs

**Results** 14 articles including 10 in vitro studies, 1 in vitro and clinical study, 1 in vitro and animal study, 1 ex-vivo study, 1 clinical study were selected. The antibiotic loading capacity and release was confirmed in all studies using doxycycline, gentamicin, linezolid, vancomycin, metronidazole and penicillin. In addition, the antibacterial effect was obtained against E. coli, P. aeruginosa, S. mitis, H. influenzae, S. pneumoniae, S. aureus

**Conclusions** The incorporation of antibiotics into APCs facilitated the effective release of antimicrobial agents at optimal concentrations, potentially reducing the incidence of post-operative infections, substituting or augmenting systemic antibiotic treatment while retaining APCs inherent healing properties. Additional research is needed to validate APCs loaded with antibiotics as a viable topical antibiotic delivery method in dentistry

0485

# A Multidisciplinary Approach to Rehabilitation in Cranio-Maxillofacial Surgery

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**Objectives** The aim of the study is to demonstrate the outcome of rehabilitation after surgical procedures of the facial part of the cranium.

**Methods** The group included in the study consisted of 132 patients (18-85 age) treated in the period between 2020 and 2022. There were patients suffering from craniofacial injuries, oncological, orthognathic, as well as patients with other conditions. Performed procedures most often included: lymphatic drainage, scar therapy, kinesiology taping, mobilisation of the temporomandibular joints and respiratory therapy.

**Results** Thanks to the implementation and development of various physiotherapeutic techniques, in 79,2% of the cases the correct range of mandibular abduction was achieved, in 83,2% - reduction of pain, as well as a satisfactory cosmetic effect in 90,9% of the patients.

**Conclusions** The developed rehabilitation methods enabled to set up an algorithm for multidisciplinary treatment of diseases of the facial part of the cranium.

0489

# Neural Crest-Derived Stem Cells From Ovine Palate for Alveolar Regeneration

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**Objectives** Most dental-related stem cell sources are believed to derive from the neural crest, and because of this there is an increasing interest in the study of their neural crest-derived stem cell (NCSC) characteristics.

The potential of obtaining cell cultures with neural crest resemblance from animal-related tissues has been discussed in the literature. However, most reports include the use of serum-rich conditions and do not describe the potential for osteogenic differentiation, slowing translation to the clinic. Therefore, we aimed to culture and characterize NCSCs from the ovine palate (oNCScs) *in vitro* and *ex vivo* and evaluate their ability to

differentiate into bone cells.

**Methods** Cultures were established from a varied cohort of sheep samples and grown, as monolayers, in serum-free, and under sphere-aggregation conditions to induce and identify a NCSC phenotype. Ovine NCSC cultures were characterized by immunocytochemistry and reverse transcription quantitative polymerase chain reaction.

**Results** Monolayer cultures expressed stem cell, neural progenitor, and neural crest-related markers. Culturing ovine NCSCs as neuro- spheres (ovine NCSCs) resulted in an increased expression of neural crest-related genes. The neural-like phenotype was evidenced by the expression of TUJ1, peripherin, NFH, TAU, SYN1, and GAP43. Our results describe the establishment of ovine NCSC cultures from a large variety of sheep in serum-free medium, as NCSC that differentiate into neural-like cells, and differentiation of ovine NCSCs. NC stem cell sheets had large masses of disorganized calcified material which appeared to be resorbed bone tissue. Lack of osteocytes has been illustrated by Tartrate-resistant acidic phosphatase (TRAP).

**Conclusions** Therefore, we present here a detailed description of the establishment and characterization of ovine NCSCs grown in serum-free media *in vitro*, and the characterization of their molecular NCSC signature.

In addition, we present an *ex vivo*-proof of concept that these NCSCs, generated under serum-free conditions from palate can derive osteogenic-like cells, proposing them as candidates for bone regeneration treatments.

## 0490

## Osteonecrosis of the Jaw Post Covid-19: a Case Report

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**Objectives** Aspergillosis and Mucormycosis encompass a spectrum of clinical diseases, ranging from asymptomatic infection and colonization to life-threatening invasive conditions. Aspergillus hyphae can spread through the blood vessels, resulting in a secondary thrombosis and subsequent tissues necrosis. The primary risk factor for contracting aspergillosis and mucormycosis is the severe alteration of the host immune system caused, for example, by prolonged steroid use. COVID-19 was a recent disease characterized by a otolaryngological symptoms and other non-specified symptoms. Patients affected by Post-acute Covid-19 syndrome (PACS), typically show an imbalanced immune system that is responsible for the occurrence of opportunistic bacterial and fungal secondary infections. This case report describes



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a unique and complex presentation of osteonecrosis of the maxilla, complicated by Aspergillosis and Mucormycosis, developed in an immunocompetent patient recovering from COVID-19.

**Methods** A 74-year-old male patient was referred with the complaint of unilateral rhinorrhea, cacosmia, persistent cough and frontal headache. The patient suffered from a severe form of COVID-19 infection three months before the access to our clinic and following the SARS-CoV-2, he developed a maxillary sinus bacterial infection treated with corticosteroids. The intraoral examination showed an edentulous maxillary ridge, a left oro-antral fistula with purulent exudate, and a diffuse necrotic bone exposure. The patient was treated with sequestrectomy surgery to remove necrotic bone tissue.

**Results** Histologic examination revealed, in both sinuses, the presence of severe lymphoplasmacytic infiltrate, bone necrosis, and broad aseptate hyphae. These aspects were consistent with the diagnosis of Mucormycosis. Moreover, the bone sample also showed the presence of septate hyphae with dichotomously branching suggesting an Actinomyces-like bacteria coinfection.

**Conclusions** This clinical study showed a potential association between SARS-CoV-2 infection and osteonecrosis of the jaws, as complication arising from COVID-19-induced coagulopathy, particularly prevalent in long-COVID patients. Furthermore, SARS-CoV-2 infection may amplify the risk of superinfections by opportunistic pathogens like Aspergillus and Mucor.

0491

# Microcirculation Changes After Graft Harvesting by a Novel Technique

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**Objectives** To analyze the post surgical blood flow changes of palatal donor sites during early healing (up to 30 days) after graft harvesting by Laser Speckle Contrast Imaging (LSCI)

**Methods** Data were obtained from clinical studies including the harvestment of palatal connective tissue grafts. An analysis of palatal blood perfusion from 25 mucogingival surgeries utilizing two different graft harvesting techniques (Free gingival graft and Modified double blade harvesting technique) is presented. Blood supply changes of 5 regions of interest (ROI) were measured at baseline, 7, 14, and 30 days in the donor site, and then compared between the two techniques. Changes in heart rate and body temperature were also considered. The means and standard deviation of the Perfusion Units in each ROIs were registered and compared at different timepoints.

**Results** Differences in perfusion changes between the two techniques were found, although there was no statistically significant difference. In both techniques, the donor site showed an increase in superficial blood supply from the 7-day follow-up. In the FGG harvesting, the perfusion was higher than in the MDBHT in almost all ROIs at different timepoints except for the endpoint (30 days), when the FGG group's values reach the baseline, while the other group's values stay elevated. The most representative changes are in the graft area, which is presented in the Table.

**Conclusions** The results suggest that healing after the MDBHT is more traumatic and requires more time for complete revascularization according the the evaluation of perfusion changes with the LSCI, a reliable method for early healing assessment. One month seems insufficient for the complete revascularization process within this time frame in the MDBHT group.



# Blood perfusion changes in the graft area (Means and Standard Deviation)

	BL		DAY 7		DAY 14		DAY 30	
1	Mean	SD	Mean	SD	Mean	SD	Mean	SD
MDBHT	283,12	57,50	258,96	123,56	332,69	122,87	343,27	53,50
FGG	293,87	37,95	374,39	88,88	416,00	97,08	289,52	62,13

(BL = Baseline, MDBHT = Modified Double Blade Harvesting Technique, FGG = Free Gingival Graft, SD = Standard Deviation)

#### 0492

## Nutritional and Micro-Nutritional Analyses in the Management of Periodontitis

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**Objectives** Periodontitis has been related to excess sugar intake (even diabetes), local and systemic inflammation (due to fatty acid imbalance and vitamin D deficiency), oxidative stress and even intestinal dysbiosis. This study aims to establish a list of nutrionnal and micro-nutritional analyses (i.e. functional analysis) for objectively identifying the patient's level of systemic inflammation and his excess or deficiency in certain nutrients in order to improve his periodontal condition.

**Methods** The literature was examined in two ways. Firstly, by listing all the biologic systemic conditions and nutrients correlated with periodontitis. Secondly, by seeking reliable biological means to assess the patient's status in these various parameters.

**Results** Excess sugar intake results in hyperinsulinism (before the development of diabetes), which can be assessed by the HOMA index. The ability to cope with inflammation can be assessed by measuring erythrocyte fatty acids profile and the depth of vitamin D deficiency. Low-grade systemic inflammation can be mesured by CRPus. The level of oxidative stress can be evaluated in particular by dosing oxidised LDL and the SOD-GPX balance, as well as vitamins A, C, E and coQ10. Finally, an LBP measurement can be used to assess the presence of intestinal dysbiosis.

**Conclusions** Precise functional analyses should be used to guide the nutritional and micro-nutritional management of periodontitis, optimising local treatments and contributing to the patient's overall health.


# Adjunctive Sodium-Hypochlorite and Hyaluronic Acid in Supportive Periodontal Therapy

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**Objectives** The aim was to investigate the adjunctive application of an amino-acid sodium-hypochlorite gel (AA-NaOCl) and a crosslinked hyaluronic acid gel (xHA) to subgingival reinstrumentation in supportive periodontal therapy (SPT).

**Methods** Thirty-four patients with need for re-treatment in at least two periodontal pockets were included. All patients were treated with subgingival instrumentation, in the test group (n=17) additionally adjunctive AA-NaOCl and xHA was applied. The treatment was performed at baseline (T0) and if needed again after three months (T1). Periodontal clinical indices were recorded at T0, T1 and T2 (after six months), the primary outcome was the probing depth reduction (ΔPD) at T2. Levels of interleukin (IL)-1 beta and matrix metalloproteinase (MMP)-8 were quantified in gingival crevicular fluid (GCF). Biofilm samples were analyzed for major periopathobionts. Friedman's two-way analysis of variance and Wilcoxon tests with Bonferroni correction were used for intragroup changes and Mann–Whitney U tests for intergroup comparison.

**Results** All periodontal clinical indices significantly improved at T1 and T2 vs baseline in both groups. The test group demonstrated a more pronounced reduction of PD (by 1.5 vs 1.0 mm; p=0.013 at T2), a greater decrease in BOP compared to control 8.8% vs 75.0% at T2 (p<0.001) and a higher CAL gain (by 1.18 vs 0.56 mm; p=0.012). IL-1beta in the GCF declined in the control group from T1 to T2 (2.41 to 1.55 pg/µl; p=0.033). At T2, the abundance of *Campylobacter rectus* was reduced by 1.11 log10 counts/site (p=0.003) in the test and by 1.27 log10 counts/site (p=0.012) in the control group and *Fusobacterium nucleatum* by 1.36 log10 counts/site (p<0.001) and by 0.93 log10 counts/site (p=0.005), respectively. *Porphyromonas gingivalis* declined in the test group from 2.50 to 1.79 log10 counts/site (p=0.028) at T1. **Conclusions** AA-NaOCl and xHA may present a promising adjunct to mechanical subgingival re-instrumentation in non-responding periodontal pockets during SPT.

## 0495

# Human Palatal Connective Tissue Grafts: Molecular Profiles and Cell-Cell Interactions

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**Objectives** We have recently evaluated the molecular profiles of subepithelial connective tissue grafts (CTGs) obtained at different locations and depths in the human palate. Sixty-four grafts were assigned to four groups: anterior deep (AD), anterior superficial (AS), posterior deep (PD), and posterior superficial (PS). The data suggested strong impact of A-CTGs on epithelial cell behavior. Increased growth factor gene expression and significantly activated Erk and Akt signaling in primary human palatal fibroblasts (HPFs) derived from A-CTGs implied their involvement in cell survival, proliferation, and motility. In a follow-up study, we aim to investigate the interactions of primary HPFs, obtained from different CTG types, with oral



# epithelial cells.

Methods Indirect and direct co-culture systems of oral fibroblast and epithelial cells were established and cell-cell interactions were explored by using cell and molecular biology techniques. Results Migration of primary epithelial cells as well as two immortalized epithelial cell lines was strongly (p < 0.001) potentiated by AD-, AS-, and PS-HPFs. In an indirect co-culture model, using transwells that allow exchange of nutrients between the two cell types but no direct contact, A-HPFs triggered prominent epithelial cell proliferation compared to P-HPFs. This finding was confirmed by experiments, in which epithelial cells were cultured in the presence of conditioned media harvested from A-HPFs. BrdU incorporation into newly-synthesized DNA as well as proliferative gene marker expression were significantly upregulated in epithelial cells cultured in A-HPF-conditioned medium. In contrast, in a coculture model, where fibroblasts and epithelial cells were grown in direct contact, epithelial cell proliferation was not affected but expression of differentiation markers such as keratin 10, transglutaminase 1, involucrin, filaggrin and loricrin was significantly upregulated in the presence of A-HPFs.

**Conclusions** Our findings strongly support the suitability of A-CTGs for soft tissue augmentation in the esthetic zone, where epithelial cell migration, proliferation, and keratinization are of prime importance.

#### 0496

#### Minimally Invasive Treatment Impact on Cardiovascular Biomarkers in Periodontitis Patients

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**Objectives** New evidence suggests that the approach to periodontal treatment may influence the reduction of key cardiovascular risk mediators in periodontal patients in different ways. The present randomized controlled clinical study aims to compare the impact of minimal invasive nonsurgical therapy (MINST) with quadrant-wise subgingival instrumentation (Q-SI) on C-reactive protein (CRP) together with lipoprotein-related phospholipase A<sub>2</sub> (Lp-PLA<sub>2</sub>) levels and clinical periodontal indices in subjects affected by periodontitis as early markers of cardiovascular disease risk. Furthermore, it was assessed whether CRP baseline levels influenced the effectiveness of NSPT protocols.

**Methods** 31 included subjects with periodontitis were randomly allocated for treatment with MINST (n=15) or Q-SI (n=16). Serum CRP and Lp-PLA<sub>2</sub> and periodontal indices (probing depth, PD; clinical attachment level, CAL; full-mouth bleeding score, FMBS) were assessed at baseline, 1-, 3-, 6-months, and 1-year follow-up after treatment.

**Results** After 1 year, MINST significantly induced a reduction of mean PD (p=0.011), the number of pockets >4 mm (p= 0.032), pockets ≥6 mm (p= 0.026), full-mouth plaque score (FMPS) (p= 0.044) and full-mouth bleeding score (FMBS) (p= 0.048) compared to Q-SI. The generalized multivariate regression analysis showed that high baseline CRP (p= 0.039), baseline FMBS (p= 0.046) levels, and MINST treatment (p= 0.007) were significant predictors of PD reduction at 1-year follow-up. Moreover, the Jonckheere-Terpstra test evidenced that individuals with higher baseline CRP levels gained more benefits from the MINST protocol at 1-year follow-up (p= 0.019) compared to Q-SI (p= 0.258).



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**Conclusions** Subjects treated with MINST showed a higher reduction in serum CRP levels than individuals with Q-SI after 1-year follow-up. Moreover, patients with greater baseline levels of CRP and Lp-PLA<sub>2</sub> gained more benefits from the MINST approach at 1-year follow-up.

# 0498

# Comparing Mid- and Long-Term Teriparatide Efficacy in Chronic Periodontitis

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**Objectives** To evaluate the differences in bone regeneration and clinical improvement between mid-term and long-term TP administration in periodontal therapy, and to assess the associated side effects. **Methods** Participants: 22 patients with severe periodontitis were selected based on specific dental and medical criteria, excluding those with conditions such as osteoporosis, metabolic bone disease, and significant smoking habits. <div>Procedure: Each participant had one periodontal defect surgically treated, followed by TP or placebo administration. Clinical and radiographic evaluations were conducted at multiple intervals up to 12 months post-surgery.</div>

**Results** Both treatment durations led to similar improvements in bone levels at 9 months, with a slight, non-significant advantage in the long-term group. Clinical attachment gains were also comparable. However, the long-term group reported more gastrointestinal and musculoskeletal discomfort, suggesting increased side effects with longer TP use.

**Conclusions** Mid-term TP treatment appears to be as effective as long-term treatment in enhancing periodontal recovery while being better tolerated. These findings suggest optimizing TP treatment duration could improve patient outcomes with fewer adverse effects.

0494

## Periodontal Therapy, Oral Microbiome and Respiratory Health: an Intervention Study

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**Objectives** To evaluate whether change in the oral microbiome impact respiratory health. **Methods** Periodontitis patients (n=57), never-smokers and free from any other medical conditions, received periodontal therapy with full-mouth disinfection protocol. At baseline (T0) and six weeks following therapy (T1), subgingival plaque and airway resistance (Rrs) by Forced Oscillation Technique (Tremoflo C-100, Thorasys Medical Systems, Canada) were collected. Plaque was sampled from the deepest pocket from each quadrant and pooled before freezing.

Shotgun sequencing was used for microbiome analyses. Alpha-diversity was analysed with Wilcoxon rank test and beta-diversity by Bray-Curtis dissimilarity and PERMANOVA. Differential abundance testing was performed with Analysis of Compositions of Microbiomes with Bias correction adjusted for sex. **Results** Mean age was 35.8 years; 21% had stage I periodontitis, 66% Stage II and 13% had Stage III. Rrs at



11 and 19Hz decreased with 4.7% and 5.4%, respectively (p<0.05). The alpha-diversity was significantly reduced from T0 to T1, and the beta-diversity also changed significantly (both p<0.001). The alpha- and beta-diversity did not differ by change in Rrs.

Patients with improved airway resistance had significantly higher abundance

of *Neisseria*, *Actinomyces*, *Collinsella*, and *Gemella spp*. at T1, whereas patients with no Rrsimprovement showed significant reduction

in *Peptostreptococcus, Tannerella, Treponema, Saccariamonas, Selenomonas* and increased abundance of *Ottowia spp.*, which was not observed in the Rrs-improvement group.

**Conclusions** Following periodontal therapy, a significant decrease in Rrs was observed alongside significant changes in alpha- and beta-diversity for the subgingival plaque samples. The airway resistance improvement vs the no improvement group differed in the types of bacteria showing significant increase or decrease in abundance following therapy.



# **POSTER PRESENTATIONS** abstracts

0001

## Monolithic Complete Dentures From Two-Color Shell-Geometry Disks: a Pilot Study.

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**Objectives** This pilot study aims to evaluate monolithic digital complete dentures fabricated from shell-geometry two-colored Polymethylmethacrylate pucks (Ivotion<sup>®</sup>, Ivoclar).

**Methods** Ethical approval was obtained. The Biofunctional Prosthetic System (Ivoclar) workflow was used for manufacturing complete upper and lower dentures. Analogue impressions and bite-registrations were scanned and the dentures designed digitally before milling. The primary outcome were the accuracy of the transition between pink and white resin, as well as an esthetic score. Secondary outcomes included oral health-related quality of life (OHRQoL) measured with OHIP-EDENT, denture satisfaction index (DSI), chewing efficiency (CE), maximum bite force (MBF), bite pressure (BP) and prosthetic maintenance. Data analysis included descriptive statistics and multivariate comparison tests.

**Results** Three women and 7 men with a mean age of 65 years participated in the study; 9 completed the 3-month follow-up. Evaluations were performed with the old dentures (Baseline) as well as 2- and 12-post insertion. On average four appointments were used until denture delivery. Among the 20 Complete removable dental prostheses, 8 presented imperfections of the white-pink transition with a median of 1 mm (range 0.3-10mm). After 2 weeks and consistently thereafter the novel dentures were scored higher on the esthetic score than the old dentures (*P*<0.05), except surface details of pink denture base. A marked improvement, yet non-significant, of OHRQoL, DSI and CE was noted between baseline and the 3-months follow-up (Baseline: OHIP-EDENT: 13.67; DSI: 89.77; CE: 0.364, 3-months: OHIP-EDENT: 5.78; DSI: 96.44; CE: 0.344). MBF and BP improved significantly over the observation period (p<0.05). Prosthodontic maintenance events included 2 small adjustments before the 2-week follow-up.

**Conclusions** The positive evaluations on esthetics, MBF and BP suggest that this novel system using a monolithic two-colored shell-geometry resin puck for CAD/CAM complete denture manufacturing seems to be a viable treatment modality that warrants further investigation.

#### 0002

#### **Relationship Between Oral Health and Progression of Frailty**

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**Objectives** The objectives of the present study were to investigate the relationship between: a) tooth loss; and b) removable denture usage, and the progression of frailty in an ageing population.

Methods The subjects were the participants of the English Longitudinal Study of Aging [ELSA] aged 50 years and older. We used panel data from three waves of the study: Waves 7-9 (2014-2015; 2016-2017; 2018-2019). Indicators of oral health were a) the number of teeth (≥20; 10-19; 1-9; 0); and, b) a combination of removable denture usage (partial or complete) and the number of teeth. Frailty was assessed by the 32-item Frailty Index (FI) comprising comorbidity, self-reported general health status, activity of daily living, intellectual activity of daily living, mobility, depressive symptoms, and cognitive function. Covariates were age, sex, smoking, alcohol intake, education, marital status, and physical activity. The longitudinal relationship between oral health indicators and change in FI were investigated using linear mixed-effect model considering the FI as a time-varying variable.

**Results** Among the 7,557 participants across the selected waves, compared to those people with 20 or more teeth, change in frailty score over time was significantly higher among those with less than 20 teeth: 10-19 teeth ( $\beta$ : 0.249, 95%CI: 0.116 to 0.382), and 1-9 teeth ( $\beta$ : 0.238, 95%CI: 0.053 to 0.423), and edentate ( $\beta$ : 0.286, 95%CI: 0.106 to 0.465) when adjusting for co-variates. The change in frailty score over time was significantly higher among those with fewer teeth, regardless of denture use. **Conclusions** This longitudinal study across three time points suggests that tooth loss below the threshold of 20 teeth is related to the accelerated progression of frailty, when adjusting for covariates. Thus,

maintaining a natural dentition is potentially effective for the gradual progression of frailty.

## 0003

# Masticatory Performance and QoL of Older Adults in Long-Term Care

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**Objectives** To investigate the relationship between masticatory performance (MP) of older adults receiving long-term care services and their oral health-related quality of life (OHRQoL) and general health-related quality of life (HRQoL).

**Methods** Older adults aged 60 years and above who were able to communicate clearly were recruited from day care centers (DCs) and residential care homes (RCHs) in the Hong Kong Island. MP of participants was assessed (i) objectively using colour-changeable chewing gum, maximum anterior and posterior bite force; and (ii) subjectively using a validated self-rated chewing function questionnaire (CFQ). OHRQoL and HRQoL were evaluated using the validated Cantonese version of Geriatric Oral Health Assessment Index (GOHAI) and 12-item Short-Form Health Survey (SF-12), respectively. The score from SF-12 was aggregated into a physical component summary (PCS-12) and a mental component summary (MCS-12) score. Covariates including smoking habit, disease count, nutritional status, handgrip strength, cognitive status, frailty, and functional status, were also recorded.

**Results** A total of 219 elders (70% women, mean age: 83.3±8.6 years) were recruited from six DCs (n=97) and nine RCHs (n=122). The number needed to screen to recruit one participant was 3 for DCs and 10 for RCHs. The mean GOHAI, PCS-12 and MCS-12 scores were 49.8±7.3, 38.2±9.8 and 53.4±10.5, respectively. Multiple linear regression controlling for covariates showed that CFQ score had significant positive association with GOHAI and MCS-12 scores, whilst maximum posterior bite force was inversely associated with MCS-12. There were no statistically significant relations between objective and self-rated



measures of MP and PCS-12 score.

**Conclusions** Among the Chinese older adults receiving long-term care, a better subjective MP was associated with a better OHRQoL and mental health aspect of HRQoL, whereas a higher maximum posterior bite force was associated with a poorer mental health status.

## 0004

# Relation Between Phase Angle and Tongue Pressure in Older Women

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**Objectives** The phase angle (PhA) obtained via bioelectrical impedance analysis (BIA) can evaluate skeletal muscle quality and nutritional status. A decrease in the phase angle was reported to be associated with physical activity level; however, the relationship with oral function is unclear. This study aimed to evaluate the relationship between PhA and tongue pressure in older women.

Methods The study included 16 female outpatients aged ≥65 (78 ± 5) years who visited the Department of Prosthodontics, Tokyo Dental College, Suidobashi Hospital. Body composition data including PhA were measured using BIA (S-10, InBody, Korea); tongue pressure was measured using TPM-01 (JMS, Japan). The participants were divided into low and high PhA (L-PhA and H-PhA, respectively) groups based on PhA value of 4.66, which is the average PhA value of community-dwelling Japanese older women reported by Uemura et al. Tongue pressure was compared between the two groups using the Wilcoxon rank-sum test. The level of significance was set at 0.05. This study was approved by the Ethics Committee of Tokyo Dental College (Approval no. 1069). This work was supported by JSPS KAKENHI Grant Numbers JP21K7073.

**Results** The age (mean  $\pm$  SD) was 79  $\pm$  5 years in the L-PhA group and 77  $\pm$  4 years in the H-PhA group. The PhA (mean  $\pm$  SD) was 4.3  $\pm$  0.3 in the L-PhA group and 5.0  $\pm$  0.2 in the H-PhA group. The tongue pressure (median) was 31.3 in the L-PhA group and 35.5 in the H-PhA group, showing a significant difference. **Conclusions** The study findings suggest that older women with L-PhA have lower tongue pressure.

0005

## Relationship Between Oral-Health and Body Weight in 7-Years-Old Children

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**Objectives** Diet-related habits and physical activity insufficiency in XXI century leads to growing prevalence of public health challenges like overweight despite the age of patients. Dental caries is another diet-related disease and is often diagnosed in early childhood. The objective of this research was to find out the relationship between overweight and caries prevalence in 7-years-old children in Lithuania. **Methods** This was a cross-sectional study with sample size was 560 children of 7 years-old attending different 11 primary schools in Lithuania. 286 girls and 274 boys were clinically investigated for dental caries and dental plaque and anthropometric measurements including weight and height were measured. Statistical analysis was carried out by SPSS program using descriptive statistics, T-test, ANOVA with



Bonferroni Post hoc adjustment. Research funded by Vilnius University.

**Results** The mean body mass index (BMI) was  $16,9\pm2,9$  without significant difference between girls and boys (p>0,05). 31,6% (N=177) of children were overweight or obese. It was found out that only 9,1% (N=51) of children had healthy teeth. Caries prevalence (DMFs) was high in both girls ( $12,2\pm10,7$ ) and boys ( $13,7\pm10,4, p=0.08$ ). Plaque index was significantly higher in boys ( $1,4\pm0,5$ ) than girls ( $1,6\pm0,5, p=0,001$ ). Although caries incidence was higher in overweight (DMFs  $12,8\pm10,7$ ) girls than in girls with normal BMI ( $11,9\pm10,9$ ) the difference wasn't statistically significant (p=0,5). Overweight girls and boys had more dental plaque than children with normal BMI (p>0.05).

**Conclusions** This study revealed high prevalence of overweight in 7 year-old children in Lithuania. There was found higher dental plaque index and higher incidence of dental caries in overweight children.

0006

# Periodontal Treatment Decreases the Levels of HbA1c: Real-World Clinical Setting

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**Objectives** To assess the effectiveness of periodontal treatment (PT) on glycated hemoglobin A1c (HbA1c) levels in patients with type 2 diabetes mellitus (T2DM) in a real-world clinical setting of the Chilean public healthcare system.

**Methods** A prospective observational cohort study was conducted at two primary care centers in Chile between March 2023 and March 2024 to evaluate the effects of a specialist provided PT on patients with T2DM currently enrolled in a national program to treat this disease (Cardiovascular Health Program). The intervention was compared to a group of patients on the waiting list for PT during the same period. Groups were matched 1:1 through Propensity Score Matching (PSM) using age, sex, years of T2DM diagnosis, metabolic control at baseline, time between HbA1c tests, and insulin requirement. The propensity score was estimated using probit regression of the treatment on the covariates and then matched using cardinality matching. A generalized linear regression model with differences in HbA1c levels from baseline as the outcome and the treatment, covariates, and their interaction as predictors was fitted and then contrasted between both groups using a Mann-Whitney test, with a significance level of p<0.05. **Results** 55 participants were observed in the intervention group. After 9 patients left the follow-up and PSM, a sample of 19 matched individuals was studied. All standardized mean differences for the covariates used for matching were below 0.1, indicating good balance between groups. PT group had a median reduction in HbA1c levels of 1.47% (95% CI -2.41,-0.53; p=0.002) compared to control group (-1.67 vs -0.20, respectively), after 6 months of follow-up.

**Conclusions** PT demonstrates a clinically and statistically significant reduction in HbA1c levels in patients with T2DM in a real-world clinical setting in Chile compared to the current standard. These findings reinforce the importance of including periodontal care in the policies of treatment for T2DM.



CED/NOF-IADR 2024 Oral Health Research Congress 12—14 Sept 2024 Geneva, Switzerland

# 0007

# Intraoral Cold Test as a Predictor of Postoperative Dental Pain

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**Objectives** Establishing a framework to identify patients at a heightened risk of experiencing postoperative pain by using an Intra-oral Quantitative sensory testing (IQST) cold test

**Methods** 66 dental patients (27 women, 39 men; average age 36) with Class 1 or Class 5 tooth lesions underwent preoperative assessments including a dental anxiety questionnaire (DAS), Patient health questionnaire 4 (PHQ 4), and IQST involving a cold swab applied to the oral mucosa measuring the cold sensation's duration in seconds, its intensity and severity. Follow-up evaluations at 6, 24, and 48 hour post operation gauged pain levels and medication usage

**Results** Throughout the study, a noteworthy trend emerged regarding pain perception between the sexes. Male participants consistently reported higher levels of pain compared to female counterparts at all recall points. This observation suggests a potential sex difference in pain experience following dental procedures. Furthermore, analyzing pain scores for the entire participant group, irrespective of sex revealed a consistent pattern. Pain peaked at the 6 hour mark post-operation, indicating a period of heightened discomfort immediately after the dental procedure. However, there was a discernible decrease in reported pain at the 24 and 48-hour marks, indicating a gradual alleviation of discomfort over time.

Throughout the study, a noteworthy trend emerged regarding pain perception between the sexes. Male participants consistently reported higher levels of pain compared to female counterparts across all three recall points. This observation suggests a potential sex difference in pain experience following dental procedures. Analyzing pain scores for the entire participant group, irrespective of sex revealed a consistent pattern. Pain peaked at the 6 hour mark post operation, indicating a period of heightened discomfort immediately after the dental procedure. However, there was a discernible decrease in reported pain at the 24 and 48 hour marks, indicating a gradual alleviation of discomfort over time **Conclusions** Intra oral cold stimulation reactions hold the potential for predicting postoperative dental pain (PDP) following restorative procedures. Identifying high risk patients enables tailored treatment, such as selective prescription of analgesics, thereby optimizing medication use

# 8000

# Knowledge of Signs Regarding Child Abuse and Neglect in Lithuania

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**Objectives** The violence experienced by a child can have a range of short- or long-term negative consequences and we must protect the fundamental rights of the child. Dentists are in close contact with patients during clinical practice, therefore they are able to identify child abuse and neglect. The aim of this study was to assess knowledge of dental professionals and dental students in Lithuania, regarding signs of child abuse and neglect.

**Methods** The data were collected through a self-reported questionnaire based on previous similar studies. The content validity of the questionnaire was tested by conducting a pilot survey. 153 dental



students and 414 dental professionals participated in the survey. The anonymous questionnaire consisted of 21 questions and 2 clinical situations. Statistical analysis was performed using the IBM SPSSv.23. Non-parametric Chi-square ( $\chi$ 2) test (p<0.05) served for statistical analyses.

**Results** The most commonly mentioned signs of physical violence were fractures/dislocations/avulsions (58% professionals, 22% students), bruises behind the ears (65% professionals, 23% students). Fear of physical contact (67% professionals, 25% students), syphilis signs in the mouth (55% professionals, 23% students) were most mentioned signs of sexual abuse. The most commonly mentioned signs of psychological abuse were pronounced nervousness (63% professionals, 23% students) and when child tries to avoid any contact (63% professionals, 24% students). Untreated rampant caries (67% professionals, 23% students) and untreated pain, infection or trauma of orofacial region (66% professionals, 26% students) were most selected signs related to child neglect. Significantly more students (71.7%) were correct in clinical situation with child neglect than professionals (38.4%) (p<0.05). **Conclusions** Dental professionals could better describe signs of child abuse and neglect, but dental students were better at identifying clinical situations related to the problem.

## 0091

# Non-Axial Loads Increase Risk of Cervical Restoration Debonding

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**Objectives** Achieving durable retention of cervical restorations remains a persistent challenge in adhesive dentistry. Despite widespread speculation on the detrimental roles of non-axial loads, numerical evidence is still lacking. Using in-silico damage mechanics, this study aims to investigate the interfacial damage of a cervical restoration under different load directions.

**Methods** A finite element model of a maxillary premolar, with a wedge-shaped buccal cervical restoration, was constructed using a mid-sagittal slice from micro-computed tomography data. To simulate debonding at the restoration-tooth interface, a damage mechanics-based cohesive zone model was utilized to define the strain-softening damage behavior based on interfacial stress and fracture energy. Occlusal loads, ranging from 0 to 150N, were applied in three different regimes: (1) obliquely on the buccal triangular ridge, (2) obliquely on the palatal triangular ridge, and (3) axially on both ridges with equal magnitudes. Furthermore, the implications of damage were elucidated by comparing the maximum principal stress distribution between damaged and conventional perfect-bond models.

**Results** Under buccal oblique loading, damage initiated at 100N and propagated to 88.3% of the interface by 150N. Notably, a higher stress of 42.5MPa was observed at the central groove in the damaged model compared to the perfect-bond model, indicating an elevated risk of tooth fracture. Under palatal oblique loading, damage initiated at 120N and propagated to 43.3% of the interface by 150N. In contrast, damage was initiated at 130+130N under axial loading on both ridges.

**Conclusions** This study presents the first concrete evidence supporting the tooth flexure hypothesis, revealing the adverse effects of non-axial loads on the cervical bonding interface. To ensure the longevity of cervical restorations, meticulous occlusal assessment prior to treatment is imperative. As debonding markedly alters overall stress distribution, integrating damage mechanics into finite element analysis constitutes a crucial step toward clinically relevant simulations.



Maximum principal stress of the damage models at 150N and line plots indicating damage development with respect to the applied loads. (a-c) Maximum principal stress in different loading regimes: (a) buccal oblique, (b) palatal oblique, and (c) axial loads. Arrows indicate the load directions of the respective models. (d) The extent of damage plotted against the applied loads. \*Damaged interface marked with black lines. †In the axially loaded model, two equal-magnitude loads were exerted on both ridges. Therefore, the bonding interface can endure more than twice as much axial load as oblique loads.

# Material and interface properties

Component	Poisson's ratio	Elastic modulus [MPa]
Enamel	0.30	84,100
Dentin	0.30	18,600
Composite	0.35	12,000
Periodontal ligament	0.45	68.9
Cortical bone	0.30	13,700
Medular bone	0.30	1,370
Interface	Critical stress [MPa]	Critical energy release rate [mJ/mm^2]
Enamel-composite	34.5	0.05
Dentin-composite	17.0	0.01

# 0092

# Adhesive With L-Arginine-Containing Mesoporous Silica Nanoparticles: Antimicrobial and Physico-Mechanical Properties

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CED/NOF-IADR 2024 Oral Health Research Congress 12 — 14 Sept 2024 Geneva, Switzerland

**Objectives** To evaluate the effect of addition L-arginine-containing mesoporous silica nanoparticles (Arg@MSNs) into a commercially available universal dental adhesive for anticariogenic purposes, focusing on its antimicrobial and physico-mechanical properties.

Methods Arg@MSNs were synthesized and incorporated into Ambar Universal (AU, FGM) at 2wt% (AU\_2%Arg@MSNs) and 5wt% (AU\_5%Arg@MSNs). Unfilled AU was used as control (AU\_unfilled). Antimicrobial activity of adhesive-coated dentin blocks against a polymicrobial suspension was tested by adenosine trisphosphate (ATP) and confocal laser scanning microscopy (CLSM) assays. For ATP test, microorganisms attached to the adhesive surface and microorganisms in the polymicrobial suspension were quantified as relative light units (RLU) after 4 and 6 weeks, respectively (n=17). For CLSM analysis, percentage of viable cells in each stack was determined after 3 weeks (n=20). Additionally, the following physico-mechanical properties were determined: ultimate tensile strength (UTS), flexural strength (FS), elastic modulus (E) after 24h in distilled water (DW) (n=10); water sorption (W<sub>SP</sub>), water solubility (W<sub>SL</sub>), mass change (MC) after 7 days in DW (n=5); Vickers microhardness (VHN) after 24h in dry conditions and after 12h softening in absolute ethanol (n=5); and degree of conversion by ATR-FTIR (DC) (n=5). ANOVA with post hoc Tukey test and Kruskall-Wallis test with Bonferroni correction were applied ( $\alpha$ =0.05). Results Mean values (standard deviations) are shown in table. No differences in microorganisms attached were detected for any adhesive, however, AU\_5%Arg@MSNs demonstrated a significant reduction in microorganisms in polymicrobial suspension and viable cells. Addition of Arg@MSNs at both concentrations tested did not affect UTS, FS, W<sub>SP</sub>, MC, VHN and DC. Nevertheless, it resulted in increased EM and decreased WsL. Also, AU\_5%Arg@MSNs experienced lower softening in ethanol compared to other adhesives.

**Conclusions** The addition of Arg@MSNs in AU, especially at 5%, seems to enhance the antimicrobial activity without compromising physico-mechanical properties, even, improving W<sub>SL</sub> and softening in ethanol.

Adhesive	Antimicrobial properties			Physico-mechanical properties								
	ATP assay (RLU)		CLS M assa		TS FS 1P (MP a)	E V (Gpa (µ ) m	Wsp (µg/m m3)	Wsl (µg/m m3)	MC (%)	VHN (dry conditi ons)	VHN (% of reducti on after softeni ng)	DC (%)
	Microorgan isms attached	Microorgan isms in polymicrob ial suspensio n	y UTS (% (MP viabl a) e cells )									
AU_unfilled	15,012 (14,104) A	147,083 (185,208) A	82.5 1 (9.9 4) A	16. 11 (4.3 8) A	19. 91 (3.4 0) A	0.28 5 (0.0 16) A	124.38 (3.42) A	57.90 (4.60) A	5.5 3 (0.4 0) A	8.72 (0.45) A	45.85 (2.82) A	80. 73 (2.0 1) A



AU_2%Arg@ MSNs	12,340 (8,668) A	103,760 (118,801) AB	73.5 8 (18. 96) AB	14. 38 (2.0 8) A	18. 13 (2.8 4) A	0.31 7 (0.0 39) B	118.70 (6.47) A	45.63 (9.75) B	6.0 1 (0.9 0) A	8.65 (0.20) A	38.75 (6.85) AB	81. 05 (1.1 0) A
AU_5%Arg@ MSNs	17,864 (16,831) A	61,976 (117,053) B	67.4 5 (12. 23) B	16. 06 (2.8 8) A	20. 44 (4.6 3) A	0.31 7 (0.0 23) B	120.67 (9.68) A	40.21 (5.61) B	6.6 8 (0.9 6) A	8.50 (0.25) A	37.58 (3.97) B	80. 22 (1.5 3) A
Different letters in the same column indicate statistically significant differences.												

# Effect of VPT Antiseptic Agents on Dentin Bonding After Aging

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**Objectives** To evaluate the effect of antiseptic agents used for hemostasia control and pulp lavage in vital pulp therapy (VPT) on microtensile bond strength (µTBS) to dentin after 6-month aging, using a universal adhesive, with self-etch (SE) and etch-and-rinse (ER) strategies.

**Methods** Exposed dentin surfaces of 40 human molars were randomly divided into 8 groups (n=5) according to the (I) antiseptic agent (untreated [Control], 2.5% NaOCl for 5 minutes [NaOCl\_5], 2.5% NaOCl for 10 minutes [NaOCl\_10] or 2% chlorhexidine for 5 minutes [CHX\_5]) and (II) adhesive strategy ([SE] or [ER]). After universal adhesive application (Scotchbond Universal Plus) crowns were restored with composite (Ceram.x Spectra ST). Specimens were sectioned into beams and half of them were subjected to  $\mu$ TBS test after 24 water storage and the rest after 6 months. Failure mode was determined (FM) and data were analyzed by three-way ANOVA and Student's t test (p<0.05), without considering pre-test failures (PF).

**Results** Table shows  $\mu$ TBS mean values in MPa (sd). No relevant effect of the antiseptic solutions on  $\mu$ TBS was detected as values were only influenced by the adhesive strategy (p<0.001), aging (p<0.001) and interaction between them (p<0.013). After 24 hours, higher bond strength values were determined when the adhesive was applied with an ER strategy, although after 6-month aging a significant reduction was detected.

**Conclusions** The antiseptic solutions evaluated for pulpal hemostasia seem not to affect  $\mu$ TBS. ER adhesive strategy yielded higher bond strength values immediately in comparison with SE strategy. However, both strategies showed similar values after aging. ER application mode was associated to a significant reduction on  $\mu$ TBS after 6-month water aging.



	Self-etch strate;	gy	Etch-and-rinse strategy			
	24 h	6-month	24 h	6-month		
	Mean (sd)	Mean (sd)	Mean (sd)	Mean (sd)		
Control	53.9 (9.1)	43.5 (8.3)	57.9 (9.3)	41.6 (14.1)		
NaOCl_10	46.3 (11.4)	45.0 (9.8)	61.6 (12.8)	48.7 (5.9)		
NaOCl_5	44.6 (5.9)	45.8 (7.7)	59.4 (5.5)	47.1 (2.6)		
CHX_5	45.0 (6.5)	47.8 (3.9)	61.1 (11.4)	54.3 (8.9)		

# Glass-Hybrid Cement Adhere Better Than Glass-Ionomer Materials to Primary Dentine

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**Objectives** The aim of the study was to analyze the interface zone between sound (SD) and cariesaffected (CAD) primary dentin, and three types of restorative materials: glass-hybrid (GH), conventional (C-), and resin-modified (RM-) glass ionomer cements (GIC).

**Methods** Occlusal cavities were prepared in 120 extracted primary molars, and randomly divided into two groups: SD and CAD. After formation of the artificial caries lesion, teeth (n=12) were restored with a GH (Equia Forte HT, GC Int- EF), two C-GIC (Equia Fill, GC Int- E; Ketac Molar, 3M ESPE- KM), and two RM-GIC (Fuji II LC, GC Int- II, Photac Fill, 3M ESPE- PF). Samples were immersed in artificial saliva at 37°C for 7 days, and subsequently exposed to thermal aging (10.000×). Sectioning of teeth was done in the occluso-gingival direction, and the interface between dental tissues and restorative materials was analyzed using a scanning electron (SE) microscope. The developed algorithm used for SE microphotographs analysis was done in the Python programming language.

**Results** Intimate contact of the material and dental tissues along the entire interface was not observed. In the C-GIC group, a crack along the entire interface was observed in 33% of SD, and 25% of CAD samples. The mean proportion of intimate contact between the material and SD was EF (76%) > KM (55%) > E (38%) > II (7%) > PF (4%), and EF (32%) > KM (24%) > E (16%) > II (15%) > PF (0%) for CAD (p<0.05, Kruskal-Wallis test). GHC showed significantly better adherence to SD than to CAD (p<0.05, Mann-Whitney test). **Conclusions** Caries-induced demineralization of hard dental tissues affects the quality of GHC/ and GIC/CAD dentin interface. When compared to C- and RM-GIC, GHC shows better seal of primary dentin.



# Effect of Dichloromethane Treatment on Adhesion With Additive Manufacturing Resin

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**Objectives** Although autopolymerizing resin is often used to repair removable dentures fabricated using the additive manufacturing method (AM), appropriate surface treatments for fracture surfaces have not been established. This study aimed to clarify the effect of primer agents containing dichloromethane on the shear bond strength of autopolymerizing resin with specimens fabricated using the additive manufacturing method.

**Methods** Denture base resin for AM and conventional denture base resin (D) specimens were fabricated. One of the following dichloromethane-containing primer agents was used for surface treatment: Primer-S (Denture Liner Adhesive, Shofu) or Primer-G (Resin Primer, GC). No surface treatment on AM was assigned as the control group. After surface treatment, the autopolymerizing resin (Provinice, Shofu) was bonded in a 5.0-mm diameter area on specimens and the shear bond strength was measured.

**Results** The shear bond strength (median of 10 specimens in each group) was 8.87 MPa for AM with Primer-S, 14.0 MPa for AM with Primer-G, 19.4 MPa for D with Primer-S, and 5.77 MPa for AM without Primer. Significant differences were observed among all groups, except between AM with Primer-S and AM without Primer (Mann–Whitney's U test with Bonferroni correction after Kruskal–Wallis test,  $\alpha = 0.05$ ). **Conclusions** The shear bond strength of AM with Primer G was superior compared to that of AM without Primer and with Primer S, however, it was not higher than that of primer with conventional resin. The results may be due to the effect of dichloromethane on resin used for AM, which is different from that on conventional resin. Other components were also suggested to have an effect on bonding strength. The findings suggest the need for a more effective surface treatment for additive manufacturing resin to increase the bond strength. Primer containing dichloromethane could also be used although it's not strong enough.

0010

#### Effect of Hydrogel-Encapsulated Carbohydrates on Caries-Related Variables During Physical Activity

ali alshabeeb, Anna Lehrkinder, Peter Lingström

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**Objectives** Various forms of energy products have appeared on the market in recent years. Even if an increased performance is achieved, negative side effects such as an increased risk for caries disease may occur. The purpose of this study was to evaluate the effect of a new sportgel, in which high concentrations of carbohydrates are encapsulated in a hydrogel structure, on different caries-related variables during resting and physical activity.

**Methods** Two different sportgel products: 1) Maurten Gel 100 (Maurten, Gothenburg, Sweden) and 2) SIS Beta Fuel (Science in Sport, London, UK) were tested in 12 healthy adults. They were instructed to consume identical amounts (based on sugar content) of each product on two separate occasions – either resting or physical activity (on a stationary bicycle indoors). Plaque acidogenicity was assessed via the Strip-method, and salivary samples were collected to determine glucose/fructose before and up to 45 min



after consumption. Mv  $\pm$  SD and area under the curve (AUC) were calculated for the two variables. Paired t-test was used to compare differences with p<0.05 considered statistically significant. **Results** A more pronounced pH fall was seen during physical activity than in resting conditions for both products. The AUC calculations showed less pronounced pH-lowering effect by the hydrogel during the first 10 min during both resting (p<0.01) and physical activity (p<0.05). Only minor differences were found from 10 min and onwards. Total salivary sugar concentration differed between the two products with lower values for SIS during physical activity (p<0.01), while no difference was seen during resting conditions. **Conclusions** The main findings indicate a lower risk for dental caries to occur of this new encapsulated hydrogel sugar formula. However, it is of outmost importance that further studies be conducted during more realistic physical activity conditions.

## 0011

# Effect of a Progressive Hydrogel-Incorporated Sugar on Oral Clearance.

# Anna Lehrkinder, ali alshabeeb, Peter Lingström

# Cariology, Odontology, Gothenburg, Type a choice below ..., Sweden

**Objectives** A novel carbohydrate-ingestion technology that uses a hydrogel network to encapsulate monosaccharides within biopolymer matrix provides high-sugar intake whilst minimizing their impact on oral health. This study investigated the effectiveness of oral sugar clearance after consuming sugar-concentrated drinks with different degrees of sugar encapsulation compared with the control solution. Additionally, the research explored whether the encapsulation of carbohydrates influences the perception of sweetness of those products.

**Methods** Twelve participants tested three products with identical sugar concentration (60% glucose + fructose): Gel 100 (Maurten, Gothenburg, Sweden), alginate beads (Maurten, non-commercial product) and control solution during three sessions. Interproximal and whole saliva were collected before and after rinsing up to 45 min. The saliva was collected using paper points at three sites: maxillary front, maxillary premolar/molar and mandibular canine/premolar. Participants graded the sweetness experience of the products on a VAS scale. Sugar concentrations in saliva samples were analyzed using dinitrosalicylic acid (DNS) method. Two-way ANOVA with Šídák multiple comparisons test was used to compare differences between areas under the curve (AUC) with p<0.05 statistically significant.

**Results** Beads showed the lowest sugar concentration in whole and interproximal saliva compared with Gel 100 and the control. Beads also had significantly lower AUC, indicating an effective elimination from the oral cavity thus, a rapid oral clearance rate (p<0.01). A significant difference (p<0.05) was observed between Gel 100 and control for mean AUC for the three sites. The highest sugar concentration was found in the premolar/molar region, followed by mandibular canine/premolar region and lowest in the maxillary front. The sugar encapsulation affects the sweetness experience of the test products, where beads were graded as the least sweet of all three products tested.

**Conclusions** A higher degree of carbohydrate encapsulation (beads) resulted in more effective oral clearance, thus preventing damaging exposure of the oral cavity to high concentrations of sugars.



# Encapsulated Sugar - a Novel Method for Sugar Administration

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**Objectives** Caries remains a widespread health problem with sugars as the central etiology factor. Dietary advice has primarily focused on reducing intake frequency and amount. Recently, a new way of administering sugar has emerged where sugars are encapsulated in a hydrogel network. The aim was to evaluate the effect of three versions of this new sugar formulation containing glucose/fructose on the metabolic activity in bacterial suspensions *in vitro* and on the dental biofilm metabolism *in vivo*.

**Methods** The following novel formulations, containing 60% glucose/fructose, were tested: a) beads (Maurten AB, Sweden, non-commercial product), b) gel (Gel 100; Maurten AB) and c) reference solution for products a and b. The acid production *in vitro* of six different bacterial suspensions was followed up to 90 min using a micro-pH meter after the addition of  $25 \,\mu$ l (products c) or 50 mg (products a and b). *In vivo*, 13 healthy volunteers rinsed with respective product after which biofilm acidogenicity was followed using the microtouch method up to 45 min after consumption. Data was analyzed using one-way ANOVA/Tukey multiple comparison test. p<0.05 was considered statistically significant.

**Results** The beads resulted in the most favorable outcome for all bacterial strains *in vitro*. A statistically significant reduction in plaque-pH was found for both the beads and the gel in comparison to the reference solution at different time points (p<0.01) and when evaluated as area under the curve (p<0.001). The percentage reduction in total biofilm acidogenicity in comparison to the reference product was for the beads 66.0% and for the gel 54.7%.

**Conclusions** The encapsulated sugars showed *in vitro* and *in vivo* promising results with lower acidogenicity compared to a reference product - a central mechanism for the caries disease.

## 0013

## Impact of Hydrogel-Encapsulated Sugar on Dental Caries Incidence in Rats

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**Objectives** Formulations of sports energy gel should not only focus on optimizing carbohydrate oxidation for ergogenic purposes, but also on mitigating the risk of dental caries. To achieve this goal, hydrogel-encapsulated fructose-glucose (FRU-GLU) has been developed. The present study aimed to assess the incidence of dental caries in rats subjected to daily administration of hydrogel-encapsulated FRU-GLU. **Methods** Hydrogel-encapsulated FRU-GLU, a test sugar, was prepared in two forms: spherical-shaped beads (Beads) and gel form (Gel; Gel 100, Maurten, Gothenburg, Sweden). A control sugar (Ctrl) was also prepared by simply blending alginate gel with FRU-GLU to attain a texture similar to that of Gel. All three formulations contained 27% FRU and 33% GLU. The protocol for the animal study was approved by the Institutional Animal Experiment Committee of Tohoku University (approval number: 2018DnA-053).



Twenty-four male Wistar rats (3-week-old) were allocated to Beads, Gel, and Ctrl groups (n = 8) on Day 0. Between Day 6 and Day 10, cariogenic bacteria (*Streptococcus mutans*) were inoculated into the oral cavity of all animals. Additionally, oral administration of the sugars (approximately 1 g) using a syringe commenced on Day 6 and was repeated daily throughout the 12-week study period. After euthanasia, the maxillary and mandibular molars underwent micro-CT analysis.

**Results** Analysis of 288 molars revealed a significantly lower incidence of distinct dental caries in the Beads (17.7%) and Gel (21.9%) groups compared to the Ctrl group (39.6%). When suspected cases of caries were included, the incidence rates were 54.2 % for Beads, 66.7% for Gel, and 76.9% for Ctrl. **Conclusions** Hydrogel-encapsulated sugars (Beads and Gel) exhibited reduced dental caries compared to the control sugar (Ctrl), despite that both types contained identical amount of FRU and GLU. Therefore, utilization of hydrogel-encapsulated FRU-GLU as a sports fuel may alleviate concerns regarding the development of dental caries.

## 0014

# Intergenerational Caries Disease Perceptions Among Adults in Sweden

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**Objectives** The concept of 'attitude to illness' relates to an individual's perspective on the illness and reflects a range that encompasses appraisal and response - the thoughts, feelings and behaviours of an individual in response to the illness. The research question for this survey was about the value and social perception of dental caries. To answer this question, an online survey was planned with a quantitative approach.

**Methods** The survey contained 12 questions formulated in Swedish on the individuals' perception of caries in relation to seven other well-known medical conditions, and it was carried at a random sample of Swedish adults aged 27–58, two "generations" (X and Y) were selected. The survey was distributed via the two different social platforms Facebook and Instagram. The Likert scale questionnaire items were transformed in dichotomous variable and frequencies were calculated for each item. The Principal Component Analysis (PCA) was used to determine the component that bears the greatest proportion of information to generate the definition to caries as disease.

**Results** The link was opened by 25503 individuals of which 6404 completed the questionnaire and 6388 questionnaires were considered (4153 generation X/2235 generation Y). Dental caries was defined as a disease in almost 60.0% of the responders in the X generations respect to 51.4% in the Y generation ( $\chi^2_{(1)}$ =33.7, p<0.01). The gradings from disagree (1) to agree (6) for dental caries shown lower degree in comparison to other diseases.

**Conclusions** There was a difference in the view of dental caries as a disease in comparison to several other medical conditions. Furthermore, it was considered a disease to a higher degree in the older age cohort (generation X) in comparison to the younger age group (generation Y).



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0015

# Microstructure of Subsurface Enamel Lesions Treated With Fluoride Varnish

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**Objectives** We have previously reported that the application of fluoride varnish did not promote remineralization in subsurface lesions, but improved acid resistance in the deeper zone. To investigate in more detail, in this study, fluoride varnish was applied to bovine enamel subsurface lesions, and the microstructure was observed before and after demineralisation and compared with that of specimens with no fluoride treatment and with multiple treatments with fluoride mouth-rinse.

**Methods** Bovine enamel subsurface lesions were prepared by using a lactic acid gel system for 10 days. The specimens were subjected to single application of fluoride varnish (W: Clinpro White Varnish F, 3M Oral Care), immersion in a fluoride mouth-rinse (M: Miranol, Bee Brand Medico Dental) for 10 min twice a day for 3 days, or no fluoride treatment (Control), and were stored in a saliva reference mineral solution for 3 days, except when being treated. The specimens were then immersed in artificial decalcifying solution for 3 days. Cross-sections before and after the final demineralisation were observed using a scanning electron microscope.

**Results** Before demineralisation, an acid-etching pattern with preferentially removed prism peripheries was visible in the subsurface lesion in all groups. After demineralisation, in groups W and M, an acid-resistant zone was observed below the subsurface lesion, and a second lesion below it. In part of this second lesion, a pattern of hollowed prismatic cores and relatively intact prismatic peripheries was found. The acid-resistance zone and distinctive demineralization pattern were not found in the control group.

**Conclusions** It was found that a characteristic etching pattern with selective demineralisation of the prismatic core occurs below the deeper layer of the enamel subsurface lesion where acid resistance has been improved by fluoride varnish or fluoride mouth-rinse.

## 0017

# Analysing Healthy Versus Decayed Tooth Tissues Using Spectroscopic Methods

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**Objectives** The aim of this study is to understand the chemical alterations in deep dental and grossly decayed caries in contrast to healthy dentine and enamel.

**Methods** Enamel and dentine samples from 20 healthy teeth and 21 carious teeth were collected using a low-speed bur, pooled into vials, and weighed. Samples were ground under liquid nitrogen and divided into sound enamel (ME1), sound dentine (MD1), deep dentine (DD0) and grossly decayed dentine (GDi), respectively. Fourier-transform infrared (FTIR) analysis followed by 13C and 15N nuclear magnetic resonance (NMR) analysis was performed to compare the chemical composition of healthy and decayed tooth material.

**Results** FTIR revealed notable differences in the Amide1 (1650 cm<sup>-1</sup>) and phosphate (1100 cm<sup>-1</sup>) bands between sound and carious tooth material. Decayed dentine exhibited an increase in the ratio of transmission of amide I / transmission of phosphate in carious as compared to ratio for healthy teeth. This trend was confirmed by 13C and 15N NMR. Sound enamel has the lowest signal ratio organic carbon/inorganic carbon compared to the corresponding ratio for the dentine tissues (healthy and carious) This signal ratio infers that the protein/mineral content in carious tissues increases with higher degree of decay. The 15N NMR analysis aligned with the 13C NMR and FTIR results.

**Conclusions** It is evident from FTIR and 13C, 15N NMR analyses that the ratio of the protein and mineral components increases in decayed as compared to healthy teeth.

## 0217

## Tooth Wear and Its Etiology: Common Clinical (mis)Conceptions

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**Objectives** To investigate the predictive value of commonly thought major risk factors (acids in diet, presence of tooth wear, bruxism and reflux) at baseline and tooth wear progression over time. **Methods** To evaluate predictive values 34 patients with moderate to severe tooth wear were questioned at baseline regarding bruxism habits, diet (acidic drinks) and acid reflux through questionnaires. Tooth Wear Index was measured at baseline through clinical exam. The etiological factors were dichotomized except for acidic drinks, which were included both as a dichotomized and continuous variable. Intra-oral scans (IOS) were taken at baseline and again 3 or 5 years later. Tooth wear progression was measured using the 3D Wear Analysis protocol on 64 surfaces per dentition, scoring the highest profile loss per surface in millimeters. Height loss was recalculated to mm/year, and patients were dichotomized into high and low tooth wear groups. Fisher-exact test, sensitivity, specificity, positive predictive value (PPV) were calculated for the dichotomized etiological factors. For acidic drinks as a continuous factor, the Area Under Curve (AUC) was also calculated.

**Results** Bruxism, TWI-score and acid reflux resulted in insignificant differences with low predictive values between high and low wear patients. Acidic drinks dichotomized had a PPV of 84.6%, sensitivity of 78.6%, specificity of 75%, and was able to distinguish between low and high wear progression groups (p=0.026). Acidic drinks as a continuous factor had an AUC of 0.821.



**Conclusions** The predictive value of self-reported bruxism and acid reflux on tooth wear progression is low, as well as the TWI score. Patients should be informed that a high acidic intake can predict higher progression of tooth wear and clinicians should be aware that acidic diet can have a significant effect on both mechanical and erosive tooth wear.

# 0019

# Postpolymerization Affect Microbial Adhesion of Additively-Manufactured Resins for Definitive Restorations

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**Objectives** To investigate the influence of postpolymerization time (PPT) and atmosphere (PPA) on surface properties, protein adsorption, and microbial adhesion of two different types of additively manufactured (AM) resins for definitive restorations.

**Methods** Two different types of commercially available AM resins for definitive restorations (UR and CR, respectively), were used to fabricate disk-shaped specimens by using digital light processing. Specimens were categorized into 8 groups based on the type (chemical composition), PPT (standard and extended), and PPA (air and nitrogen). After postpolymerization, all specimens were analyzed for surface roughness (R<sub>a</sub> and S<sub>a</sub>) and surface free energy (SFE). Protein adsorption, microbial (*Streptococcus gordonii*) attachment, and cytotoxicity were also investigated. Based on data distribution, non-parametric factorial analysis of variances and post-hoc analyses were performed with the level of significance (α) of 0.05.

**Results** R<sub>a</sub> and S<sub>a</sub> values of CR group were higher than UR group, regardless of PPT or PPA (P<0.05). For UR, SFE under extended PPT was higher than that under standard PPT. CR showed higher SFE than UR under standard PPT. PPT and PPA interaction significantly affected the protein adsorption of resins (P<0.05). Under standard PPT, nitrogen significantly increased protein adsorption of resins compared with air. Interactions between the type and PPA, and the type and PPT had significant effects on microbial adhesion (P<0.05). For both resins, PPA or PPT significantly affected microbial adhesion on their surfaces. Cytotoxicity was not affected by the changes in PPT or PPA.

**Conclusions** Surface properties, protein adsorption, and microbial attachment were affected by postpolymerization time, atmosphere, and chemical composition of the AM resins used for definitive restorations.

## 0020

# Effect of Buccal Cusp Coverage on Restored Non-Vital Premolars

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**Objectives** When restoring root-canal treated premolars, the decision of the position of the buccal margin and the amount of cusp reduction is often driven by esthetic considerations. However, the impact of the cavity configuration on mechanical strength should also be considered. Therefore, this study assessed the effect of different levels of buccal cusp reduction on marginal adaptation and fracture strength of root-canal treated premolars restored with CAD/CAM composite endocrowns, a direct composite restoration being used as control.

**Methods** 40 endodontically-treated premolars were restored and divided into four groups (n=10): 1) MOD direct resin composite restoration with no cusp reduction, 2) Endocrown with buccal cusp coverage of 1.5 mm, 3) endocrown with buccal cusp coverage of 3 mm and 4) endocrown with full buccal cusp coverage (Figure 1). The materials used were a micro hybrid resin composite (Brilliant Everglow) for direct restoration and a CAD/CAM composite block for the endocrowns, (Brilliant Crios) combined with a universal adhesive system (One Coat 7 Universal) as luting agent. Marginal adaptation of the restorations before and after thermo-mechanical loading was evaluated by semi-quantitative SEM analysis. Samples were then subjected to static loading until fracture. The results were statistically evaluated by non-parametric tests, significance level set at 0.05.

Results No significant differences in marginal adaptation were observed between groups both before and after loading (Figure 2). MOD direct composites (Median 552.5 N) and endocrowns with buccal cusp coverage of 1.5 mm (Median 658.5 N) presented significantly lower values of fracture strength than endocrowns with 3mm (Median 977 N) or full cuspal reduction (Median 985.5 N) (Figure 3).
Conclusions Although marginal adaptation of MOD direct restorations was not significantly different than endocrowns, resistance to fracture was directly related to the level of cusp coverage. 3mm or full cusp reduction appear to improve the fracture strength. On the contrary, comparable fracture strength were observed between a buccal cusp reduction of 1.5mm and a direct composite without cusp reduction.

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## 0021

# Water Sorption and Solubility of Composites Containing Bioactive Glass

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**Objectives** Experimental composites based on copper-doped mesoporous bioactive glass nanospheres (Cu-MBGN) were developed as functional restorative materials serving as a source of antimicrobial and remineralising ions. The aim of this study was to investigate the influence of Cu-MBGN on the mass change of an experimental composite material during 180 days of water storage and to compare it with conventional bioactive glass (BG) and inert fillers.



**Methods** The experimental composites contained 35 wt% Bis-GMA/TEGDMA base (60/40), 55 wt% silanised barium-glass fillers and 10 wt% of either Cu-MBGN (10-CuBG), 45S5 bioactive glass (10-BG) or inert silica nanofillers (10-Si). Composite specimens were prepared and polymerised in Teflon moulds (d=5 mm, h=2 mm). Water sorption and solubility were measured by a modified ISO 4049 gravimetric method for up to 180 days. Mass change at each time point during water immersion was expressed as a percentage of the initial mass of the specimen (mean±s.d.). The results were statistically analysed using one-way ANOVA with Tukey post-hoc correction.

**Results** Both composites containing bioactive glass demonstrated significantly higher mass change at all measured time points compared to the inert control material 10-Si (p<0.001), in the decreasing order 10-BG>10-CuBG>10-Si. 10-BG showed the peak of mass increase after 30 days (4.02±0.21%), followed by a decrease until the end of the measurement after 180 days. At the same time, after 30 days, the mass of 10-CuBG increased to 1.67±0.10%. 10-Si had a similar trend in mass increase (1.19±0.07% after 30 days). 10-CuBG and 10-Si showed a gradual mass increase until the measurement's end after 180 days. **Conclusions** Composite material containing copper-doped nanospherical particles of bioactive glass had a lower mass increase during water immersion than the composite with the commercial bioactive glass 45S5 but higher values than the inert control.

0022

# Impact of Nanofiller Fractions on Microfilled Resin Composite

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**Objectives** The aim of this study was to assess the impact of incorporating various weight fractions of nanometer-sized particulate fillers on specific properties of microfilled resin composite.

**Methods** Microfilled resin composite was prepared by mixing 29 wt.% of resin matrix (BisGMA/TEGDMA) to the 71 wt.% of silane treated micrometer-sized (0.4 µm) particulate fillers. Then, various fractions of nanometer-sized (180 nm) fillers (0, 5, 10, 15, 20, 25, 30, 35 wt.%) were added gradually using high speed mixing machine. For each resin composite, flexural properties (n=8) were evaluated using a three-point bending test on a universal testing machine (ISO standard 4049). FTIR-spectrometry was used to calculate the degree of monomer conversion (DC%). Surface microhardess (Vickers) was also determined. Surface gloss was measured before and after polishing (paper grits: 4000). A two-body wear test was performed in a ball-on-flat configuration using a chewing simulator with 15000 cycles. A non-contact 3D optical profilometer was utilized to measure wear depth. ANOVA was applied to statistically interpret the results, and then the post hoc Tukey's analysis was performed.

**Results** ANOVA revealed that fraction of nanofillers had significant effect (p<0.05) on flexural modulus, DC%, microhardness, gloss and wear depth. The group without nanofillers showed the highest DC% (56.6), gloss after polishing (76.2 GU) and wear resistance (24.2 µm) values. While the group with 35 wt.% of nanofillers had the highest flexural modulus (9 GPa) and microhardness (70 VH).

**Conclusions** It is beneficial to add nanofillers to microfilled resin composite, however it is essential to carefully assess the proportion ratio. Optimizing different properties of resin composite at once with just one formulation is challenging.



# New Liner/Base Material in a Novel Low-Waste Delivery System

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**Objectives** The aim of the study was to compare liner base materials offered in different delivery systems on the market with a new experimental hybrid Resin-Modified Glass-Ionomer (RMGI) liner/base material in a new Auto-mix delivery system (EXPmaterial) in respect of wasted material remaining in the application tip at each use. All these systems generate a certain amount of paste waste with each application. Sustainability is an important goal today.

**Methods** 3 Different liners were used for the study. Waste was determined by weight. Weighting an empty mixer or application tip and weighting a used static mixer or application tip. Calculate the wasted material in the mixer by the weight difference. The test was repeated 10 times using a new application tip or mixer every time. Since waste volume is the more precise comparison, the densities of the materials have been measured to calculate the waste volume remaining in the application tips.

**Results** The mean values for waste and resulting standard deviations and grouping are shown in the Table. Data was analyzed using one-way ANOVA with 95% confidence Tukey's method.

The paste waste of the New EXP Syringe is  $38,1\pm0,6\mu$ l whereas the paste waste of the compared one component material is  $53,2\pm11,7\mu$ l and the paste waste of the compared two component automix material is  $205,5\pm1,7\mu$ l.

**Conclusions** The new EXP hybrid-RMGI Liner Base material produces significantly less paste waste than the other two materials. This is remarkable since the new material is a two component automix system and the compared material with the lowest waste is a one component system without a static mixer.

waste weight	EXPmaterial	TheraCal LC®	ACTIVA™BioACTIVE Liner
Avg.,mg	67,0	103,7	287,8
Stdev.,mg	1,0	22,8	2,4
Grouping	A	В	С
waste volume			
Avg.,µl	38,3	53,2	205,5
Stdev.,µl	0,6	11,7	1,7
Grouping	А	В	С

## Results



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# 0024

# **Curing Conditions Affect Flexural Strength of FRC Post**

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**Objectives** Root canal anchoring can be made with prefabricated fiber-reinforced composite (FRC) posts or individually formed fiber post (IFP) concept. The prefabricated FRC post is polymerized industrially to a high degree of cure, whereas in the IFP concept post is cured in situ in the root canal. This study compared bending strength of industrially polymerized FRC posts with FRC materials polymerized in conditions simulating in situ curing concept. Radiopacity of the materials was also measured.

**Methods** Three different FRC materials were tested. Group 1: prefabricated FRC posts, GC Fiber Post (GC, Japan) with high degree of cure (cured by manufacturer). Group 2: Individually formed FRC posts, everstick POST (GC, Japan), rolled into the form of posts between Mylar film and light-polymerized 3 x 40 s with dental light-curing device. Group 3: Individually formed FRC posts of ECR-glass fibers impregnated in a mixture of UDMA(95%) and PMMA (5%) and light-polymerized 2 x 20 s. Flexural strength of the posts (n= 6 per group) was measured with three-point bending test (span length= 10mm). Radiopacity of the posts

was asessed and compared to aluminum standard.

**Results** Flexural strength was significantly higher for FRC posts (1041 MPa) in Group 1 compared to posts in Groups 2 (675 MPa) and 3 (662 MPa) (p<0.05; ANOVA). No significant difference was found between the posts in Group 2 and 3. The FRC posts in Group 1 showed significantly higher radiopacity compared to the other groups. The FRC posts in Group 3 had slightly higher radiopacity compared to the posts in Group 2. **Conclusions** Individually formed and cured FRC posts have lower bending strength compared to industrially polymerized FRC post material. This highlights the importance to use in situ curable FRC with the concept of "individually formed FRC post system" which compensates the lower bending strength by allowing higher fiber volume and direct adaptation of the FRC in the root canal.

## 0025

## Water Storage Effect on Mechanical Stability of Self-Adhesive/Universal Resin Cements

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Objectives Sufficient resistance to water degradation is a pre-requisite for the clinical success of resinbased dental materials. In this study the long-term stability in water of a self-adhesive and a universal resin cement containing hydrophilic adhesion monomers was determined by flexural strength testing. Methods 3-point flexural strength (n=6, in accordance with ISO 4049:2019) of 3M<sup>™</sup> RelyX<sup>™</sup> Unicem 2 Automix Self-Adhesive Resin Cement (RUN) and 3M<sup>™</sup> RelyX<sup>™</sup> Universal Resin Cement (RUV) was tested after 24 hours, 3-, 6- and 9-months storage in deionised water at 36°C. Both self-cure (sc) and light cure (lc) modes were investigated. For each cement, data was analysed by One-Way ANOVA separated for self-cure and light-cure mode (Tukey; p<0.05).



**Results** No statistically significant change in flexural strength was observed for RUN (significance level  $\alpha = 0,05$ ; p-Value (sc)= 0,059; p-Value (lc)= 0,135) and RUV (significance level  $\alpha = 0,05$ ; p-Value (sc)= 0,225; p-Value (lc)= 0,584).

**Conclusions** Cements investigated displayed high mechanical stability during water storage.

Mean Values Flexural Strength (MPa)						
Water storage	RUN		RUV			
	sc	lc	sc	lc		
24h	86,0±6,5	92,5±13,3	98,8±6,0	99,4±9,5		
3 month	91,7±9,5	87,1±11,4	97,2±3,5	101,8±2,7		
6 month	78,1±8,6	83,8±5,2	97,0±9,6	98,6±2,6		
9 month	78,3±10,8	78,9±6,6	88,4±13,9	102,3±3,8		

# 0026

# Flexural Strength and Polymerization Shrinkage Stress of Composite Materials

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**Objectives** Secondary caries and fracture are the main reasons for restoration failure in the posterior. Thus, shrinkage stress and flexural strength of a composite are two important parameters that can influence the longevity of dental restorations. Objective of the study was to investigate the polymerization shrinkage stress and the flexural strength of various composite materials.

**Methods** Composite materials under investigation were Venus Diamond (Kulzer), Venus Pearl (Kulzer), Essentia (GC), Admira Fusion x-tra (VOCO), Filtek Universal (3M), Tetric Prime (Ivoclar), Ceram.x Spectra ST HV (Dentsply Sirona) and Omnichroma (Tokuyama Dental).

Measurement of flexural strength (n=7-11) was conducted according to standard EN ISO 4049:2019. Polymerization shrinkage stress (n=4-5) was investigated after 24 h by photo-elastic measurement following a previously described method from Ernst et al. with the main alteration of 24 h water storage (37°C). Mean and standard deviation (SD) were collected. Results were analysed by ANOVA.

**Results** Some significant differences in flexural strength and shrinkage stress between the composite materials were detected (figure 1).

**Conclusions** Within the limitations of this study Venus Pearl and Venus Diamond showed the most pronounced combination of high flexural strength and low shrinkage stress.



Figure 1: Mean shrinkage stress after 24 h [MPa] and mean flexural strength after 24 h [MPa] of the tested composite materials.

	Shrinkage stres 24 h (water sto	ss after rage) [MPa]	Flexural strength (ISO 4049:2019) [MPa]		
	Mean	SD	Mean	SD	
Ceram.x Spectra ST HV	8.2	0.1	127.0	7.0	
Filtek Universal	7.5	0.2	155.0	19.0	
Tetric Prime	7.2	0.2	116.0	7.0	
Omnichroma	7.1	0.1	92.0	12.0	
Essentia	6.9	0.1	94.0	9.0	
Admira Fusion x-tra	5.7	0.0	85.0	13.0	
Venus Pearl	5.6	0.1	164.0	11.0	
Venus Diamond	5.6	0.0	168.0	8.0	

## 0027

# Self-Adhesive Composites and Their Viscosity: Insights of the Adhesive Interface

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**Objectives** To evaluate and compare the interfacial interdiffusion zone formation, of self-adhesive composites made with different functional monomers and viscosities, using micro-Raman spectroscopy. **Methods** Nine experimental self-adhesive composites were formulated, with a base mixture of urethane dimethacrylate (UDMA) and propylene glycol dimethacrylate (PPGDMA) and 15 mol% of a functional monomer (either 2-hydroxyethyl methacrylate, HEMA; glycerolphosphate dimethacrylate, GPDM or 10-methacryloyloxydecyl dihydrogen phosphate, 10-MDP). The powder phase comprised hybrid barium glass/silica particles. In order to vary the viscosity of the composites, three powder-liquid ratios were tested (1.9, 2.2 and 2.5). Composites were made using a centrifugal speed mixer (45 s, 1500 rpm). For the spectroscopic study, 27 sound human molars were sectioned by the middle dentin, polished (600 SiC)



and restored (n=3) with 2 mm of each composite, light-cured at 20 s (LCU DB686; COXO Medical Instrument Co., Guangzhou, China). After 24 h storage in water, they were sectioned to expose the adhesive interface. The dentin-composite interfaces were analyzed by mapping a 15 x 15  $\mu$ m surface area between 800 – 1750 cm<sup>-1</sup> (resolution 2 cm<sup>-1</sup>; 50x). Data analysis included the creation of intensity scale maps, based on characteristic peaks and the measurement of the interdiffusion zone, using a Boltzmann fit.

**Results** Qualitative analysis of the spectroscopic images revealed that the formulations with 10-MDP contributed to the formation of an interdiffusion zone, irrespective of the powder-liquid ratio. This was verified to contrast with other monomers, which showed poor diffusion, dependent upon the viscosity. **Conclusions** The quality and width of the interdiffusion zone seems to be influenced by the adhesive monomer, while the powder-liquid ratios tested were not a major contributing factor.

## 0028

# Bioactive Glass-Functionalized Composites: 1-Year Bond Strength With a Universal Adhesive

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**Objectives** To evaluate the dentin bond strength of experimental resin composites functionalized with an F-containing bioactive glass (BG) after simulated aging for 1 year *in vitro*.

**Methods** Experimental composites were prepared using a light-curable bis-GMA/TEGDMA resin matrix (60:40 by weight), 10–40 wt% of a low-Na F-containing BG, and reinforcing fillers (micro-sized barium glass and nano-sized silica). The total filler content was 70 wt%. The reference composite was prepared with reinforcing fillers only, and a giomer was used as a commercial reference material. The substrates for bonding were prepared from mid-coronal dentin, a universal adhesive was applied in self-etch mode, and composite cylinders (diameter=3.1 mm, height=3 mm) were bonded in two 1.5-mm increments (cured separately). Three subgroups of test specimens were prepared for aging over 1, 6, and 12 months. A total of 270 specimens were tested (5 materials x 3 time points x 18 specimens per experimental group). The bond strength was tested in macro-shear mode using a universal testing device at a crosshead speed of 0.5 mm/min until failure. Bond strength values were compared with the Kruskal-Wallis test and Bonferroni *post-hoc* adjustment.

**Results** Median bond strength values at baseline (1 month) were 25–32 MPa and were statistically similar for all materials. After 6 months, no statistically significant change in bond strength was observed with median values in the range of 23–26 MPa. After 1 year, all experimental composites showed a significant increase in bond strength compared to the 6-month values, with median values of 30–36 MPa. The 1-year bond strength of all BG-containing composites was statistically similar to that of the experimental reference material and the commercial reference material (giomer).

**Conclusions** Functionalizing experimental composites with 10–40 wt% BG showed no adverse effects on their dentin bond strength after 1 year.



# Gloss Retention of CAD/CAM and Conventional Materials After Chemical/Mechanical Degradation

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Objectives Three-dimensional (3D) printed composite resins have recently become a topic of interest for permanent restoration in clinical settings with its advantage in terms of production efficiency and costeffectiveness. However, the evidence of their surface gloss retention after exposure to chemical and mechanical degradation in the oral environment is still missing. Thus, this study aims to evaluate the surface gloss of 3D-printed composite resin, CAD/CAM materials and light-curing composite resins for direct restoration after the in vitro degradation simulation by chemical and mechanical methods. Methods 416 specimens were prepared from 4 different 3D-printed composite resins (Brilliant-Print-Experimental, Crowntec and VarseoSmile-Crown-Plus, Temp-PRINT), 6 subtractive CAD/CAM materials (Tetric-CAD, Katana-Avencia, Vita-Enamic, Telio-CAD, IPS-e.max-CAD, Initial-Lisi-Block) and 3 light-curing composites for direct restoration (Tetric-EvoCeram, Clearfill-Majesty-ES-2-Classic and G-ænial-Universal-Injectable) and polished with abrasive paper (600,1200,2400,4000). The samples were then measured for gloss value (Novo-Curve) with 3 points per 1 sample, at the same point, each time turning 120 degrees. Four surface treatments including water, 75% Alcohol, Acid (Elmex-Gelée) and Mechanical Brushing were applied to the specimens for an hour. They were then measured for gloss value and the  $\Delta GU$  data were statistically analyzed between each surface treatment group and then between each material group (Independent-Samples Kruskal-Wallis One-way ANOVA Test).

**Results** Initial result demonstrates that the e.max-CAD, Initial-Lisi-Block and Tetric-CAD from acid aging and Telio-CAD from brushing group show  $\Delta$ GU above 17.6 (gloss value difference detectable by at least 50% of observers). The rest of experiment groups present  $\Delta$ GU value below 17.6. Statistical tests show significant differences between initial and final gloss value for all materials and aging groups. **Conclusions** The investigated commercially-available 3D-printed composite resins may present acceptable gloss retention after *in vitro* chemical and mechanical degradation. Their gloss retention property are similar to CAD/CAM materials and light-curing composite resins for direct restoration.

Material	Commercial Name	Composition	Lot Number
3D-printed composite resin	BEGO; VarseoSmile Crown plus (3D-VB)	30–50 % Silanized dental glass (particle size 0.7 μm), 4'-isopropylidiphenol, ethoxylated and 2 methylprop-2enoic acid, methyl benzoylfor- mate, diphenyl (2,4,6-trimethylbenzoyl) phosphine oxide	600317
3D-printed composite resin	Saremco; Crowntec (3D-CS)	50 –<70% BisEMA, 0.1 –<1% trimethylbenzoyldiphenylphosphine oxide	E741
Temporary 3D-printed	GC Temp Print; GC (3D-TP)	UDMA 50–<75%, 2,2'-ethylenedioxydiethyl dimethacrylate 10%<25%, inorganic silica fillers 20% wt	2103191



composite resin			
Experimental 3D-printed composite resin	Brilliant Print Experimental; Coltene (3D-EXP)	Undisclosed	Experimental 1
Milled Composite resin	Tetric CAD - Ivoclar Vivadent (CC-TC)	71.1 % barium glass, silicon dioxide , 28.4 % Bis GMA, Bis-EMA, TEGDMA, UDMA	Z03T89
Milled Composite resin	ATANA Avencia - Kuraray Dental (CC-KA)	62% silica, alumina filler, 38% UDMA, TEGDMA	000488
Milled polymer- infiltrated Ceramic	VITA Enamic (CC-VE)	86% ceramic Silicon dioxide, Aluminum oxide, Sodium oxide, Potassium oxide, Boron trioxide, Zirconia, Calcium oxide, 14% UDMA+TEGDMA	94890
Milled PMMA	Telio CAD - Ivoclar Vivadent (CC-PM)	99.5% PMMA	Z03DXV
Conventional Composite resin	Tetric EvoCeram - Ivoclar Vivadent (CR-TE)	75%-76% Barium Glass, mixed oxide, filler, YbF3, prepolymers, 24%-25% Bis-GMA, UDMA, Ethoxylated Bis- EMA	Z03D9S
Conventional Composite resin	Clearfil Majesty ES-2 Classic - Kuraray Dental (CR-CM)	78% Silanated barium glass, 22% Bis-GMA, dimethacrylate	CG0217
Flowable Composite resin	G-ænial Universal Injectable – GC (CR-INJ)	69% Silicon Dioxide, Strontium glass, 31% UDMA, Bis- MEPP, TEGDMA	211015A
Milled Lithium Disilicate	IPS e.max CAD - Ivoclar Vivadent (CC-EM)	57-80% Silicon dioxide, 11-19% Lithium oxide, 0-13% Potassium oxide, 0-11% Phosphorus pentoxide, 0-8% Zirconium oxide, 0-8% Zinc oxide, 0-5% Aluminum oxide, 0-5% Magnesium oxide, 0-8% Coloring oxides	Z0366T





Milled Initial LiSi Block Lithium – Disilicate GC (CC-IL)	Silicon dioxide, Phosphorus oxide, Potassium oxide, Aluminum oxides, Titanium oxide and Cerium oxide 0.6%	2112131
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# Effectiveness of Hydrogen Peroxide-Free Bleaching Agents on Color Change

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**Objectives** The purpose of this in vitro study was to evaluate the effectiveness of five bleaching gels with four different active agents with the same active concentration when applied to human teeth following athome bleaching treatments.

**Methods** Human intact incisors were collected and the crowns were separated from the roots. For tooth color change assessment the tooth specimens were randomly distributed to 5 groups (n=6) and received at-home bleaching treatment for 14 days by applying the bleaching gel for 30 min each day. During this period the teeth were stored in artificial saliva at 37°C. In Group 1 a bleaching gel containing 3% phthlamidioperoxycaproic acid (PAP) was applied, in Group 2 the gel contained 17.3% polyvinylpyrrolidone (PVP) with 3% bounded hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), in Group 3 it contained 3% H<sub>2</sub>O<sub>2</sub>, in group 4 it contained 8.6% carbamide peroxide (equivalent of 3% H<sub>2</sub>O<sub>2</sub>) and in Group 5 the gel had the same composition with Group 1 but without PAP. Tooth color change ( $\Delta E_{ab}^*$  and  $\Delta E_{00}$ ) and whiteness index ( $\Delta WI_D$ ) was evaluated 24 h, 15 and 30 days after the treatments using a spectrophotometer. **Results** All the experimental groups exhibited  $\Delta E_{00}$  and  $\Delta WI_D$  higher than 50:50% acceptability (AT:  $\Delta E_{ab}^* > 2.66$ ,  $\Delta E_{00} > 1.77$ ,  $\Delta WI_D > 2.6$ ) and 50:50% perceptibility (PT:  $\Delta E_{ab}^* > 1.22$ ,  $\Delta E_{00} > 0.81$ ,  $\Delta WI_D > 0.7$ ) thresholds. The highest tooth color and whiteness changes presented the PAP-containing bleaching agent ( $\Delta E_{ab}^* = 7.35 \pm 3.72$ ,  $\Delta E_{00} = 3.79 \pm 1.58$ ,  $\Delta WI_D = 7.35 \pm 3.72$ ), while the lowest the PVP-containing bleaching agent

 $(\Delta E_{ab}^{*}=3.67 \pm 1.39, \Delta E_{00}=1.97 \pm 0.46, \Delta WI_{D}=3.67 \pm 1.39).$ 

**Conclusions** The use of a novel  $H_2O_2$ -free bleaching agent presented comparable and even better effectiveness in color change when compared to conventional  $H_2O_2$ -containing bleaching agents for athome bleaching treatment.

0031

#### **Compressive Strength Evaluation of Fiber-Reinforced Glass Ionomer Cement**

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**Objectives** The aim of this study was to assess the effect of the addition of different percentages of short glass fibers to a commercially available resin-modified glass ionomer cement on its compressive strength.

**Methods** GC Fuji II LC, a glass ionomer cement, was used for sample preparation. Three experimental groups were prepared by adding a volume of 10%, 15%, and 20% of short glass fibers ( $6\mu$ m in diameter, average length of 140 $\mu$ m) to the powder portion of cement, while the control group contained no fibers.



The material was in encapsulated form and mixed according to the manufacturer's instructions. Five samples for each group (n=5) were prepared using 6mm x 4mm silicone molds and stored in deionized water for 5 days at 37° C in an incubator prior to testing (ISO Standard ISO9917-1). Compressive strength was determined using a linear actuator STEP Lab UD08 at a temperature of 20°C with a load speed of 20 N/sec. The results were analysed using descriptive statistics (mean, standard deviation), and statistical inferences were made using a mixed-design ANOVA. The statistical significance level was set to 0.05. **Results** Obtained compressive strength values (N/mm<sup>2</sup>) were 103.7±4.8 (control group), 120±11.31 (10% of glass fibers), 133.2±11.35 (15% of glass fibers), 136.2±7.6 (20% of glass fibers), with statistically significant differences noted among the groups (P=0.0001). Unpaired t test results found statistically significant increase of compressive strength in the group modified with 20% wt. of glass fibers compared to the control group (P<0.001).

**Conclusions** The addition of short glass fibres increases the compressive strength of resin-modified glass ionomer cement. Statistically significant increase occurs at glass fiber wt. of 20%.

# 0032

# Printing Orientation Effects on Dual-Indications Photopolymer Compared to Traditional Material

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**Objectives** 3D printing enables healthcare professionals to create models with multiple applications. Throughout the printing process, and depending on the material, variations in printing orientations can alter the surface of the printed models and their mechanical properties. This study aimed to evaluate the flexural strength (FS) and elastic modulus (EM) of a 3D printing resin with dual indications for fabricating individual impression trays and surgical implant guides, printed in various orientations, compared to a traditional material for manufacturing individual trays.

**Methods** A DLP 3D printer was utilised to print six specimens using the photopolymer dima Print Guide & Tray (Kulzer) in three different printing orientations of 0°, 45°, and 90°, followed by the cleaning and postcuring protocols. In parallel, six additional samples were prepared with a cold-curing polymer based on methylmethacrylate (Pekatray, Kulzer). All specimens were stored unpolished under dry conditions for 24 hours. Subsequently, a 3-point bend test in dry conditions was conducted to determine the FS and EM, thereby comparing the mechanical properties of printed specimens in different orientations to the coldpolymerised resin. The data were analysed statistically (α=0.05).

**Results** The values of FS and EM were measured in MPa with their respective standard deviations in parentheses. dima Print Guide & Tray exhibited at 0°, FS 81.6(6.4) and EM 2691(26); at 45°, FS 88.4(13.4) and EM 2613(26); at 90°, FS 107.5(3.9) and EM 2738(34). Comparatively, the traditional material, Pekatray, exhibited FS of 38.4(3.3) and EM of 1967(139).

**Conclusions** Within the limitation of the study, findings suggest that regardless of the printing orientation, the 3D printing resin dima Print Guide & Tray exhibited superior performance compared to the traditional reference material for its use as individual impression trays.



# Light Transmission of Different Dental Composite Resins

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**Objectives** This study aims to analyze light transmittance of three different dental composites in various thicknesses to investigate how power of light sources influences the penetration.

**Methods** A total of 216 samples were fabricated from IPS Empress Direct (IPS), Lava Ultimate (LU), and Neo Spectra ST (NST) materials in three thicknesses (1 mm, 2 mm, 3 mm; n = 12/group) and cured using Valo and high power (HP) D-Light Pro light-curing devices. The light transmittance of the materials was measured with a spectrometer. Statistical analysis was performed using one-way ANOVA and post-hoc tests.

**Results** Samples with a thickness of 1 mm demonstrated significantly higher light transmittance compared to those with thicknesses of 2 and 3 mm within each material group. Samples with 1 mm thickness cured with HP showed light transmittance similar to 2 mm thick samples cured with Valo in the IPS group. Similar light transmittance was observed for samples with thicknesses of 2 and 3 mm across all materials and light-curing devices. The highest light transmittance was observed in 1 mm IPS samples, while the lowest was in 3 mm NST samples, in both light-curing devices. Additionally, 1 mm IPS samples polymerized with Valo showed significantly higher light transmittance compared to 2 and 3 mm NST and LU samples polymerized with both light devices.

**Conclusions** Light transmission in resin-composites is significantly influenced by thickness and curing device. Thinner samples generally exhibit higher transmittance with notable variations among materials and curing methods. Optimal transmittance was observed in 1 mm IPS samples, emphasizing the importance of thickness control for desired aesthetic outcomes.

## 0034

## Short Fiber-Reinforced Flowable Composite in Cementation of Fiber-Reinforced Composite Post

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**Objectives** The aim of this *in vitro* study was to investigate bonding of two types of resin composites used as luting cement for fiber-reinforced composite post.

**Methods** Two different composites were tested; light-cure flowable short fiber-reinforced composite (SFRC) everX Flow (Dentin, GC) and dual-cure composite Gradia Core (GC). Four groups were made with everX Flow and four with Gradia Core. Two different prefabricated fiber-reinforced composite (FRC) posts (diameter 1.6 mm) were used; GC-post (GC) and Snowpost (Abrasive Technology). Posts were conditioned with two different primers; either Ceramic Primer (GC) or G-multiprimer (GC). After conditioning, the posts were placed in the resin composites and pressed between two glass plates along the long axis of the post into thickness of 1.6 mm and then light-polymerized. The post-composite plates were cut to micro-tensile strength test specimens (1.6mm x 1.6mm x 1.8mm). Eight different test groups were made (n=7 per group).



Micro-tensile bond strengths of the specimens were measured and fracture types were categorized. **Results** Both composite groups (everX Flow and Gradia Core) had similar bond strength values between 7.5-13.5 MPa. No significant difference in the tensile strength between post and cement materials was found among the groups (p>0.05).

The fracture types showed significant differences among the post groups (p<0.001) varying from adhesive to cohesive in type.

**Conclusions** EverX Flow revealed similar bonding properties to FRC post as Gradia Core and could alternatively be considered as a cement material with fiber-reinforced composite post if light curing of the everX Flow can be confirmed.

## 0035

# Irradiation Parameters Influence on Micro Hardness Rate of Light-Cured Composite-Resins

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**Objectives** To assess the influence of irradiation parameters (type of lamp/radiation intensity, exposure time, distance of optical fibre from sample's surface, sample thickness) on composite-resin degree of polymerization by evaluating Micro Hardness Rate (MHR).

**Methods** Six light-cured composite-resins (colour A2) were studied: Filtek Z550 (3M ESPE), G-aenial Posterior (GC), Filtek Bulk Fill Posterior (3M ESPE), SDR (bulk-fill) (Dentsply), Filtek Ultimate Flow (3M ESPE), G-aenial Universal Flow (GC). Three LED polymerization lamps were used: lamp\_1(control)- Elipar FreeLight 2 LED (3M ESPE)-1000 mW/cm<sup>2</sup>, lamp\_2-MiniLED Supercharged (Acteon)-2000/3000 mW/cm<sup>2</sup>, lamp\_3-FlashMax P3 460 4W (CMS Dental)-5000/6000 mW/cm<sup>2</sup>. Cylindrical samples (2mm height-5mm diameter and 4mm height-5mm diameter, n=6) of each material were irradiated (distance 0, 2 and 4mm, time: 20s/lamp\_1, 10s/lamp\_2, 3s and 1s/lamp\_3), stored (24h, 5ml water, 23°C); dried, subjected to microhardness testing, statistically analysed (Anova, U-Mann-Whitney, p<0,05). Degree of polymerization was assessed using MHR (lower to upper surface's microhardness ratio); greater than 0.80 indicates a properly polymerized lower surface.

**Results** For all materials: the highest MHR was obtained for control lamp exposure, no differences were observed in microhardness of each material's upper surfaces irradiated for 20 and 10s, all 4mm samples were not adequately polymerized at the bottom surface (MHR<0,80). All material's lower surfaces were less hard (MHR 0,94 to 0,00) than upper ones (MHR 1,0 to 0,13). Increased distance of optical fibre from sample's surface (>0mm) negatively impacted through-cure (MHR<0,80) of all materials. Acceptable polymerization of composite-resins (MHR>0,80) required light intensity 1000mW/cm<sup>2</sup>, longest available exposure time (20s), and 0mm distance of optical fibre from sample's surface, 2mm thick.

**Conclusions** Irradiation with higher light intensity lamps causes deterioration of the polymerization degree. Short exposure time has the most significant negative impact on MHR of bulk-fill and flowable composite-resins. Sample's thickness above 2mm negatively affects MHR of all tested composite-resins, including bulk-fills.



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# 0036

# Bacterial Adhesion and Surface Roughness of Particulate-Filled and Short Fiber-Reinforced Composites

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**Objectives** This work intended to assess the initial adhesion of *Streptococcus mutans* (*S. mutans*) and surface roughness of different particulate-filled (PFC) and short fiber-reinforced (SFRC) composites. **Methods** Five PFC composites (CeramX Universal, Filtek Universal, Omnichroma, Tetric Prime and Venus Diamond) and four SFRC composites (everX Posterior, everX Flow Bulk, everX Flow Dentin and experimental packable SFRC) were tested in this study. A non-contact 3D profilometer has been employed to assess the surface roughness (Ra) of the polished specimens (using 4000-grit abrasive paper). For the bacterial adhesion test, the specimens (n=5/group) were immersed in a solution of *S. mutans* to facilitate initial adhesion. In order to determine the number of cells on the surfaces of the discs as colony forming units (CFU), the vials holding the microbial samples were aggressively agitated using a Vortex machine. Subsequently, the samples were diluted multiple times and anaerobically incubated for 48 hours at 37°C on Mitis salivarius agar plates (Difco) supplemented with bacitracin. Bacterial adherence assessment was performed using SEM. The data was analyzed using ANOVA.

**Results** All tested PFC and SFRC composites showed similar adhesion of *S. mutan*. The lowest Ra values (0.26  $\mu$ m) (p<0.05) were found in the flowable SFRCs (everX Flow Bulk & Dentin) while the highest values (p<0.05) were observed in CeramX and everX Posterior (0.42  $\mu$ m). Experimental SFRC had comparable Ra value (0.38  $\mu$ m) than other commercial composites.

**Conclusions** The presence of short microfibers in the composite appeared to have no adverse effects on the initial adhesion of bacteria or the surface roughness.

# 0037

# Physico-Mechanical Properties of Universal Composite Resins After Aging

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**Objectives** To evaluate the effect of three aging procedures on flexural strength, elastic modulus, and microhardness of several universal resin composites. Water sorption, solubility, and degree of cure were also determined.

**Methods** Five universal resin composites: Omnichroma (Omnichroma), G-ænial A'Chord (Achord), Essentia Universal (Essentia), Filtek Universal shade A2 (FUniversal) and Tetric Prime (Tetric) were compared to Filtek XTE Supreme (Supreme), used as control. Specimens were subjected to three aging procedures: 1) 14 days in artificial saliva at 37°C, 2) 10,000 thermo-cycles in distilled water (5-55°C), and



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3) 10,000 thermo-cycles in distilled water (5-55°C) followed by storage in 75% ethanol (48h, 37°C). Flexural strength and elastic modulus in a three-point bending test (ISO 4049) (n=10) and microhardness (VHN) (n=5) were determined. Water sorption and solubility tests (n=5) were also performed following ISO 4049:2009 and degree of cure (%) (n=3) was analyzed by FTIR. Data were analyzed using Kruskal-Wallis with Bonferroni correction, one-way ANOVA and Tukey post-hoc tests (p<0.05)

**Results** FUniversal showed the highest flexural strength and elastic modulus values. Thermocycling aging reduced flexural strength and elastic modulus of all composites except elastic modulus of FUniversal. Supreme was the hardest composite and Essentia was the softer, before and after aging processes. Regarding sorption, Tetric, Omnichroma and FUniversal showed lower values than Supreme. Achord, Essentia and Omnichroma yielded higher solubility than Supreme. No differences were found in degree of cure among universal resin composites and Achord, Omnichroma and Tetric obtained higher percentage than Supreme.

**Conclusions** Supreme and FUniversal showed higher mechanical properties than other universal composites tested. Thermocycling decreased flexural strength of all composites. Thermocycling followed by ethanol reduced flexural strength and elastic modulus of all materials, except elastic modulus of FUniversal. Microhardness values were less affected after aging, and similar percentages of degree of cure were measured for all composites.

# 0038

## **Bone Substitute Interaction With Gingival Cells**

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**Objectives** In guided bone regeneration, in addition to the bone substitute, a membrane is used to allow bone regeneration and avoid the injured site colonization by soft tissues. Although soft tissues healing is essential from a functional and esthetic point of views, studies on the materials' effects on soft tissue healing/regeneration are scant. The aim of this study was to investigate the effects of collagenated bone substitutes on gingival cells as compared to those of an anorganic substitute.

**Methods** Primary human gingival cells were prepared from extracted third molars by the explant outgrowth method. Three bone-filling materials were used. Collagenated Gen-Os<sup>®</sup> and GTO<sup>®</sup> (Tecnoss Dental) and anorganic Bio-Oss<sup>®</sup> (Geistlich Pharma) were prepared according to the manufacturers' instructions. The samples were dipped in MEM culture medium (20 mg/mL) through a membrane (Evolution<sup>®</sup>, Tecnoss Dental) for 24 hours. The effect of the extracts was evaluated on human gingival cell viability/proliferation (MTT test), while the effect on their colonization potential was investigated using a scratch assay after 24 hours.

**Results** None of the materials was toxic to human gingival cells. Bio-Oss decreased cell proliferation after 3 and 7 days. Gingival cell proliferation significantly increased with collagenated materials. This increase was higher with GTO which significantly increased injured site colonization followed by Gen-Os. No increase of colonization was observed with Bio-Oss.

Conclusions This study showed that bone substitutes extracts interact with gingival cells and affect their


proliferation and the colonization of the injury site. These effects are dependent on the material nature. They are higher with collagen-containing materials than with the anorganic material. While our previous work demonstrated that collagenated substitutes induce angiogenesis and osteogenesis to a higher level than anorganic substitutes, these results are confirmed on gingival cells.

# 0039

# Camellia Sinensis in Managing Oral Diseases: Systematic Review and Meta-Analysis

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**Objectives** To evaluate the efficacy of dental products containing tea components with other antimicrobial agents in the treatment of different oral diseases.

**Methods** A systematic search of the literature using predetermined criteria to identify relevant randomised controlled trials was conducted. Studies were critically appraised using Critical Appraisal Skills Programme (CASP), Cochrane and Jadad tools. For meta-analysis, standardised mean differences (SMD) and 95% confidence intervals (CI) were calculated for each group, then compared in multiple comparisons to identify the differences between green tea mouthwash (GTM) and chlorhexidine (CHX) mouthwash.

**Results** A total of 39 studies were included in this study. GTM is comparable to Nystatin for treating denture stomatitis. Green tea (GT) lozenges increase saliva flow. GT gels and GTM improve gum health and reduce post-extraction bleeding but have limited impact on alveolar osteitis and trismus. High GT extract doses treat herpes, but not epidermolysis bullosa. GT lowers caries risk, and GT tablets reduce halitosis. No adverse effects were reported for GT preparations when used topically.

Three high-quality studies were included in the meta-analysis with a low degree of heterogeneity ( $I^2 = 13\%$  for Plaque Index (PI) and  $I^2=0\%$  for Gingival Index (GI)). Compared to CHX, GTM had a medium to high effect on PI with a significant difference found between the groups from baseline to two weeks (SMD - 0.60, CI: -1.13, -0.08; P = 0.02). However, a small effect with no statistically significance on GI was reported (SMD -0.33, CI: -0.80, 0.14; P = 0.17).

**Conclusions** According to the evidence available, GT preparation with no reported side effects, and may be used as alternative to traditional topical antimicrobial preparation for the prevention and management of periodontal infection, caries, halitosis, and mucosal lesions, such as denture stomatitis and herpes labialis.

# 0040

# 3D Printing of Oral Muscle Tissues Based on Medical Imaging and Biological Hydrogels

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**Objectives** The surgical management of oral cavity cancers frequently involves the complete resection of the malignant lesion, along with a wide margin of surrounding tissues. This often results in significant functional compromise, given the critical role of oral musculature and mucosa in daily functions such as speech, mastication, and swallowing. The current standard of care involves reconstructions with autogenous tissue grafts, which necessitates the harvest of healthy tissues from the patient, alongside structural incompatibility between the harvested tissues and the recipient site. Unfortunately, this approach often fails to restore normal function while also causing tissue morbidity at the donor site. The proposed project aims to create custom, patient-specific reconstructed oral soft tissues that mimic the resected site's anatomy and function, emphasizing muscle and epithelial architecture.

**Methods** We achieve this by utilizing 3D printing of a sacrificial polymer to create an anatomically inspired scaffold derived from magnetic resonance imaging. The 3D-printed sacrificial polymeric mold is injected with polycaprolactone polymer, which, following a freeze-drying process in a high-power vacuum, will lead to the creation of the scaffold. The fabricated scaffolds are then loaded with collagen-based hydrogel to induce a favorable cellular loading and tissue maturation environment.

**Results** Scaffolds were fabricated with appropriate microarchitecture to support tissue organization and tubular formation for muscle regeneration, which was evident from the micro-computed tomography of scaffolds before *in vitro* induction and *in vivo* implantation studies. *In vivo*, experiments indicated oral muscle tissue organization and mucosal coverage of scaffolds mimicking resected oral soft tissues, positive for both desmin and cytokeratin coupled with endothelial organization within implanted constructs. Finally, a large-scale sacrificial mold and polymeric construct were fabricated, affirming the possibility of creating a clinically-sized implant.

**Conclusions** The following study provides a novel methodology for oral cancer rehabilitation with clear, clinically relevant implications.

## 0041

## Dental Biomaterials Adverse Reaction Reporting Following Amalgam Ban in Norway

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**Objectives** The Norwegian Dental Biomaterials Adverse Reaction Unit administers a nationwide system for reporting of suspected clinical biological adverse reactions related to dental biomaterials. The system aims to document all types of biological adverse reactions linked to dental biomaterials. Its primary objectives are to collect information about material-related adverse reactions and to monitor changes over time.

This study aimed to investigate whether the ban on the general use of amalgam, introduced in Norway in 2008, was associated with an increase of adverse reaction reports related to alternative materials, with special emphasis on resin-based materials and cements.

**Methods** The reporting system is based on voluntary and spontaneous reporting from dentists, physicians, and dental hygienists. Reporting forms can be obtained from the Norwegian Dental Journal,



the online platform of the Norwegian Dental Biomaterials Adverse Reaction Unit, and the most used electronic patient record software in Norway. Details from submitted adverse reaction reports are entered into a database (Microsoft Access).

Reactions linked to resin-based materials and cements, metals/alloys, and materials for short-term use (<30 days) were monitored.

**Results** From the start in 1993 to the end of 2023 the Norwegian Dental Biomaterials Adverse Reaction Unit has received more than 2700 adverse reaction reports.

The proportion of reports related to amalgam was considerably reduced after the ban of the general use of amalgam in 2008. The proportion of reports related to resin-based materials and cements and to metal/alloys has increased accordingly after 2008. However, the general amalgam ban has not resulted in an increase in the number of reports related to these materials. The proportion of reports on materials for short-term use has generally remained stable over time.

**Conclusions** General amalgam ban in Norway was not associated with an increase in the number of reports related to resin-based materials or to the other material categories monitored.

0042

## Dust Particles of Dental Restorative Materials: Effects on Gingival Keratinocytes

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**Objectives Objective:** This investigation elucidates the biological effects of dust particles from dental restorative materials on human gingival keratinocytes (HGK). The study specifically focuses on cellular proliferation, differentiation and ECM synthesis, which are elemental for understanding the implications of dental material-derived particles on oral health.

**Methods Methods:** Dust particles from three dental composites (Admira Fusion, Filtek Supreme XTE, Ceram.x Spectra ST) were generated under standardized conditions. HGK exposure to these particles (300µg/µl) and derived eluates were analyzed by subsequent assessments of proliferation and differentiation markers Cytokeratin 1 (KRT1), Cytokeratin 10 (KRT10), Involucrin (IVL) and Filaggrin (FLG). Furthermore, the role of Fibronectin (FN) and the related signaling molecules ERK1/2, p38, and Yes-associated-protein (YAP) were analyzed.

**Results Results:** HGK exposed to dust particles showed a significant increase in fibronectin expression of up to 70-fold increase for Filtek Supreme XTE and 50-fold for Ceram.x Spectra ST, indicating enhanced cellular adhesion, cell motility and matrix synthesis. Furthermore, particle eluate exposure stimulated HGK proliferation and modulated significantly the differentiation profile, as evidenced by in part drastic changes in expression of the differentiation markers KRT1, KRT10, IVL and FLG.

**Conclusions Conclusion:** This study elucidates the impacts of dental composite-derived dust particles on gingival keratinocytes, underscoring the importance of assessing the biological consequences of dust particles from dental materials. Increased fibronectin synthesis, the promotion of cell proliferation and differentiation highlight potential tissue repair and regeneration implications. Understanding the cellular and molecular mechanisms underpinning these responses is essential for ensuring the safety and efficacy of dental restorative materials.



0043

# Biological Properties of Calcium Phosphate Based Cement With Acetylsalicylic Acid

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Objectives The aim of this study was to evaluate the biocompatibility and antimicrobial effects of a newly developed calcium phosphate cement (CPC) with the addition of acetylsalicylic acid (ASA). Methods Hydroxyapatite doped with ions of strontium, copper, and zinc (multi-ion doped HAp, miHAp) powder was obtained by hydrothermal synthesis. Characterization of miHAp was done using X-ray diffraction analysis (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray analysis (EDX). CPC was prepared by mixing calcinated miHAp with a liquid component (20% citric acid) containing three different concentrations of ASA. Five groups were studied: CPC; mineral trioxide aggregate (MTA); CPCA1 (1500 µg/g ASA); CPCA2 (3000 µg/g ASA); CPCA3 (4500 µg/g ASA). Biocompatibility was assessed on human dental pulp stem cells (hDPSCs) by MTT assay. Antimicrobial properties were evaluated by counting colony-forming units (CFUs) of Streptococcus mutans and Lactobacillus rhamnosus biofilms on material discs and in the medium surrounding discs. Results Characterization of the calcinated powder revealed particles ranging from a few hundred nanometers to approximately  $2\mu m$ , presence of Sr and Cu ions as dopants, and  $\alpha$ -tricalcium phosphate phase ( $\alpha$ -TCP) as dominant. The results of biocompatibility show that compared to medium without extracts, cell viability was higher in the presence of two concentrations of CPCA1 and CPCA2 extracts, and all concentrations of CPCA3 extracts. Antimicrobial analysis indicated significantly lower CFUs on CPCA3 and MTA discs compared to CPC for both bacterial species (p<0.05). In the medium, antimicrobial effects against both bacterial species were observed for CPC and CPCA3 ( $p \le 0.0001$ ). Conclusions Multi-ion doped cement based on calcium phosphate was successfully obtained. CPC with the addition of ASA increased cell proliferation. CPCA3 exhibited an antibiofilm effect against both bacterial species, while the antimicrobial effect was shown in the medium surrounding both CPC and CPCA3.

0045

## Clinical Evaluation of a New Simplified Shading Composite (non-Interventional Study)

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**Objectives** To evaluate the satisfaction of general dentists via a follow-up survey after completing several weeks of testing a new simplified shading composite.

**Methods** 3M<sup>™</sup> Filtek<sup>™</sup> Easy Match Universal Restorative (FEM) was tested by U.S. dentists in a 6-week invivo test phase in August/September 2023. Each participant received one bottle of each of the three product shades: Bright (15 capsules), Natural (25 capsules) and Warm (15 capsules). They were asked to use FEM in their clinical routine for various indications following the instructions for use to evaluate overall



satisfaction, handling, and performance. The feedback was then collected via a web-based questionnaire and analyzed using descriptive statistics (Minitab 20, Minitab Inc., USA).

**Results** 46 participants completed the questionnaire, and 2,490 restorations were placed, 1,017 in Anterior and 1,473 in posterior. ≥85% of the respondents were overall satisfied with handling, ease of use, ease of shade selection, shade match, shade blend/chameleon effect and ease of achieving the desired esthetic results for anterior and posterior restorations. Additional data shows that 87% would recommend FEM to a colleague. Quantified responses on 5-level point scale (coding: Very Satisfied=1, Satisfied=2, Neutral=3, Dissatisfied=4, Very Dissatisfied=5) were descriptively statistically analyzed and summarized (Median, non-parametric 1-sample sign with 95% confidence level).

**Conclusions** Dentists rated several features of 3M<sup>™</sup> Filtek<sup>™</sup> Easy Match Universal Restorative with high overall satisfaction for both anterior and posterior restorations, especially the ease of shade selection and shade matching.

Characteristics	Median, CI 95% (Anterior Restorations)	Median, CI 95% (Posterior Restorations)
Overall Handling	1.0; 1.1	1.0; 2.0
Overall Ease of Use	1.0; 1.0	1.0; 1.0
Ease of Shade Selection	1.0; 1.0	1.0; 1.0
Shade Match	1.0; 2.0	1.0; 1.1
Shade Blend/Chameleon Effect	1.0; 2.0	1.0; 2.0
Ease of Achieving the Desired Esthetic Result	1.0; 2.0	1.0; 1.0

#### 0046

## 48-Month Clinical Performance of a Restorative GLass Ionomer in NCCLs

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**Objectives** This randomized clinical trial assessed the efficacy of a restorative glass ionomer (GI) compared to a resin composite for the restoration of non-carious cervical lesions (NCCLs) of patients with systemic diseases over a period of 48 months.

**Methods** A single clinician placed 134 restorations in 30 patients with a mean age of 61.8 years having different systemic diseases. The NCCLs were restored either with a restorative GI; Fuji Bulk (GC, Tokyo Japan) [FB] or a posterior resin composite; G-ænial Posterior (GC, Tokyo Japan) [GP] used with a universal adhesive in etch & rinse mode. All procedures followed the manufacturer's guidelines. The restorations were evaluated for retention, marginal discoloration, marginal adaptation, secondary caries, surface texture, and post-operative sensitivity using modified United States Public Health Service (USPHS) criteria at baseline (1 week) and at 6, 12, 36 and 48 months. Chi-square and Dunn's tests were used for statistical



## analysis (p<0.05).

**Results** After 48 months, recall rate was 60%. Seven (18.4%) FB and 4 (13.3%) GP restorations lost retention (p>0.05). There was not any significant difference between the survival rates of FB (82.1%) and GP (89.3%). When compared to baseline, significant changes were observed in marginal adaptation, marginal discoloration and surface texture of both FB and GP restorations (*p*<0.05). However, no significant difference was seen between the groups at any evaluation periods (*p*>0.05). **Conclusions** The restorative GI and the resin composite demonstrated acceptable clinical performances in treating NCCLs of patients with systemic diseases after 48 months.

#### 0047

# Sensitivity and Bleaching Efficacy With Every Other Day Application

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**Objectives** To compare tooth sensitivity (TS) and bleaching efficacy of 16% carbamide peroxide applied daily or every other day for three weeks at home. Gingival irritation (GI) and the impact of oral condition on quality of life were also determined.

**Methods** A randomized, parallel and double-blinded clinical trial was performed. Forty-two volunteers were randomly allocated into two groups: 1) Bleaching trays containing 16% carbamide peroxide gel (Whiteness Perfect, FGM, Brazil) were used daily 2) Bleaching trays were used every each other day. All patients were asked to bleach for two hours completing for three weeks of treatment. Patients self-reported the risk and intensity of TS and GI using a visual analogue scale. The color change (CIELab  $[\Delta E^*_{ab}]$ , CIEDE00  $[\Delta E_{00}]$ , and whiteness index  $[\Delta WI_D]$ ) were assessed using a spectrophotometer and with Vita Classical and Vita Bleachedguide 3D-MASTER guides ( $\Delta SGU$ ) at baseline, and after one, two and three weeks of bleaching. The impact of oral condition on quality of life was assessed using the Oral Health Impact Profile (OHIP-14). Absolute TS and GI risk were analyzed by Fisher exact test, intensity of GI, TS and color assessments by Student t-test, and OHIP-14 by paired t-test (p<0.05).

**Results** The intensity of TS was similar for both experimental groups after one, two and three weeks of treatment, with an absolute risk higher than 80%. A significant and similar whitening effect was determined for every other day application and the daily use, for all the color parameters tested. No differences were detected regarding GI. However, an improvement in quality of life was observed for every other day regime.

**Conclusions** Although every other day application of at-home bleaching with 16% carbamide peroxide produced similar TS, bleaching efficacy, and GI than a daily regime, the improvement on the quality of life was significant.



#### 0048

## Survival in Head and Neck Cancer Patients Received Oral Examination

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**Objectives** To evaluate the overall survival (OS) and the prognostic factors of head and neck cancer (HNC) patients.

**Methods** A retrospective cohort study reviewed data from 1,310 patients with HNC who received oral examination before radiation therapy at Rajavithi Hospital between 2014 and 2020. Associations with OS were analyzed using Kaplan-Meier and Cox proportional hazard models. This study was reviewed and approved by the ethics committee, at Rajavithi Hospital.

**Results** Of these 1,310 patients, 75.6 were male, age was 56.56±12.12 years, 63.2% were smoking, 7.1% were betel quid chewing and 74.4% were at advanced stage (stage III and IV) at presentation. Five-year OS was 31.5% for all HNC cases, 32.6% for the oral cavity, 29.4% for the larynx, and 17.6% for the oropharynx. The median survival time of 41 months. Predictors of OS were recurrence (HR = 22.49; 95% Cl: 10.55-47.94) and Node III (HR = 1.70; 95% Cl: 1.28-2.27) respectively.

**Conclusions** HNC patients have poor OS, especially in the high stage. Recurrence and Node III are significant factors. These data provide important prognostic information for HNC.

## 0049

## Benefits of Recruitment Methodologies: "Passing the Baton" in Educational Research

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**Objectives** Utilizing the same oral health presentations to 4<sup>th</sup> graders that helped recruit WV families into the Center for Oral Health Research in Appalachia (R Crout et al *JDR* 94 (Spec Issue A) # 4141, 2015), a study with the same format/presenter (RC) resulted in significant knowledge acquisition to 4<sup>th</sup> graders in an elementary school in Florida (R Crout et al, NRHA, 2016). Due to lack of oral health professionals/educators in rural areas, this study will evaluate knowledge acquisition to 4<sup>th</sup> graders by a high school senior (HSS) mentored/trained by a dentist (RC) followed by the dentist/ student comparison. **Methods** A HSS was mentored/trained (RC) utilizing earlier Florida study slides/ information followed with 4<sup>th</sup> graders invited to participate at the same school. The same baseline test, was administered followed by the HSS presenting updated information. Questions included brushing/flossing behavior; tobacco products/ methamphetamine effects; when children should have a first dental visit and familiarity with the findings of the first-ever Surgeon General's Report on Oral Health including oral disease/systemic connections. Questions were Likert style (1=Strongly Disagree to 5=Strongly Agree).

**Results** Of 41 students, 38 (92.6%) filled out questionnaires. Utilizing the Wilcoxon Signed-Rank Test for statistical analysis of baseline/posttest differences, the presentation increased baseline brushing time,



reasons to brush and floss to more recommended levels in the future (p<0.05). With regard to knowledge acquisition: increased correct agreement was noted for the Surgeon General's Report on Oral Health (p<0.05), connections of oral health and systemic disease (p<0.01), tobacco/methamphetamine effects, and time for first dental visit (p<0.05). Results further revealed non-significant differences compared to the dentist (p>.05).

**Conclusions** A presentation to a 4<sup>th</sup> grade by a senior mentored/trained by a dentist effectively raised knowledge with non-significant differences compared to the dentists' presentation. Studies are currently ongoing with the past HSS mentoring/educating a younger HSS student with encouragement by the teachers/ administrators of both the Florida high and elementary schools. This approach may also be usefu in rural areas where there may be a llack of oral health professionals/educators.

# 0050

# Oral Health of Patients With Epidermolysis Bullosa - a Retrospective Study

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**Objectives** This retrospective study assessed oral health in patients with Epidermolysis bullosa (EB) compared to a healthy control group, aiming to develop tailored dental protocols.

**Background**: EB is a rare genetic skin disorder leading to blistering and scarring and is notably affecting oral health, due to limitations in mouth opening, ankyloglossia, pain during tooth brushing, and frequently fused fingers. EB is classified into four main types (EB simplex (EBS), EB junctionalis (EBJ), EB dystrophica (EBD), and Kindler EB (KEB)). This study addresses the lack of comprehensive dental treatment concepts for EB.

**Methods** Medical records and x-rays from patients with EB (n=37), including EBS (n=3), EBJ (n=5) and EBD (n=28) and EB unknown (n=1), treated at the Center for Dental Medicine at the University Medical Center Freiburg in 2014 to 2024 were analyzed and compared to a healthy control group with similar age- and gender distribution. The oral health status including DMFT/dmft analyses and following therapy, such as tooth extractions and fillings were determined. Statistical analysis was performed using Wilcoxon-Mann-Whitney test; a=0.05; STATA 17.0.

**Results** The study included 34 male and 40 female patients in total with a mean age of 11.53 years. Compared to the healthy control group, patients with EB exhibited significantly higher DMFT/dmft (p<0.0001) and more carious teeth (p<0.0001), resulting in more tooth extractions (p<0.0001), especially in severe EBD cases.

**Conclusions** The findings of this study highlight the necessity of specific dental interventions emphasizing preventive care to enhance EB patients' quality of life.



## 0051

# Effect of Oral Health Behavior on Life Cycle Age Groups

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**Objectives** This study aimed to examine the impact of oral health behavior on oral health across different age groups throughout the life cycle in Korea using 2013-2015 data from the Korea National Health and Nutrition Examination Survey (4th KNHANES).

Methods This study included 20,336 individuals aged 6 or older who participated in oral examinations. Oral health behavior variables included toothbrushing, use of oral hygiene products, regular dental visits, and not smoking. Practicing all of these behaviors was operationally defined as good oral health behaviors. Oral health status included number of natural teeth, dental caries and periodontal disease. The model also considered socio-economical, psychological, dietary, and systemic health factors. Complex sample general linear model and complex sample logistic regression analyses using SPSS Statistics 28.0 were conducted to examine the impact of oral health behavior according to life cycle age group. Results In children and adolescents, their oral health behavior variables did not have a significant effect on oral health. However, adolescents whose mothers had poor oral health behaviors were 2.95 times more likely to have dental caries than adolescents whose mothers did practice good oral health behaviors (OR 2.95, 95% CI 1.47–5.89). Adults with poor oral health behaviors were also more likely to have dental caries (OR 3.16, 95% CI 2.41-4.13) and periodontal disease (OR 2.03, 95% CI 1.53-2.69). Elderly people who practiced all good oral health behaviors were more likely to have 6.08 more existing natural teeth than the group that did not practice (95% CI 4.51-7.64).

**Conclusions** The study emphasizes that good oral health behaviors in adults not only affect their dental health but also influence the oral health of their children and adolescents. It suggests developing an integrated strategy that promotes the practice of good oral health behaviors across all generations to reduce disease burden and improve overall health.

# 0052

# Efficacy of an Experimental Toothpaste in Reducing Dentin Hypersensitivity

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Objectives To investigate the efficacy of an experimental toothpaste containing 3% polyvinyl methyl ether/maleic anhydride co-polymer (PVM/MA) + 5% potassium nitrate (KNO<sub>3</sub>), to reduce dentin hypersensitivity (DH), compared to a 3% PVM/MA only toothpaste, a 5% KNO<sub>3</sub> only toothpaste, and a regular fluoride toothpaste (negative control), following twice daily use over an 8-week period.
Methods This was a proof of principle, single-centre, 8-week, randomised, controlled, examiner-blind, parallel design, stratified clinical study in healthy subjects with sensitive teeth. At baseline, two stimuli (evaporative air and tactile) were used to assess DH and measured by Schiff Sensitivity Score and Tactile Threshold, respectively. Eligible subjects were stratified by maximum baseline Schiff Sensitivity Score of



the two selected test teeth and randomized to one of the four treatments: a 3% PVM/MA + 5% KNO<sub>3</sub> toothpaste, a 3% PVM/MA only toothpaste, a 5% KNO<sub>3</sub> only toothpaste, and a regular fluoride toothpaste. After 3 days, 2, 4 and 8 weeks of twice daily brushing with their allocated treatment, subjects returned to the site for tooth sensitivity assessments. The subject level mean change (on the two test teeth) from baseline for Schiff Sensitivity Score and Tactile Threshold, at each time point, were analysed using an analysis of covariance (ANCOVA) model on the mITT population. One hundred thirty-three subjects were screened, 120 randomized and 118 completed the study.

**Results** Statistically significant between-treatment differences were observed for both Schiff Sensitivity Score and Tactile Threshold at all time points (p<0.05), favouring the experimental toothpaste compared to the reference products (3% PVM/MA only [except Schiff at Day 3: p=0.50], 5% KNO<sub>3</sub> only, and a regular fluoride toothpaste).

**Conclusions** The experimental toothpaste was shown to be superior to a 3% PVM/MA only toothpaste, a 5% KNO<sub>3</sub> only toothpaste and a regular fluoride toothpaste in reducing (DH) over an 8-week period.

# 0053

# Evaluation of Knowledge on Antibiotics' Resistance in Undergraduate Dental Students in Albania

## <u>Stela Panteqi</u>

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**Objectives** Antimicrobial resistance (AMR) presents a global threat to public health. As dentists prescribe around 10% of all antibiotics commonly used, they are key stakeholders in combating AMR. The objective of this study is to evaluate the awareness and knowledge of last year dental students about AMR.

It aims to find out if there is a need in having additional knowledge as a supplement teaching class. This might be beneficial to other generations of undergraduate students.

**Methods** In Albania, a cross-sectional study was conducted in one of the Dental Schools using a questionnaire with open questions involving the final year dental students. More specifically, participants were asked about their knowledge on the use of antibiotics, the way of prescribing them, the level of knowledge about antibiotics resistance, as well as the desire to strengthen their knowledge about the use of antibiotics and their impact on a national and global scale.

**Results** Engaging all healthcare professionals and including undergraduate students of Dentistry to raise awareness about AMR is vital. Sharing and spreading good practice in teaching on AMR is a key motive in Albania.

A total of 148 students completed the questionnaire. They showed good knowledge about the indications of antibiotics uses in oral and dental pathologies, general knowledge about AMR and the ways that their everyday work will affect resistant infections on dentistry. They expressed the need to learn more about the risks of both infections and antibiotics to patients in dental healthcare.

**Conclusions** Antimicrobial resistance is an increasing global concern, due to increased prescription and dispensing of antibiotic drugs, mostly in developing countries. Before graduation, students should receive complete information about this problem and ways of prevention. Students were positive about the addition of an extra education training to supplement university teaching. This approach may be beneficial for other undergraduate dentistry programs.



#### 0054

# Oral-Health Knowledge of Parents and Children Attending Nice Dental Hospital

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**Objectives** The aim of this study was to describe oral health knowledge of parents and children in Nice Dental Hospital to implement an oral health promotion strategy.

**Methods** A sample of parents and children, volunteers, attending the Nice Dental Hospital for one week (Week 14, 2024), were invited to fill in a form concerning childhood and oral health, in a face-to-face mode. Statistical analyses were conducted thanks to Fisher's exact test.

**Results** A total of 24 parents and 63 children (25 aged 3-6 and 38 aged 7-14) filled in the form. 44% of children were female. Concerning the frequency of brushing, the youngest children thought it was necessary to brush one's teeth once (32%) or twice a day (64%), whereas the oldest thought it was recommended to brush one's teeth once (15.8%), twice (31.6%) or three times a day (52.6%). Almost all parents thought that the correct brushing frequency was twice a day (96%) (p<0.0001). The older children knew soft bristle toothbrushes (84.2%) were the best choice and most of them tended to know the benefits of fluorides (68.4%). Half of them thought they should only consult their dentist in case of pain. One third of parents thought they had to take their child for a first dental visit at 6 years. Over 33% considered fluorides were not recommended before 3 years of age. Only 41.7% of parents knew it was necessary to clean their child's teeth as soon as the first tooth appeared. No parent was able to cite sealants as a mean of preventing dental decay.

**Conclusions** Parents and children in this sample had globally poor oral health knowledge. Confusion regarding dental attendance (first visit and reason for consultation) or fluoride use suggests that these items require particular emphasis in oral health promotion program.

0055

## Discussion About Oral-Health During Medical Monitoring of Pregnancy in France

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**Objectives** The preventive maternity oral health check-up is a French scheme that is entirely free of charge for pregnant patients between the 4th month of pregnancy and the 6th month after giving birth. Preventive dental care is crucial during pregnancy. The aim was to conduct an epidemiological study to assess the use of preventive maternity oral health check-up and the factors that might influence this use, thanks to discussions with the perinatal care professional in charge of medical monitoring of pregnancy. **Methods** An anonymous electronic questionnaire dealing with oral health and prevention was proposed to 257 pregnant women in the Centre Hospitalier Universitaire de Nice or midwifery practices. The study protocol was approved by the Research Ethics Committee of the Cote d'Azur University. A logistic



regression was conducted.

**Results** Only 37.2% of pregnant women actually used the preventive maternity oral health check-up. Univariate analyses showed that patients who had discussed their oral health with their perinatal care professional, consulted their dentist significantly more often during pregnancy than those who had never discussed this issue during a prenatal consultation (p<0.001). Patients who were used to visit their dentist regularly before pregnancy, for dental care or regular check-ups made greater use of the preventive maternity oral health check-up (p<0.001). Logistic regression revealed that oral health was significantly more frequently discussed during pregnancy follow-up for patients who were used to visit their dental practitioner once a year or more (p<0.001).

**Conclusions** A lack of take-up of the free preventive prenatal oral health check-up has been noted. It seems that the perinatal care professional in charge of medical monitoring of pregnancy does not spontaneously address the patient's oral health. There is a need for oral health acculturation among gynecologists and midwives.

## 0056

# Prenatal and Genetic Determinants of Third Molar Agenesis

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**Objectives** Third molar agenesis (M3A) research may provide a better understanding of the etiology of craniofacial and dental development. We aimed at investigating determinants of M3A, including prenatal factors, ancestral background and genetic factors in the context of a genome-wide association study (GWAS).

**Methods** We included 4487 participants (mean age 13.62 years) from the Generation R study, a multiethnic population-based cohort. Orthopantomographs were assessed for M3A. Maternal smoking and alcohol consumption during pregnancy were assessed using questionnaires. Ancestral background was established using admixture analysis. The association between prenatal factors and M3A was analyzed with binary and multinomial logistic regression corrected for confounders. GWAS was conducted in a subset genotyped using microarrays and imputed to the 1000 Genomes Project panel (N=4192; 825 M3A cases) with a linear mixed modelling approach using SAIGE.

**Results** The prevalence of M3A was 19.7%; comprising the M3A of only mandible (N=286, 32%), maxilla (N=266, 30.2%) or both jaws (N=333, 37.8%). Maternal smoking (p=0.35) and alcohol consumption (p=0.74) were not significantly associated with M3A. Children of sub-Saharan African ancestry had significantly lower prevalence of M3A (9.3%) compared to European (20.8%) and Asian (19%) ancestries. African ancestry was significantly associated with M3A in the mandible and in both jaws, but not in the maxilla (OR=0.27, 95%CI:0.13-0.58, OR=0.19, 95%CI:0.08-0.44, OR=0.70, 95%CI:0.39-1.23). GWAS identified two variants at genome-wide significant levels (P<5x10-8). The top-associated variants with common minor allele frequency (MAF) mapped in the vicinity of *CACNA1S/ASCL5* (rs10920121, MAF=0.43, OR=1.46, P=3.56×10-11) and *TEX37/FOXI3* (rs6759657, MAF=0.19, OR=1.51, P=3.69x10-9). **Conclusions** We found no evidence supporting the involvement of prenatal environmental factors in M3A. The prevalence of M3A is higher in children of European ancestral background. We report two variants in



the vicinity of genes previously associated with tooth agenesis, suggesting M3A and hypodontia share a common genetic background.

#### 0057

## Possible Role for IRF6 in the Development of Neural Crest-Derived Palate

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**Objectives** The fact that TFAP2A activates IRF6 in orofacial epithelial tissue via the enhancer MCS-9.7 containing a risk single nucleotide polymorphism (SNP) for orofacial clefting has long been known (Rahimov et al. 2008). Given that TFAP2A is a bona fide marker for neural crest cells, we speculated that the TFAP2A – IRF6 axis is also important for proper development of neural crest-derived orofacial tissue. **Methods** For luciferase assays, the neural crest-derived cell line Neuro-2A was transfected in triplicates with a reporter plasmid containing MCS-9.7 upstream of a minimal promoter and expression plasmids for effectors under control of CMV enhancer/promoter. 24 h after transfection, cells were harvested and luciferase activity was measured. Controls with empty expression vector were set to 1. Mouse embryos were fixed in 4% paraformaldehyde, dehydrated and embedded in tissue freezing medium at -80°C. 10 μm sections were stained by immunofluorescence with antiserum directed against Irf6. A mouse cranial neural crest cell line was used for quantification of Irf6 transcripts.

**Results** Transcription factors expressed in neural crest tissue could activate the Irf6 enhancer MCS-9.7. Antiserum directed against Irf6 could detect Irf6 protein in mouse embryonic neural crest-derived palate tissue. Irf6 transcripts were detected in a cranial neural crest cell line.

**Conclusions** Irf6 is also expressed in neural crest-derived palate tissue. Therefore, neural crest-related phenomena should be considered as possible disease-causing mechanisms of risk SNPs for orofacial clefts related to IRF6.

## 0058

## Effect of Different Tablets With Zinc Lactate on VSC

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**Objectives** To assess the efficacy of two sugar-free tablets of different weights containing the same quantity of zinc lactate on oral VSC for 2 hours versus placebo.

Methods Eligible participants had to have at least 24 teeth, no oral or systemic diseases, no removable dentures. They had to avoid professional oral hygiene and drugs for two weeks, brushing teeth, smoking, assuming alcohol, coffee, tea, onion, garlic, licorice for six hours before the test. They had to score the basal measurement of VSC ≥75 ppb. Subjects were randomly assigned to the groups. The test tablets contained 0.51mg zinc lactate, but they were in two different weights (0.7g or 1g); the placebo tablet was 1g without zinc. The OralChroma2<sup>®</sup> device was utilized to measure the oral VSC at baseline, after sucking one tablet and after 30 minutes, 1 hour and 2 hours. Data were analyzed with SPSS.



**Results** 90 subjects completed the trial (30 in each group). None reported problems linked to the assumption of zinc lactate. The mean reductions of total VSC from baselines at the end of tablets sucking, after 30 minutes, 1 hour and 2 hours were statistically significant in all the test groups but not in the control group as shown in Table I. The comparisons between each test group and the control group showed a statistically significant difference for reductions at the end of the sucking period (p<0.005), after 30 minutes (p<0.001), after 1 hour (p<0.001) and after 2 hours (p<0.01), no statistical difference was reported between the test groups at any time.

**Conclusions** Tablets containing the same dose of zinc lactate, even with different weights, can statistically significantly reduce the oral VSC levels immediately and for over 2 hours. Moreover, all test tablets reduce oral VSC significantly more than placebo over time.

Time	Control	Test 0.7g	Test 1g
baseline	123±36	130±49	122±50
after Ts*	73^±34	45^±40	44^±32
after 30 minutes	114^±37	61^±48	60^±40
after 1 hour	117±35	83^±55	82^±45
after 2 hours	118±42	101^±61	91^±51

VSC (ppb) at different times within the groups

\*After tablet sucking. ^Mean statistical significance from baseline (p<0.001) intra-groups (paired T-test)

0059

# Patient and Clinician Awareness of MRONJ in Intravenous Anti-Resorptive Therapy.

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**Objectives** Intravenous antiresorptive therapy is a commonly used treatment modality in the management of breast cancer and metastatic bone disease. Medication-related Osteonecrosis of the Jaws (MRONJ) is a potentially debilitating oral health-related complication of this therapy. This study aimed to evaluate patient and clinician understanding of oral health requirements for those undergoing this therapy. Subsequently, an information leaflet outlining these risks, specifically MRONJ, was formulated for dissemination.

**Methods** This cross-sectional study comprised two questionnaires targeting patients and clinicians respectively, adapted from pre-existing questionnaires. Following face validity, all patients with breast cancer or metastatic bone disease due to commence treatment with intravenous bisphosphonates or denosumab in Cork University Hospital in Ireland were eligible, in addition to clinical staff involved in their care. Data collection was undertaken over a predetermined four-month period. The information leaflet



was then drafted, modelled on pre-existing ones used in other institutions.

**Results** A total of 105 patient responses were recorded. The majority (n=91) were breast cancer patients with 38.1% (n=65) reporting metastases, most frequently (n=25) to bone. 41.9% (n=44) of patients were aware of MRONJ, with the information primarily communicated via the oncology team (43.18%). 98% (n=103) supported development of an information leaflet. Chi-square tests assessed the correlation of MRONJ awareness and demographic factors, with a statistically significant association demonstrated with a higher level of education (p=0.017, 95% Cl). 11 responses were recorded among clinicians therefore descriptive analysis alone was performed. All clinicians reported awareness of MRONJ but none currently use an information leaflet to communicate this risk.

**Conclusions** This study highlighted deficiencies in both communication and awareness of MRONJ. Among patients, support for an information leaflet was clearly demonstrated. Furthermore, a majority of clinicians (n=6) were unaware of guidelines surrounding MRONJ, suggesting support for further education. Following formulation and implementation of the information leaflet outlining these risks, a future followup study ascertaining its effectiveness may prove beneficial.

## 0060

## Evaluating Oral Precancerous and Cancer Knowledge Among Tirana Dentists and Hygienists

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**Objectives** Early detection is the most effective way for survival and reduced mortality in the case of oral cancer.Dentists and dental hygienists play a key role in early diagnosis. The aim of this study was to evaluate the knowledge of dentist and dental hygienists regarding early detection of oral cancer and precancerous lesions, risk factors.

**Methods** A cross-sectional study was conducted by using a questionnaire was among 300 dental practitioners and hygienists, selected randomly. The purpose of the questionnaire was explained. The questionnaires were distributed by the researchers between September 2023 and December 2023. Despite general information, such as gender, education, qualifications the questionnaires pointed, information on the level of knowledge about risk factors for precancerous lesions, and oral cancer the ability to identify suspected lesions, methods of diagnostics. At least one year of work experience in the current position was a criterion for eligibility to be included in the study.

# Results

The study shows that the information of dentists and dental hygienists about precancerous lesions and oral cancer is mostly based on knowledge obtained during university studies. Training courses and continuing education seems to be an essential strategy to increase and maintain knowledge about oral potentially malignant disorders.

The developments of aesthetic dentistry and implantology have caused attention to be overlooked by these pathologies. In cases of obvious suspicious lesions, the patients are referred to the University Hospital Center where all data is gathered at the Albanian Cancer Registry

**Conclusions** Nowadays, oral cancer represents an enormous global issue. According to the latest WHO data published in 2020 Oral cancer Deaths in Albania reached 90 or 0,31% of total deaths. In Albania, as in many other countries of the world, cancer represents a growing concern. Although several efforts to



control cancer are underway, oral cancer in Albania is often detected in the later stages. Cost limitations, inadequate technology, and insufficient training of medical personnel for widespread screening measures have severely limited oral cancer screening in Albania. Dentists and dental hygienists should be involved in prevention policies, diagnosis and follow -up.

## 0061

## SARS-CoV-2 Salivary Viral Load: a Critical Review

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**Objectives** Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) salivary viral load when patients are incubating the virus, asymptomatically or symptomatically infected, can theoretically lead to contamination of the dental operatory during dental procedures leading to transmission of infection. It is, therefore, important to review the literature on the level of detection of SARS-CoV-2 in saliva and compare this to nasopharyngeal swabs to understand the risk for public health.

**Methods** Systematic literature search was conducted across multiple scientific servers including PubMed, MEDLINE, Science Direct, and Google Scholar from 2019 to 2023. This was followed by manual screening of all reference lists of the included studies. Quantitative studies utilizing real time polymerase chain reaction (qPCR) and antigen testing to detect SARS-CoV-2 in saliva were included. Critical appraisal and bias assessment were conducted using the relevant Joanna Briggs Institute tools.

**Results** Out of 2588 studies, a total of 37 studies were relevant, 25 used general probes for SARS-CoV-2 and 12 used specific probes for the different variants of concern. Out of the total number, 20 studies compared the viral load of SARS-CoV-2 in saliva and nasopharyngeal swabs. The cycle threshold (Ct) values ranged between 24-34 for saliva and 20-34 nasopharyngeal swabs. Furthermore, in 12 studies, the Omicron variant, showed the highest salivary viral load during the first stage (0-3 days) of symptomatic infection, with mean Ct value of 21 (ranging from 17 to 27).

**Conclusions** Salivary SARS-CoV-2 viral load is like nasopharyngeal swabs with Omicron variant exhibited the highest salivary viral load. These findings highlight the importance of adhering to best practice of infection prevention and control to prevent infection transmission in the dental operatory during aerosol generated procedures (AGPs).

0062

# EBV Seroprevalence and Salivary Viral Load in Oral Lichen Planus

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**Objectives** Oral lichen planus (OLP) is a chronic inflammatory condition of the oral mucosa with suspected autoimmune origins. Epstein-Barr virus (EBV) has been implicated in autoimmune diseases due to its ability to modulate immune responses. This study aims to investigate the association between EBV serological markers, viral load in saliva and OLP clinical severity.

**Methods** 24 OLP patients who visited RSU Clinic of Oral Medicine, RSU Institute of Stomatology during 17.06.2021- 02.03.2023 were included in the study. Demographic data and clinical characteristics of OLP



were recorded. Serum samples were collected and EBV-specific IgG and IgM class antibody levels were measured using ELISA. Virus-specific genomic sequences were detected in DNA samples isolated from saliva by real-time PCR. JMP17 and GraphPad Prism9 were used to analyse correlation between levels of IgG and IgM class antibodies, EBV load in saliva and clinical parameters

**Results** EBV-specific IgG class antibody level surpassed the upper detection limit (>750 IU/ml), suggestive of past EBV exposure or persistent infection in 9 (37.5%) patients. In almost all patients except one virus-specific IgM class antibody level was below detection threshold (<10 IU/ml), indicating absence of acute infection or reactivation of persistent EBV infection. EBV load was detected in 17 (70.8%) OLP patients saliva samples and in 6 it was >10<sup>5</sup> copies/ml. Out of those 6 patients, 5 with high EBV load in saliva had elevated IgG antibody levels in blood serum and 80% had reticular form of OLP. Histopathology showed dense lymphocyte/macrophage accumulation beneath mucosal epithelium, epithelial cell apoptosis, vacuolar damage in lower mucosal layers, and basal layer degeneration, suggesting viral infection.

**Conclusions** Our findings suggest a potential association between EBV infection and OLP. Elevated EBV IgG class antibody levels and presence of viral genomic sequences in saliva indicates that EBV could be involved in pathogenesis of OLP through immune dysregulation.

## 0063

# **Oral Potentially Malignant Disorders and Their Therapeutic Modalities**

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**Objectives** The aim of this study was to investigate potentially malignant oral disorders, including leukoplakia, erythroplakia, oral lichen planus, oral candidiasis (mainly chronic), and actinic cheilitis, and their propensity for malignancy. The study aimed to explore novel techniques and treatments for managing these precancerous lesions and conditions.

**Methods** A comprehensive search for articles pertaining to the oral potentially malignant disorders and their therapeutic modalities was conducted for the review. The study was prepared according to PRISMA guidelines 2020. The literature search encompassed databases including PubMed, Web of Science, Medline, Google Scholar, and Elsevier's EMBASE. Over twenty-five articles were eligible for the study, dating from 2019 to 2024. Factors considered included website reputation, author expertise, information currency, alignment with reputable sources, and specific selection criteria.

**Results** Females predominated in leukoplakia (69.44%), erythroplakia (54.23%), and oral lichen planus (74.89%), while males were more prevalent in oral candidiasis (52.25%) and actinic cheilitis (62.99%). Therapeutic management, including corticosteroids and immunomodulatory agents, was common for oral lichen planus and candidiasis. Surgical interventions like excision, cryosurgery, and laser therapy were prevalent for leukoplakia, erythroplakia, and actinic cheilitis. The likelihood of malignancy varied: leukoplakia (7.27%), erythroplakia (91%), oral lichen planus (1.40%), oral candidiasis (18.35%), and actinic cheilitis (20%).

**Conclusions** The study identifies gender disparities in oral conditions, with females having higher prevalence in leukoplakia, erythroplakia, and oral lichen planus, possibly due to gender-specific susceptibility or hormonal influences. Conversely, males exhibited higher rates of oral candidiasis and actinic cheilitis, suggesting potential behavioral or biological factors. Treatment approaches varied, with



medications favored for lichen planus and candidiasis, while surgical interventions were common for leukoplakia, erythroplakia, and actinic cheilitis. Further research is needed to understand the underlying mechanisms and clinical implications of these gender differences.

0064

# Role of EBV in the Pathogenesis of Oral Lichen Planus

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**Objectives** Oral lichen planus (OLP) is a common chronic inflammatory non infectious disease with an uncertain etiology, predominantly affecting 1-2% of the adult population, particularly women over 40 years old indicating a higher prevalence in females. Rates of malignant transformation of OLP range from 1 -5% over a 10-year period. Epstein-Barr Virus (EBV), a prevalent herpes virus, affects over 90% of individuals worldwide before the age of 20. This study aims to elucidate the potential role of EBV in the pathogenesis of OLP and and its potential diagnostic and therapeutic implications.

**Methods** This review includes observational studies investigating the relationship between EBV and OLP, involving patients with OLP and control groups. Online databases (PubMed, Scopus, Research gate, Science direct and Google Scholar) were searched from date of inception till date. Eligible studies confirmed OLP diagnosis histopathologically and were available in English. Studies focusing solely on skin lichen planus involvement with viruses were excluded.

**Results** Analysis of twelve studies (out of total 25 studies) revealed varying rates of EBV positivity among OLP patients and healthy controls. EBV positivity in 969 OLP cases ranged from 6% to 82%, totaling 379 cases (average: 41.3%). Among healthy individuals, EBV positivity ranged from 0% to 21.1%, with 77 cases (average: 12.5%). These findings suggest a potential association between EBV and OLP, necessitating further investigation into EBV's role in OLP etiology and pathogenesis.

**Conclusions** In conclusion, this review highlights the potential association between Epstein-Barr Virus and oral lichen planus. Rates of EBV positivity among OLP cases varied widely but EBV positivity was consistently higher among OLP patients than in the control groups, suggesting a potential link between EBV and OLP pathogenesis. Further research is warranted to elucidate the role of EBV in OLP development, which may have implications for diagnostic and therapeutic approaches.

0066

# Capnocytophaga Detection at Species Level During Pregnancy Using MALDI-TOF MS

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**Objectives** Although the genus oral *Capnocytophaga* may increase their proportional growth in relation to hormonal changes and can lead to serious inflammations and adverse effects during pregnancy, the prevalence of those organisms among pregnant women is not thoroughly examined. This study aimed to determine the distribution of human *Capnocytophaga* at the species level using MALDI-TOF MS. **Methods** Subgingival *Capnocytophaga* isolates originated from 28 generally healthy and periodontitis-free pregnant women who were clinically three times during the pregnancy and two times after delivery. All



isolates were preliminarily identified at the genus level based on phenotypic tests, then further examined with MALDI-TOF MS (Bruker Daltonics, Bremen, Germany) using the Microflex LT instrument and MALDI Biotyper software version 3.1. The specific cut-off scores were used to determine the genus level (1.700-1.999) and species level (≥2.000) identification.

**Results** Out of 780 isolates, 351 (83.18%) were identified at the species level. The highest peak of the *Capnocytophaga* populations was at the second trimester (98 isolates), where MALDI-TOF MS identified 86.7% of them at the species level. *C. ochracea* was the most identified species in all five visits (76%), followed by *C. sputigena* (5%), *C. haemolytica* (2%) and *C. granulosa* (1%).

**Conclusions** With the assistance of MALDI-TOF MS, the prevalence and distribution of *Capnocytophaga* species can be detected easily during pregnancy. C. *ochracea* in subgingival plaque was a common finding during pregnancy.

## 0067

# PMA-QPCR to Quantify Viable Cells in Disinfectant-Treated Oral Biofilms

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**Objectives** Conventional qPCR amplifies DNA from viable and dead cells, which can lead to an overestimation of live bacteria. The addition of propidium monoazide (PMA) to samples prior to DNA extraction inhibits DNA amplification from membrane-compromised cells. In this study, we evaluated the PMA-qPCR method to distinguish between viable and dead cells in oral multispecies biofilms treated with chlorhexidine (CHX) and sodium hypochlorite (NaOCl). The cell counts obtained by PMA-qPCR were compared with those obtained by culture.

**Methods** Experiments were performed with biofilms consisting of *Actinomyces oris*, *Fusobacterium nucleatum*, *Streptococcus oralis*, *Streptococcus mutans* and *Veillonella dispar* grown under anaerobic conditions for 64 h. Two different disinfectant procedures were applied: biofilms were either immersed in 0.2% CHX or 3% NaOCl for 2 min before cell harvest at the 64-h time point, or they were treated six times with the disinfectants for 2 min during growth at specific time points (16.5 h, 20.5 h, 24.5 h, 40 h, 44 h and 48 h). Six biofilms were analyzed for each treatment and control group (0.9% NaCl) by culture (CFU) and qPCR from samples with or without 50 µM PMA.

**Results** A good correlation was observed between bacteria counts estimated from culture and PMA-qPCR in the control biofilms and mature biofilms treated once with 0.2% CHX for all species, except for *F. nucleatum*, where PMA-qPCR detected significantly more bacteria than culture. Single treatment of biofilms with 3% NaOCl and six-fold exposure of biofilms to disinfectants resulted in no viable cell detection by culture. However, PMA did not completely inhibit PCR amplification in most samples. **Conclusions** PMA-qPCR suggested the presence of intact but not cultivable *F. nucleatum* cells in biofilms. In samples with disinfectant-killed bacteria, complete elimination of PCR signals using PMA remained a challenge. Limits of quantification and detection for PCR assays can help evaluate background PMA-qPCR signals.



#### 0434

# Metagenomic Analysis of Microbiota in Healthy Dental Pulps

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**Objectives** This study aims to contribute to clarify the definition of a bacteria-free dental pulp by performing a 16S rRNA gene-based metataxonomic analysis of the pulp tissues of impacted sound teeth presenting no clinical symptoms and no carious lesions or fissures.

**Methods** Specimen of the coronal pulp and outer radicular dentin of impacted mandibular third molars, as well as negative control samples were collected in 20 patients. DNA was extracted from pulp samples spiked with a known number of environmental bacteria not found in the human microbiome, for quantification purposes. Bacterial DNA content was assessed through metataxonomic analysis, based on the sequencing of the V3-V4 region of the 16S rRNA marker.

Results Bacterial DNA was present in all specimens of healthy pulp, but human DNA represented the bulk of the total DNA extracted. The three sample types exhibited substantial similarities, sharing sixteen genera across pulp, dentin and negative controls specimens. When considering the variability in inter-individual microbiota, certain species and genera demonstrated significantly higher abundance in the pulp compared to the corresponding dentin or negative control samples. *Finegoldia magna* and *Fusobacterium nucleatum*, both well-known oral species, were found to be enriched in dental pulp relative to outer radicular dentin alone or to the combination of dentin and control samples.
Conclusions The present study confirmed the presence of bacterial DNA in all specimens of healthy pulps collected from pristine teeth. Because of the low bacterial DNA burden in the pulp tissue, the inclusion of multiple negative controls and DNA quantification are of upmost importance when studying dental pulp disease using metagenomic methods. The assessment of the pulpal microbiome is a complex

0068

## Educational Effect of Edentulous Model of Hard and Soft Tissues

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matter that warrants further investigations.

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**Objectives** When educating dental students on prosthetic treatment of edentulous patients, anatomical structure of hard and soft tissues in the oral cavity must be understood. However, learning the submucosal structures using commercially available edentulous models is challenging, making them inadequate as educational tools. Therefore, we developed a novel edentulous model that combined hard and soft tissues, which allowed students to remove the mucosa to visualize the submucosal structures. This study aimed to clarify the educational effects of the new edentulous model.

**Methods** In total, 137 dental students (76 males, 61 females) were randomly divided into two groups: 68 and 69 students using the new model (group N) and conventional model (group C), respectively. Following a pretest, a lecture about the structure of the edentulous mucosa and submucosa using the assigned



model was conducted; a post-test followed. The students also evaluated the effectiveness of the models in understanding the structure of the mucosa and submucosa using a 10-point scale. Student's t-test was performed to compare the students' evaluation scores between the two groups ( $\alpha = 0.05$ ). This study was approved by the Ethics Committee of Tokyo Dental College (#1014).

**Results** The average correct answer rates of pre- and post-test of group N were 57.4%  $\pm$  22.2% and 85.4%  $\pm$  21.7%, respectively, and those of group C were 54.2%  $\pm$  23.4% and 79.7%  $\pm$  25.2%, respectively. After the lecture, the average correct answer rate of the submucosa structures and students' evaluation score in group N were 85.9%  $\pm$  7.0% and 9.3  $\pm$ 1.4 points, respectively, and in group C, the values were 72.3%  $\pm$  7.2% and 8.5  $\pm$  1.9 points, respectively. The students' evaluation scores were significantly different between the two groups (P = 0.008).

**Conclusions** These findings suggest that the new model is suitable for teaching mucosal and submucosal structures.

# 0069

# Different Ways of Assessing Empathy Among Dental Students in Nice

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**Objectives** Empathy is a core element in the practitioner-patient relationship. This study examined whether there was a correlation between different ways of assessing empathy among dental students in Nice.

**Methods** Two repeated cross-sectional studies were conducted on all 4th year dental students in the faculty of dentistry in the Cote d'Azur University, before the beginning of their clinical activity, in both 2022-2023 (n=48) and 2023-2024 (n=60) academic years. After obtaining their consent, the students completed a socio-demographic questionnaire. Then they underwent two successive simulated consultations (OSCE): OSCE1 dealing with an excessive demand of antibiotics and OSCE2 dealing with an aesthetic request. The hetero-evaluation of empathy was obtained by the teacher using the OSCE grid (score out of 20) and by the simulated patient using the Consultation And Relational Empathy measure (score out of 50). Then, students filled out a self-assessment concerning their attitude on empathy (Jefferson Scale of Physician Empathy Student Version, JSPE- MS), they also submitted to Economic games (experimental tasks) aiming at revealing the "social preferences" of the participants. We used the Pearson correlation and the Student t-test.

**Results** CARE and OSCE scores were strongly correlated (r=0.597; p<0.001). Students in the 2023-2024 class had a higher Jefferson score (r=0.472; p<0.001) and OSCEs scores than those in the 2022-2023 class (r= 0.637; p<0.001). Economic Games were correlated with each other, but not correlated with other measures of altruism (Jefferson and OSCEs). There was a significant increase in the Jefferson score between the two promotions (t-test, t=-3.812, p<0.001) (102.53 for 2022-2023 compared to 113.607 for 2023-2024).

**Conclusions** The different ways of assessing empathy are not necessarily correlated, which justifies multiplying approaches in order to better understand all its aspects.





## 0071

## The Guidance of CBCT in the Interdisciplinary Orthodontic-Surgical Diagnosis

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**Objectives** To evaluate the utilization of the 3D imaging modality of CBCT compared to the 2D conventional radiography to improve the diagnosis and outcomes of the treatment procedures. **Methods** The clinical cases presented with functional and aesthetic issues related to impacted teeth in our university clinic are evaluated first from the panoramic radiography and when it was not sufficient for the clinical assessment, diagnosis, risk compilations and treatment options we have chosen the CBCT as a supplementary method to use as a guidance to gather all the valuable data related to orthodontic-surgical management of the cases.

**Results** 3D imaging (CBCT) provides complementary information for the localization of impacted teeth, presence of supernumerary teeth, root morphology, and angulation, proximity to the vital anatomical structures of the jaws and alveolar boundaries and also the presence and localization of jaw cysts. **Conclusions** The management of interdisciplinary cases is often complex and requires accuracy in the clinical evaluation, diagnosis, and treatment planning. In all cases, the guidance of CBCT was efficient in diagnosis, choosing the right treatment option and successful outcomes.

# 0072

## Artificial Intelligence Classifies Ceramic Crown and Natural Teeth

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**Objectives** The realization of artificial intelligence (AI), which uses digital devices to capture pictures of the mouth and obtain information about prosthetic devices and oral health, will make people more interested in oral health. This study aimed to explore the possibility of the basic technology of AI classification of prosthetic devices and natural teeth, with a view to the social implementation of such AI. This study clarified the possibility of AI, especially convolutional neural networks (CNN), to classify between porcelain fused to zirconia crown (PFZ) and natural teeth.

**Methods** Four intraoral photographs were collected from a patient whose maxillary incisor was treated on both sides with PFZ. Of these, two intraoral photographs, the right side and front view, were divided into 24-pixel squares to obtain 26,774 images. From these image data, 1,000 and 113 pieces of training and validation data for the PFZ, natural teeth, and other oral parts, respectively, were randomly selected and used for CNN training.

This CNN model consisted of two convolutional, two max-pooling, and two fully connected layers based on the LeNet architecture. Intraoral photographs (left side and front views) different from those used in the



training, divided by 24 pixels, were classified into the PFZ, natural teeth, and other oral parts using the trained CNN. The classified results were reconstructed as images such that the PFZ was red, the natural teeth were cyan, and other oral parts were green.

**Results** The maxillary incisors on both sides of the two reconstructed right and front images are shown in red, indicating the PFZ; most of the areas corresponding to the natural teeth were colored cyan. **Conclusions** It was concluded that AI can discriminate between PFZ and natural teeth.

## 0074

# Influence of Model Resins on 3D Printed Dental Models' Accuracy

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**Objectives** The advantage of open 3D printing systems is that the printer can not only use the material supplied by its manufacturer but is also compatible with materials from other companies. This study aimed to evaluate the influence of different model resin materials on the printing accuracy of an open-system 3D printer.

**Methods** A maxillary typodont model with partial edentulism and four prepared teeth (#17, #14, #11, #26) was chosen to generate a reference STL file. Sixteen half-ball markers were placed on the model as landmarks for the superimposition and point-based measurements. A hollow model was designed with a cross-arch plate base in 3Shape Model Builder software. The models were printed using an open system DLP printer Asiga Pro 4K80 with 50 µm layer thickness oriented with a 30-degree build angle. Four available model resin materials were selected: Asiga DentaMODEL Almond (AS), Dreve FotoDent Model2 (DR), Harzlabs Dental Model Gray (HL), and Pro3Dure Printodent GR13.1 (PD) (n=10). Models were post-processed according to the manufacturer's instructions. The models were scanned with a Vinyl Open Air desktop scanner and imported into Geomagic Control X software to assess the trueness and precision of the printed models. Whole deviation and linear measurements of distances between the reference points were used to determine the accuracy of the 3D printed models expressed in root mean square (RMS) values.

**Results** According to our preliminary results, measurements of the printed models demonstrated deviations from the reference model. Trueness results of whole deviation are the following (mean, min., max.): AS 219,3 μm (195,3; 239,9), DR 187,9 μm (163,4; 199,4), HL 164,8 (156,4; 180,2), PD 249,0 μm (186,0; 317,8).

**Conclusions** The type of model resin material can influence the printing accuracy of an open-system 3D printer, Asiga Pro 4K80.

0075

## Robustness Evaluation on Rotated Anterior Tooth Image of CNN Model

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**Objectives** Deep convolutional neural networks (CNN) have achieved breakthrough success in image classification. However, the standard CNN model is not invariant to image rotation. In the task of detecting realistic images of the oral cavity, the dentition is not always positioned horizontally. Therefore, the recognition performance of a CNN may deteriorate depending on the degree of image tilt. This study aimed to evaluate the robustness of a standard CNN for rotating images of the anterior dentition. **Methods** In this study, 510 images of anterior teeth were collected from the web. In all images, the maxillary anterior teeth were in the upper part and the tooth dentition was in the horizontal direction (normal image). The images were randomly divided into 360, 50, and 100 images for training, validation, and evaluation, respectively. A 180° rotated image was created from all images (rotated image). Furthermore, the images were created by rotating the evaluation image from 5°–355° in 5° increments. A CNN model was built consisting of two convolutional, two max-pooling, and two fully connected layers based on the LeNet architecture to classify the normal and rotated images.

**Results** Training and validation were performed using normal and rotated images. Thus, 96% of the evaluated normal, and rotated images were correctly classified. The trained CNN was used to classify the evaluation-rotated images from 5°–355° in 5° increments. This trained CNN classified more than 90% of the 5°, 10°, 345°- and 355° rotated images as normal. More than 90% of the images rotated from 170°–200° were classified as rotated.

**Conclusions** The classification accuracy of over 90% of rotated images of the anterior dentition using a standard CNN was within approximately  $\pm 10^{\circ}$  of the rotation angle.

## 0076

## Margin Quality, Homogeneity, and Porosity Assessment of Fiber-Reinforced CAD/CAM Composite

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**Objectives** The aim of this study was to evaluate the margin quality of anterior crowns made of experimental short fiber-reinforced CAD/CAM composite (SFRC CAD) block before and after cyclic fatigue aging. Moreover, to investigate the chemical microstructure, homogeneity, and porosity of the SFRC CAD in comparison with other commercial CAD/CAM materials.

**Methods** 40 anterior crowns were milled from five CAD/CAM blocks divided into five groups (n=8/group). The first group made of lithium disilicate ceramic blocks (IPS e.max CAD, IVOCLAR), the second made of zirconia-reinforced lithium disilicate blocks (Celtra Duo, Dentsply Sirona), the third made of hybrid polymer-infiltrated ceramic network blocks (VITA ENAMIC, VITA Zahnfabrik), the fourth made of hybrid nanoparticle-filled resin blocks (Cerasmart 270, GC), and the last made of SFRC CAD blocks. Crowns were inspected with stereomicroscope and margins discrepancies were measured. Specimens were scanned using micro-CT system to investigate the porosity and homogeneity. The same crowns were subjected to cyclic fatigue aging (120,000 cycles, Fmax=220 N) and margin discrepancies were measured again. SEM/EDS and XPS analyses were employed. Margin quality data were statistically analysed using



## two-way ANOVA.

**Results** SFRC CAD group resulted in the least margin discrepancies compared to other groups before and after cyclic fatigue aging test, while IPS e.max group resulted in the highest margin discrepancy values (p<0.05). Micro-CT scanning revealed a homogenous distribution of the fillers of the tested materials with low porosity. After cyclic fatigue aging test, the SFRC CAD crowns have the highest survival rate, followed by IPS e.max, while none of the VITA ENAMIC group crowns have survived the whole fatigue aging cycles. **Conclusions** Material type and fatigue aging can significantly affect crown margin quality, with hybrid and resin-based groups resulted in better margin quality than ceramic-based ones. All tested materials have homogenous structure with extremely low porosity.

#### 0077

## Influence of the Heat Treatment on SLM-Manufactured Clasps' Deformation

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**Objectives** Many studies have assessed the effect of the printing angle of the RPD framework on the deformation or other mechanical properties using selective laser melting technique. Only few studies focus on the influence on the clasp. Even if the framework is printed at the optimal angle, each clasp at different positions of the framework may not necessarily follow the optimal angle. The purpose of this study is to reduce the deformation defects caused by the printing angle via designing supporting structures.

**Methods** The rest seat and guide plane were prepared on a model tooth. The model was scanned and the clasp was digitally designed. To allow accurately measuring the deformation, a flat plate was added to the proximal plate. The clasp was manufactured with three printing angles (90 degrees ,45 degrees, -45 degrees) and four types of supporting structures (none, automatic generation, manually added, block generation). For the group of manually added, supporting structure was added to the area with stress concentration based on the result of the clasp-removal simulation. All clasps were scanned before and after removing the support structure to evaluate deformation caused by removing the supporting structure.

**Results** When containing angles between the supporting structure and the clasp arms was closer to 90 degrees, the deformation was smaller. As the number of supporting structures increased, deformation became smaller, but surface roughness was increased. The amount of deformation in the group of manually added and block generation were similar. When the printing angle was -45 degrees, removing supporting structures resulted in less deformations.

**Conclusions** When the printing angle was 90 degrees with manually added supporting structures, clasp has less deformation and better surface roughness.



# TEER in Gingival Tissues; a Novel Approach in Testing Oral Health Products

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**Objectives** Gingival epithelial is the first line of defence against bacteria hence it is vital to understand the impact of oral care products on gingival barrier integrity. Transepithelial Electrical Resistance (TEER) is a widely recognised technique that indicates the integrity of cellular barriers in cell culture models. Often TEER is measured on monolayer cells and given their sensitive nature, studies are limited to testing merely ingredients. To understand the impact of oral health products on gum barrier integrity a novel method developed to measure TEER on reconstructed gingival tissues.

**Methods** Gin100 tissues from Mattek were challenged by exposure to E.coli LPS, P.gingivalis LPS or Subtilisin-A and incubated for 6, 12 and 24hr. TEER values collected at baseline and after each timepoint and compared to un-challenged group (PBS). TEER was measured using EVOM3. To visualise the tissues, samples were fixed and imaged using histology imaging techniques. Statistical analysis performed at the 0.05 significance and a general linear model ANOVA used.

**Results** E.coli and P.gingivalis LPS at their highest concentrations (10ug/mL) did not reduce the barrier integrity significantly (TEER value range of 73.2% to 113.52% for E.coli and 80.5% to 91.3% for P.gingivalis). However, Subtilisin-A significantly reduced the TEER value to 80.3±2.5%, 53.1±3.4%, and 28.7±3.6% at 0.1, 1 and 10 ug/mL respectively 12h post challenge (Table 1). Histology imaging demonstrates the damage on surface and basal membrane of the tissue when challenged by 1ug/mL Subtilisin-A (Figure 1). Results of this study led to selection of 1ug/mL of Subtilisin-A as bacterial challenge for future studies. **Conclusions** Development of a robust TEER method in gingival tissues provides a unique opportunity to evaluate the impact of products on gum barrier integrity. Having a reliable bacterial challenge is key to distinguish between different test items. Future studies are in progress to examine different dentifrices in this model.

Table 1. TEER Measurements of E.coli LPS, P.gingivalis LPS and Subtilisin A as bacterial challenges at different concentrations and timepoints. (n=5)

TEER Measurement %									
Concentratio n	0.1ug/mL			1ug/mL			10ug/mL		
Exposure Time	6h	12h	24h	6h	12h	24h	6h	12h	24
E.coli LPS	91.5±11. 6	73.2±9. 1	85.3±12. 2	98.2±8. 3	91.4±9	99.2±12. 3	108±6.9	105.3±6. 1	113.52±4. 7
P.gingivalis	88.3±6.4	85.8±7. 2	80.5±8.3	82.7±9. 1	81.1±6. 7	79.7±6.3	90.2±4. 9	91.3±7.4	88.7±6.2



Subtilisin A	88.2±3.4	80.3±2. 5	67.2±3.8	82.7±7. 1	53.1±3. 4	38.8±4.1	49.6±8. 5	28.7±3.6	19.6±1.5

## 0080

# Salivary Biomarkers: New Frontiers in Periodontitis Diagnosis

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**Objectives** The aim of this study was to investigate new periodontal diagnosis analyzing salivary biomarkers in periodontitis patients. The study is intended to reveal novel diagnosis factors of periodontal disease analyzing correlation between periodontitis patients with healthy patients comparing salivary biomarkers evolution.

**Methods** The study goal is to explore new methods for periodontal disease diagnosis by analyzing salivary biomarkers. Various databases, including Elsevier ,Ncbi,Wiley Online Library, PubMed, Google Scholar. The search focused on articles published between 2020 and 2024 using keywords and Medical Subject Headings such as "Salivary biomarkers periodontitis " "Periodontitis diagnosis" "Salivary biomarkers," and "Salivary interleukins." All 30 articles included in the study were in English.

**Results** Salivary MMP-9 and S100A8 are strong biomarkers associated with periodontitis (p < 0.05), displaying high screening ability (AUC = 0.86) for detection. Post-treatment, S100A8 significantly decreased by 83.7%, surpassing MMP-9 in monitoring treatment efficacy. Furthermore, salivary IL-6 levels were elevated in periodontitis (p < 0.001), correlating with disease severity parameters (CAL, PPD, FMBS). Salivary IL-1 $\beta$ , IL-6, sCD40L, and TNF- $\alpha$  offer diagnostic promise, with IL-1 $\beta$  exhibiting the highest diagnostic value (AUC = 0.88) for distinguishing healthy, gingivitis, and periodontitis subjects. **Conclusions** This review shows that salivary S100A8 and MMP-9 are effective biomarkers to detect periodontitis, especially S100A8 which declines in a significant way after periodontal treatment. Severe cases of periodontitis have prominent levels of salivary IL-6 showing IL-6 role as a marker of disease severity. Periodontitis condition can be diagnosed testing the combination of IL-1 $\beta$ , IL-6, sCD40L, and TNF- $\alpha$  in saliva chiefly by IL-1 $\beta$  (AUC = 0.88). Salivary biomarkers testing approach will innovate periodontal diagnosis approaches

## 0081

# Significance of Predicting Periodontal Disease Susceptibility by Single Nucleotide Polymorphism (SNP) Profile

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**Objectives** Periodontal disease is the destruction of the teeth supporting tissues leading to tooth loss in older adults and diseases such as cardiovascular disease, rheumatoid arthritis, premature birth, and dementia. If gingivally healthy volunteers stop oral hygiene for a week, gingivodentally adherent biofilms induce gingival crevicular fluid (GCF), an inflammatory exudate. Epithelial turnover at the crevice base maintains a barrier to biofilm downgrowth but requires the essential amino acid lysine from GCF, which is depleted to cadaverine by bacterial lysine decarboxylase (Ldc). Biofilm accumulation also requires GCF lysine. Hosts with most Ldc have the least biofilm and weakest epithelial barrier to bacteria, whereas hosts with the least Ldc have the most biofilm, but the strongest epithelial barrier. The GCF exudation rate gives 2 parallel arch-shaped curves (a weak and a strong GCF flow) which both increase and decrease depending on how much lysine remains unconverted to cadaverine.

**Methods** To find out the cause of the dual GCF response, we investigated the SNPs in 7 genes previously associated with periodontitis in buccal scraping samples from 15 volunteers using real-time PCR with SNP genotyping using the TaqMan method.

**Results** Responders with a weak GCF inflammatory response were completely separated from strong responders based primarily on gene interleukin1B SNPs at -511 and +3954 and sometime also on an SNP in gene IL6, or IL10 or CD14.

**Conclusions** Protective, strong GCF expels bacteria into saliva, whereas weak GCF incubates the bacteria and slowly converts the salivary microbiome in gingival crevices into a pathogenic microbiome responsible for periodontal inflammation. The significance of this study is that it may now be possible to use this SNP profile to identify the 40% of periodontitis-susceptible individuals apparently in the US population. Adequate treatment such as immunizing with periopathogens could slow periodontitis development enough to prevent comorbidity development in old age.

# 0082

## Quadrant-Wise vs. Full-Mouth Periodontal Treatment Impact on Parameters in Periodontitis

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**Objectives** The present randomized-controlled clinical trial assessed the efficacy of quadrant-wise subgingival instrumentation (Q-SI) versus one-stage full-mouth subgingival instrumentation (FM-SI) on probing depth and periodontal bacteria reduction after 6 months of follow-up, as well as the influence of baseline levels of periodontal bacteria on the effectiveness of periodontal treatment protocols on outcomes.

Methods Subjects with periodontitis were randomly allocated to receive Q-SI (n=43) or FM-SI (n=45) and



they were instructed and motivated on oral hygiene maintenance during the treatment sessions. Periodontal indices (probing pocket depth [PPD], clinical attachment loss [CAL], and bleeding on probing [BOP]) as well as oral pathogens were assessed at baseline and after 30, 90, and 180 days. Periodontal pathogens and total bacterial load were assessed through real-time PCR.

**Results** After 6 months, the median PPD improved from 4.8 mm (interquartile range [IQR]: 4.3-5.2) to 2.6 mm (IQR: 2.3-2.9) in FM-SI group and from 4.7 mm (IQR: 4.1-5.2) to 3.2 mm (IQR: 2.4-3.5) in Q-SI group (p<0.001). At 6 months, FM-SI resulted more effectively in reducing the median levels of *Porphyromonas gingivalis (Pg), Aggregatibacter actinocomyctemcomitans*, and *Tannerella forsythus (Tf)* (p<0.001 for each value). Multilevel linear regression analysis showed that high baseline PPD (p=0.029), *Pg* (p=0.014), and *Tf* (p<0.001) levels and the FM-SI protocol (p<0.001) were significant predictors of PPD reduction after 6 months. Moreover, PPD reduction was significantly higher in the FM-SI group when lower baseline *Pg* levels were detected.

**Conclusions** The FM-SI resulted more effectively compared to the Q-SI in improving the mean PPD and number of periodontal pathogens in patients with periodontitis after 6 months. Moreover, greater baseline PPD and *Pg* negatively impacted PPD reduction after 6 months in FM-SI group.

0086

# **Cleaning Splints' Clinical Performance on Plaque and Inflammation Parameters**

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**Objectives** In daily clinical practice, patients still find it difficult to achieve optimal oral hygiene. Especially interdental spaces continue to be problematic, as many patients find effective interdental brushes (IDBs) cumbersome and difficult to use. The aim of this study is to investigate effectiveness of plaque removal using individually manufactured cleaning splints as support for IDBs.

**Methods** 16 subjects with periodontal disease and varying residual dentition/prosthetic restoration status were included in an ongoing randomized controlled clinical trial in parallel cross-over design. In the first session, impressions were taken and an individual fitting of IDBs was performed. Thereafter, cleaning splints were digitally designed for each patient. Design included grooves in the proximal area to facilitate insertion and guide surfaces to improve effect of IDBs. Splints were produced using 3D printing. To equilibrate interdental plaque indices, a standardized oral hygiene protocol was established, including suspension of interdental cleaning for 2 weeks. Thereafter, two parallel groups either performed normal oral hygiene without a cleaning splint (Group 1) or used IDBs with the aid of the cleaning splint for 2 weeks (Group 2). After a 2-week washout period Group 1 started using the cleaning splint and Group 2 performed interdental cleaning without the splint. Oral hygiene indices (Quigley Hein Plaque-Index QHI; Gingiva Index GI) were recorded before and after each 2 week-cleaning period. The statistical analysis was carried out using SPSS.

**Results** Initial value of the QHI was between 3.14 and 3.6. After application of the cleaning splint, QHI decreased significantly ( $\Delta$ QHI1=-0.16;  $\Delta$ QHI2=-2.00; p>0.001). However, there were no effects on the GI ( $\Delta$ GI1=0.00;  $\Delta$ GI2=-0.07).



**Conclusions** Within limitations of this study, the investigated cleaning splint beneficially affected plaque reduction, while there was no short-term effect on gingival inflammation. Using cleaning splints could be a promising approach to increase the effect of IDBs on plaque reduction.

## 0087

# Effect of Microorganisms on Differently Instrumented Teeth

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**Objectives** To investigate the potential influence of various instrumentation methods in periodontal therapy on bacterial colonization of dentine, as well as on the cytokine expression profile of pulpal cells. **Methods** Eigthy extracted teeth underwent root canal treatment. The apices were sealed with composite, the pulpal chambers were left empty, and access preparations were temporarily sealed. The teeth were subjected to scaling and root planing using manual instruments, ultrasonication, and air-polishing. Uninstrumented teeth served as control. A six-species bacterial mixture (*Streptococcus gordonii, Actinomyces oris, Fusbacterium nucleatum, Parvimonas micra, Tannerella forsythia*, and *Porphyromonas gingivalis*) was used for incubation of the teeth. Bacterial counts were quantified after incubation periods of 2 and 24 hours. Following incubation with the bacterial mixture over 10 weeks, pulpal cells were seeded into the pulpal chambers and evaluated for cytokine expression.

**Results** Control samples of dentine exhibited a median bacterial count of 5.97 log10 cfu after 2 hours of incubation, which increased to 8.01 log10 cfu after 24 hours. In contrast, instrumented samples contained 5.73 log10 cfu and 7.71 log10 cfu, respectively. Among the treatment modalities, ultrasonication achieved the most significant reduction with a median decrease of 0.25 log10 cfu (p=0.010) followed by air-polishing. Twenty-four hours post-instrumentation, significantly lower cfu counts were observed in the hand-scaler group, followed by the air-polishing group compared to the ultrasonication. When pulpal cells were seeded into the chambers of teeth exposed to the bacterial mixture for ten weeks, there was an increase in interleukin-8 (IL-8) and matrix metalloproteinase-3 (MMP-3) expression compared to negative controls. Statistically significant increases in IL-8 were observed in the non-instrumented and air-polishing groups (p=0.027 vs. negative control), while MMP-3 expression was significantly higher in the hand-scaler and air-polishing groups (p=0.012 and p=0.006 vs. negative control, respectively).

**Conclusions** Instrumentation resulted in decreased bacterial colonization and increased IL-8 and MMP-3 expression in pulpal cells.



#### 0089

# Prevalence of Porphyromonas Gingivalis in Cardiovascular Samples in Periodontitis

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**Objectives** Our aim is to determine the prevalence of periopathogenic *Porphyromonas gingivalis (Pg)* in surgical samples of adults with various cardiovascular (CV) diseases needing surgical intervention compared to healthy vessel samples.

**Methods** We performed systematic search using the PRISMA guidelines. After full text selection and data extraction the proportion of patients with prevalence of *Pg* in CV surgical samples was calculated using random-effects meta-analyses. Multiple subgroup analyses were performed.

Results Twenty-five articles were included and subgrouped according to the study population presenting healthy periodontium, periodontitis or edentulousness. The articles specifying the presence of periodontitis in patients were further subgrouped to the surgery performed at different CV sites: heart, coronary artery, aorta, and carotid artery. The control group consisted of samples taken from healthy vessels. Our results show that Pg was found in CV lesions of patients with healthy periodontium in 11% (0.01-0.53) with 0% heterogenity (I<sup>2</sup>) and in periodontitis in 23% (0.13-0.36) with I<sup>2</sup> 80%, which could be explained by the diversity of the sample size, the location of the CV lesion and the different sensitivity of the PCR techniques used in the studies. In the edentulous subgroups the number of articles was low and did not allow statistical analysis. In the coronary artery subgroup of patients with periodontitis the prevalence of Pg was 40% (0.23-0.60), the highest among the vessels. Followed by the aorta and the carotid artery with 18% (0.01-0.81) and 14% (0.02-0.56), respectively. The test for subgroup differences suggests a significant subgroup effect (p<0.001). Heart sample number was not enough for statistics. **Conclusions** Periopathogenic Pg can be found in CV samples, suggesting a role in the pathogenesis of CV diseases. Coronary arteries are more susceptible to Pg compared to other investigated arteries. These data call attention to the significance of oral hygiene and health for the prevention of life-threatening consequences.

## 0446

## Bacterial-Cyclic Dinucleotides Regulate Human Osteoclast Differentiation.

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**Objectives** Bacteria and their virulence factors lead to local inflammatory reactions and activate the immune system that mediates alveolar bone loss, which is a hallmark of periodontitis progression. Cyclic dinucleotides (cyclic di-guanosine monophosphate (c-di-GMP) and cyclic di-adenosine monophosphate (c-di-AMP)) are important secondary signalling molecules, with which bacteria can sense and respond to environmental stress and stimulate the innate immune response. Our previous study showed that cyclic dinucleotides upregulate tumor necrosis factor receptor superfamily member 11B, which plays an essential role in bone metabolism and is a negative regulator of bone resorption, suppressing osteoclast activity in dental mineralized tissue. For that, the current study aims to study the effect of cyclic dinucleotides on the differentiation of human osteoclasts.

**Methods** Human osteoclast precursors were isolated from bone marrow samples of healthy donors. Osteoclasts precursors seeded in 96 well plates ( $0,3x10^6$  cells/ well) on Bovine cortical bone slices (Diameter: 6mm, Thickness: 0.4mm) with different concentrations of c-di-GMP and c-di-AMP (1, 10, and 100 µM) for two-time points. After one and two weeks of incubation, the differentiated cells adhering to the bone slices were stained by Tartrate-resistant acid phosphatase activity.

**Results** At one week of incubation, the highest concentration of c-di-AMP and all tested concentrations of c-di-GMP inhibited osteoclast differentiation. The same result was observed when osteoclast precursors were incubated with all concentrations of either c-di-AMP or c-di-GMP for two weeks.

**Conclusions** Cyclic dinucleotides exert inhibitory effects on osteoclast differentiation. Understanding this effect will aid in developing molecules that can inhibit bone resorption, which is a promising therapeutic approach to bone destruction in periodontitis.

## 0199

## Incidence of Medication-Related Osteonecrosis of the Jaw in Finland

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**Objectives** This retrospective study aimed to evaluate the incidence of medication-related osteonecrosis of the jaw (MRONJ) and associated antiresorptive drugs in Finnish population.

**Methods** All the Finnish adult patients (aged 18 years and older) who were prescribed with antiresorptive drugs (AR) during 2013-2015 were included in this study. A total of n=58367 patients met the inclusion criteria and were followed up until 2020 for between 5 to 7 years. The outcome variable was the diagnosis of MRONJ during the study period. Patients' age, gender, type of AR prescribed, reason for using AR drugs, route of administration, use of corticosteroids, use of vascular endothelial growth factors (VEGF) were used as covariates.

**Results** The incidence of MRONJ was 0.8% in this study population. The risk of developing MRONJ among denosumab users was 5.6 times higher (HR 5.57, 95% Cl 2.60 – 11.96, p-value <0.001) compared to bisphosphonates users. Patients diagnosed with cancer had a 10.8-folds risk (HR 10.75, 95% Cl 8.06 – 14.34, p-value<0.001) of developing MRONJ compared to those diagnosed with osteonecrosis. Simultaneous use of corticosteroids and VEGFs in addition to AR drug increased the risk of developing MRONJ by 3.6 and 1.5 times, respectively corticosteroids users: HR 3.58 95% Cl 2.78 – 4.64, p-value <0.001; VEGF inhibitor users: HR 1.47, 95% Cl 1.03 – 2.10, p-value 0.033).



**Conclusions** In conclusion, male, denosumab, any type of cancer diagnosis, simultaneous use of corticosteroid and VEGF were the most noteworthy risk factors for MRONJ.

Table 1. Incidence of medication-related osteonecrosis of the jaw (MRONJ) in antiresorptive drug users in Finland stratified by age, gender, medications, purpose of use and route of administration.

	Patient without MRONJ n	Patient with MRONJ n	р
	(%)	(%)	value
Age group (n=58367)			
≤64 years	13664 (23.6%)	143 (31.8%)	<0.001
≥65 years	44257 (76.4%)	304 (68.2%)	<0.001
Gender (n=58367)			
Male	9709 (17.8%)	188 (44.4%)	<0.001
Female	44924 (82.2%)	235 (55.6%)	<0.001
Antiresorptive drug (n=583679)			
Bisphosphonates	36814 (63.6%)	61 (13.7%)	<0.001
Denosumab	12585 (21.7%)	321 (72.0%)	<0.001
Both	8522 (14.7%)	64 (14.3%)	<0.001
Purpose of using antiresorptive drug (n=58367)			
Osteoporosis	42137 (72.7%)	134 (30.0%)	<0.001
Breast cancer	1878 (3.2%)	141 (31.6%)	<0.001
Prostate cancer	893 (1.5%)	145 (32.5%)	<0.001
Multiple myeloma	517 (0.9%)	16 (3.6%)	<0.001
Malignant neoplasm from other sites	2495 (4.3%)	280 (62.8%)	<0.001
History of corticosteroids			
Yes	1058 (1.8%)	146 (32.7%)	<0.001
No	56863 (98.2%)	300 (67.3%)	<0.001



History of VEGF inhibitors (n=58367)			
Yes	242 (0.4%)	54 (12.1%)	<0.001
No	57679 (99.6%)	392 (87.9%)	<0.001
Route of administration (n=47514)			
Peroral	34271 (72.7%)	97 (24.6%)	<0.001
Intravenous	12851 (27.3%)	295 (75.4%)	<0.001

Table 2. Cox regression analyses to determine the relationship between occurrence of MRONJ and co-variates.

Co-variates	HR (95% CI)			
Age group				
≤64 years	Ref			
≥65 years	0.90 (0.7 – 21.13)			
Gender				
Male	Ref			
Female	0.73 (0.57 – 0.92)*			
Antiresorptive drug				
Bisphosphonates	Ref			
Denosumab	5.57 (2.60 – 11.96)**			
Both	3.33 (2.17 – 5.12)**			
Purpose of using antiresorptive drug				
Osteoporosis	Ref			
Any type of cancer	10.75 (8.06 – 14.34)*			
History of corticosteroids				
Νο	Ref			



Yes	3.58 (2.78 – 4.64)**
History of VEGF inhibitors	
No	Ref
Yes	1.47 (1.03 – 2.10)*
Route of administration	
Peroral	Ref
Intravenous	1.06 (0.54 – 2.08)

Abbreviations: HR (95% CI): Hazard ratio (95% confidence interval); VEGFs: vascular endothelial growth factors. \*p value < 0.05. \*\* p value < 0.001.

# 0200

## Analyses of Potential Confounding in an Experimental Treatment Project

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**Objectives** An experimental treatment project funded by the Norwegian Ministry of Health was conducted comprising removal of dental amalgam fillings in individuals with health problems attributed to their amalgam fillings. The primary aims of the project were to provide experimental treatment and to evaluate changes over time in general health. The objective of this paper is to investigate potential confounding factors influencing the outcome.

**Methods** The project was designed as a prospective cohort study. In this paper two cohorts are compared, both with medically unexplained physical symptoms (MUPS): The Amalgam cohort (n=32) attributed their symptoms to amalgam and wished to have their amalgam fillings removed. Patients in the MUPS cohort (n=28) had no symptom attribution to amalgam. Participants in the Amalgam cohort had all amalgam restorations replaced with other dental restorative materials. The primary outcome of the project was the General Health Complaints index score (GHC) one year after treatment. All participants completed questionnaires at baseline (Q1), at one year follow-up (Q2) and again four years later (Q3). Linear mixed effects models were used for analyses of change scores at Q2 and Q3 and the influence of potential confounders (age, sex, education, family income). Stata (18.0) was used for the statistical analyses.

**Results** The improvement of GHC in the Amalgam cohort was significantly higher both at Q2 (p=0.003) and at Q3 (p<0.001). Only marginal changes of the change score differences were observed after adjustment for the potential confounders.

**Conclusions** There was no evidence of major effects from potential confounders.



# Smoking Habits and Health Risks Awareness Among 7,213 Sicilian Students

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**Objectives** To investigate the smoking habits and awareness about the health risks associated with smoking among middle and high school students in Sicily.

**Methods** The present study was approved by the University Hospital "P.Giaccone" of Palermo Institutional Local Ethics Committee(#4/2023); within an educational project, a questionnaire with multiple responses on the topic was administered in 48 middle and high Sicilian schools. Descriptive statistics and multiple correspondence analysis were applied to the answers.

**Results** The survey was completed by 7.213 students (49% males,49% females and 2% other) with a mean age of 14.3±2 years. 1.217 (16.9%) declared that they were smokers; among these, 355 smoked tobacco cigarettes (4.9%), 335 e-cigarettes (4.7%), and 527 both (7.3%).

The smoking start age varies among students, with 15% starting at 10-12 years old, 43% at 13-15 years old, 14% at 16-18 years old, and 27% over 18.

Regarding the risks associated with smoking habit awareness, 85% of students were already aware of it, while 12.5% discovered it through video viewing, and 3.1% were unaware.

Concerning the knowledge of smoking effects on oral health, 6.437(89%) believed smoking was very dangerous for oral health, while 589 (8.2%) responded that it was not very dangerous and 187 (2.6%) responded that smoking was not dangerous for oral health.

Concerning "vaping", 1.995 (28%) students believed that it was less dangerous than smoking tobacco cigarettes.

Regarding the difference between "first hand", "second hand" and "third hand" exposure to smoke knowledge, 1.715 (24%) students stated they did not know it, 3.966 (55%) learned it through video viewing and 1.532 (21%) already knew it.

**Conclusions** The findings reveal a concerning prevalence of smoking among students, despite awareness of its risks. However, targeted education is needed, particularly regarding the dangers to oral health and the perceived safety of "vaping" compared to traditional tobacco cigarettes.

## 0202

## The Relation Between Self-Perceived Dental Aesthetics and Self-Esteem

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CED/NOF-IADR 2024 Oral Health Research Congress 12 — 14 Sept 2024 Geneva, Switzerland

**Objectives** This study evaluated the relationship between self-perceived dental aesthetics, self-esteem, and dental habits in a dental student sample.

**Methods** A cross-sectional survey involving a sample comprising 172 1<sup>st</sup> and 2nd-year dental students from the programs taught in English and French languages within the Dental Medicine Faculty of Cluj-Napoca, Romania (mean age=20.43, 41.3% M, 58.7% F) has been conducted. The Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ), the Rosenberg Self-Esteem Scale (RSES), together with dental habits assessment questions, in both English and French versions, were applied to the two samples, in pencil and paper self-completing format. Informed consent was obtained from each participant beforehand. Subscale and overall questionnaire scores were computed and used for statistical procedures (Pearson's correlations and t-test), investigating correlations between the self-perceived dental aesthetics and self-esteem and differences between the concepts concerning the study year and gender.

**Results** The overall mean PIDAQ score was 16.56 (n=172), while the overall mean RSES score was 32.71 (n=172). For both study lines, the Dental Self-Confidence PIDAQ subscale registered the highest score, indicating the highest perceived impact at this level. Statistically significant small correlations were identified between the RSES overall score and the Social Impact (r=-0.219, p=0.04), Psychological Impact (r=-0.175, p=0.22), Aesthetic Concern (r=-0.228, p=0.03) PIDAQ subscale scores, as well as the PIDAQ overall score (r=-0.208, p=0.06). The t-test revealed statistically significant differences for the Social Impact PIDAQ subscale scores t(165.16)=-2.083, p=0.39, in respect to the year of study; furthermore, statistically significant RSES overall score differences, regarding the variables gender t(170)=1.998, p=0.47 (M>F) and year of study t(170)=-2.429, p=0.16 ( $2^{nd}>1^{st}$ ), were registered.

**Conclusions** The current study highlighted a statistically significant relation between students' self-perceived dental aesthetics and self-esteem and statistically significant differences between these concepts concerning gender and year of study.

### 0203

#### Periodontal Treatment is Efficient for Type 2 Diabetes: Meta-Analysis

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**Objectives** To assess the efficiency of periodontal treatment (PT) in improving diabetes-related outcomes in adults with type 2 diabetes mellitus (T2D) and periodontitis, providing an updated and comprehensive synthesis from economic evaluations (EE).

**Methods** Seven databases and one register were independently searched by two reviewers for articles published up to July 6, 2023. Studies that comparatively assessed the efficiency of PT versus no treatment or other dental treatments were included. Risk of bias was assessed using the Cochrane RoB 2, ROBINS-I,



and ECOBIAS tools for the first stage of EE and the CHEERS checklist and NICE quality appraisal tool for overall EE. Qualitative and quantitative syntheses of the articles were conducted and assessed using the GRADE approach. PROSPERO CRD42023443146.

**Results** Ten studies were included. PT results in a reduction in total healthcare costs, including inpatient and outpatient costs and diabetes-related healthcare costs, including related healthcare and drug costs (low to moderate certainty). A total incremental benefit of 12348 USD (2022 currency, 95% CI 12195-12500) was estimated from three high-quality model-based cost-utility analyses (high certainty). **Conclusions** Including PT in the integrative treatment of patients with T2D and periodontitis is cost-effective. Future research is required to ensure the transferability of these findings.

### 0204

### Multimorbidity, Polypharmacy, and Tooth Loss in an Older Hospitalized Population

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**Objectives** To evaluate the correlation between oral health status regarding the number of teeth, with age, polypharmacy and multimorbidity in an older hospitalized cohort.

**Methods** A cross-sectional study of patients aged 65 or older was conducted in two sites in Switzerland. Data concerning age, medical history, living conditions and dental status was assessed. Number of teeth was correlated with age, polypharmacy, and multimorbidity using Pearson correlation with a level of significance set at 0.05.

**Results** 111 patients with a mean age of 81.6±8.0 years were included. Mean number of morbidities was 2.2±1.5 with a mean of 7.5±4.0 medications taken daily. 89.1% lived at home, 5.7% lived in nursing homes, and 4.3% lived in medicalized homes. 14.4% were fully edentulous with complete dentures in both jaws, while 26.6% wore a complete denture only in the upper and 4.4% only in the lower jaw. The mean count of remaining teeth was 16.6±9.1. 55.5% had no posterior support with an Eichner classification C, and 45.5% had more than 4 functional chewing units. The number of present teeth was not correlated with age, however was negatively correlated with the number of morbidities (r=-.271; p=0.04) and with number of medications (r=-.182; p=0.05).

**Conclusions** The number of morbidities and medications has a significant correlation with the number of teeth, while none could be found for age alone. This emphasizes the importance of comprehensive dental care alongside medical management for older patients, benefitting oral and general medical health.



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### 0205

### Patient-Related Risk Factors for Xerostomia and Hyposalivation

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**Objectives** The objective of this study is to systematically identify and analyze patient-related risk factors for xerostomia and hyposalivation, with the aim of improving understanding of their etiology and prevalence.

**Methods** 116 patients at the University clinic of dental medicine of Geneva were recruited, 60 patients 18-54 years and 56 over 55 years old. Demographic details, medication intake and smoking status were recorded. Each patient underwent the unstimulated saliva flow test by drool method (UST) and the stimulated saliva flow test by chewing gum (CG). Patients completed the Xerostomia Inventory (XI) questionnaire to evaluate the symptoms of xerostomia. Statistical analyses were conducted using the Mann-Whitney U test and Spearman's rank correlation coefficient.

**Results** The Xerostomia Inventory (XI) correlates with both stimulated and unstimulated salivary test scores (p < 0.05). The distribution of results for UST, CG, and XI is independent of gender. However, the distributions of UST and XI differ between individuals with and without systemic disease, whereas the distribution for CG does not. Drug use alters the distribution of results for all three tests. The number of teeth correlates with the results of XI and UST, whereas the number of occluding units correlates only with UST. Smoking is not correlated with the presence of hyposalivation or xerostomia.

**Conclusions** This study identifies age, systemic disease and and drug use as risk factors for hyposalivation and xerostomia, but neither smoking nor gender appear to be a risk factor for either condition.

### 0206

### Accumulation and Biofilm Removal on Enamel and Root Surfaces

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**Objectives** This study aimed to quantitatively investigate the accumulation of *Streptococcus mutans* biofilm on enamel and root surfaces, and assess the amount of biofilm removal using 1) water and 2) toothpaste in a closed system of flow chamber.

**Methods** Eight sound premolars were embedded in epoxy resin disks of 25mm diameter and polished with silicon carbide grinding papers to display enamel and root surfaces. To mimic biofilm, cultures of *Streptococcus mutans* were prepared and grown on the tooth surfaces over night before they were exposed to either 2 liters Milli Q water or 2 liters of 40% experimental toothpaste in the flow chamber. The amount of biofilm was measured and quantified in Fluorescence microscopy. Mean fluorescence values were recorded and analysed using Microsoft<sup>®</sup> Excel<sup>®</sup> (MS Excel 2016). Statistical significance was set at p<0.01.

Results The ability to grow biofilm was equally present at both the enamel and root surfaces. The use of



water and 40% experimental toothpaste showed a reduction of areas covered with biofilm on both enamel and root dentin in comparison to control surfaces (p < 0.01). Significant more biofilm was removed from enamel compared to root surfaces when treated with both water and 40% experimental toothpaste (p < 0.01). Slightly less biofilm was removed by the use of water compared to 40% experimental toothpaste on both enamel and root surfaces (p < 0.01).

**Conclusions** Less biofilm is removed from the root surfaces than enamel by the use of water and 40% experimental toothpaste in a flow chamber. Assessing dental biofilm accumulation and monitoring biofilm formation on enamel and root surfaces gives oral health professionals important directions that could strengthen the significance of caries prevention. In addition, improving older individuals' oral hygiene practices should be considered an important measure to prevent root caries.

### 0207

# Repair or Replace of Defective Restorations - a Cross-Sectional Study

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**Objectives** The aim of this cross-sectional study (Tromsø 7) was to evaluate the treatment need among a random selection of adult patients in Northern-Norway by measuring the repair versus replacement for failed restorations. A secondary aim was to assess strategy differences between dentists.

**Methods** A randommised sample of 3 653 persons (51.5% women, 48.5% men, aged 40-93 years) were included. Based on FDI's Clinical criteria for the evaluation of restorations—2010, patients `clinical and radiographical pictures were evaluated in a specially designed software developed for this purpose. Descriptive statistics and multivariable multilevel-mixed-effect-logistic-regression-models (STATA 17/SE) was performed. p-value < 0.05 was used throughout.

**Results** A total of 90.062 teeth (24.7 teeth pr. patient) were assessed. Re-treatment suggestions were made for 3006 restorations, giving an overall treatment suggestion of 3.3 %. Of these, 27% (n=814) were suggested for repair and 73% (n=2192) judged to replacement). The participants' DMFT-values ranged from 0 (0.9%) to 28 (8.8%) (Median DMFT 21.3, mean 20.0). Suggestions for treatment were made for 1597 patients (43.7%, 54% men), varying from one (54% of the participants) to 14 suggestions (0.1% of the participants, one patient).

There were not found significant difference between dentists based on sex or age. Clustering by dentist level was checked using Intra-class Correlation Coefficients (ICC), demonstrating that 16% of the variance in suggestions for restoration re-treatment was explained at the dentist level. Thus, a wide range of number of treatment suggestions was noted among the dentists.

Secondary caries and restoration fracture were found to be most used diagnose for re-treatment, surface properties the least.

**Conclusions** Need for restoration revision seems low in Norway. There is a tendency towards larger and more indirect restorations, and the diagnosis secondary caries is still a matter of uncertainty.



#### 0208

### Performance and Failure Analysis of a Glassionomer-Based Restorative System at 12 Years

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**Objectives** The aim of this study is to evaluate the clinical performances of a glassionomer-based restorative system when used in single surface and multiple surfaces permanent dental restorations (molars and premolars) and cervical restorations (all teeth), evaluating the reasons of failure and/or replacement.

**Methods** 3 experienced operators with minimum 5 years of clinical experience in restorative treatments were selected in 2007 and trained before the beginning of the study. The EQUIA restorative system (GC Europe NV, Leuven, Belgium) has been selected as restorative material and restorations were executed including the final application of the coating agent (Equia Coat). Frencken's success criteria have been used for clinical evaluation of restorations.

**Results** At the end of the enrolment for the study in November 2010, 304 dental restorations (202 patients, 82 class I, 150 class II, 72 class V) have been included in the study. In December 2022, at the end of the 12-years follow-up, 103 patients with 127 restorations have been re-evaluated. During 12 years, 77 restorations were registered as drop-out since patients didn't respect the follow-up planning or they were not available anymore. Of the remaining 227 restorations, 81 were recorded as failed: 45 due to non-repairable breakdown, 16 complete loss/detachment, 30 were found substituted by other practitioners (12 described as restoration breakdown, 18 due to aesthetical reasons). 19 were lost due to tooth extraction (periodontal problems: 11; tooth/root breakdown: 5; strategical choice: 3).

General Success Rate (GSR, Frencken's Code  $\leq$  3) and General Integrity Rate (GIR, only code=0) were respectively 47,6% and 32,2% at 144 months (Table 1). The failure rate was influenced by tooth position, number of involved walls, type of restoration. Class I, Class II and Class V restorations reported respectively 93,9 %, 48,0% and 44,4% of GSR at 12 years.

**Conclusions** A high-viscosity glassionomer cement coated with a specific light-cured resin confirmed to be a considerable alternative for permanent dental restorations, especially for single surface cavities on molars and premolars. More than 22% of registered failures occurred due to unaccepted aesthetical aspect, despite the clinical success of restorations.

GIR % and GSR %

	Time 0	3 m	6 m	12 m	18 m	24 m	36 m	48 m	60 m	72 m	84 m	120 m	144 m
GIR%	100	98,7	97,4	94,7	90,8	87,2	80,6	72,3	57,3	48,9	43,6	35,7	32,2
GSR%	100	100	100	98,7	98,2	94,3	91,6	90,3	74,9	63,4	55,7	50,7	47,6



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### 0209

## Standardizing an in-Vitro Biofilm Model to Study Secondary Caries Formation

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**Objectives** The biggest issue in achieving the longevity of resin-based composite (RBC) dental restorations nowadays is the onset of secondary caries (SC). This study aimed to evaluate the parameters that influence SC formation in an *in vitro* model of cariogenic biofilm challenge.

**Methods** Four sound human premolars and 10 molars (ethical committee approval obtained) had their roots removed and their pulp chamber filled. Four Class II cavities were made in each tooth having a cervical margin in dentin. Cavities were filled with resin-modified glass ionomer cement (positive control, HVGIC, Equia Forte) or a conventional RBC (negative control, Clearfil Majesty ES-2 Universal). Each material filled two class II cavities in each tooth, one either mesial or distal and one vestibular or palatal. A pink acrylic relining resin was used to obtain two sledges in which teeth were positioned to simulate interproximal contacts between teeth (Figure 1). Sledges were sterilized and stored in artificial saliva for one week. *Streptococcus mutans* monospecies (Sledge #1) or a mixed flora inoculum (artificial oral microcosm, Sledge #2) biofilm formation was obtained on the specimens' surfaces using a bioreactor and a continuous flow (9.5 ml/h) of undefined mucin medium +1 wt.% sucrose at 37 °C for two weeks. Sledges were scanned using microCT (Skyscan 1176, 9µm resolution, 80KV, 300mA); image reconstruction was performed using proprietary software.

**Results** The microcosm expressed two times deeper demineralization than *S. mutans* and a broth pH of 3.4 vs. 4.3. In the microcosm model, vestibular and palatal cavity margins were much more affected by demineralization than interproximal ones. The resin sledge protected the underlying tooth structures from demineralization. In both models, RBC showed SC development, while HVGIC showed protection against both SC and the loss of minerals in the tissues around it.

**Conclusions** Standardizing a microbiological model for secondary caries formation and replication in vitro is paramount to a better understanding of this phenomenon.

0210

### Evaluation of the Effect of S-Prg on Enamel Reminerilization

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**Objectives** PRG Barrier Coat is based on the proprietary Giomer concept which incorporates the patented bioactive S-PRG (Surface Pre-Reacted Glass ionomer) filler technology.

Our objective is to investigate in vitro the effect of PRG Barrier Coat on remineralization of enamel subsurface lesions.

Methods The extracted molars were kept in a 0.1% thymol solution until the experimental procedure was



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initiated. 30 enamel samples which were assigned randomly to 3 groups (n=10) Group 1: 5% NaF varnish(Proshield varnishâ;President Dental; Germany) as a positive control, Group 2: Bioactive S-PRG (PRG Barrier Coat; Shofu Inc., Kyoto, Japan ) and Group 3: Deionised Water as a negative control. The enamel samples were subjected to a pH cycling regimen for 8 days. Quantitative Light-induced Fluorescence (QLF) images were taken and analysed. Data analysis was carried out using one way ANOVA. In addition, images were analysed with Zeiss Cirrus HD SD-OCT 5000 OCT (Optical Coherence Tomography; Carl Zeiss Meditec, Dublin, CA, USA).

**Results** Both  $\Delta F$  (percentage fluorescence loss) and  $\Delta Q$  ( $\Delta F$  times the area) values improved significantly after the treatment. In addition, the mean difference in  $\Delta F$  of the control group was significantly lower than PRG Barrier Coat group (p<0.05). Whereas the mean difference in  $\Delta Q$  of PRG Barrier Coat group was not significantly when compared with F varhish groups (p>0.05). Reflectivity from enamel that had increased with demineralization decreased with remineralization. OCT signal attenuation demonstrated a capability for monitoring changes of enamel lesions during remineralization.

**Conclusions** Both F varnish and PRG Barrier Coat showed a significant increase in efficacy for the remineralisation of human enamel subsurface lesions in the model used in this study.

Newer preventive agents such as PRG Barrier Coat are advocated as promoting remineralisation when used in addition to routine oral care. Additional investigation is needed to be further confirmed.

#### 0211

### Management of White Spot Lesions During Multibracket Orthodontic Treatment

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**Objectives** To determine the attitude of Spanish orthodontists regarding enamel white spot lesions (WSLs) associated to multibracket appliance.

**Methods** A modified version of the questionnaire designed by Weyland et al., (2022) was electronically distributed through mail or social media to Spanish orthodontists. The questionnaire consisted of four sections: 1) Demographic data, professional activity; 2) WSLs characteristics; 3) Strategies to prevent WSLs; 4) Management of WSLs during treatment and once it was completed. Chi-square, one-way ANOVA and Student t-tests were performed (p<0.05).

**Results** 199 responses were collected. Most of the respondents (72.4%) focused their clinical activity on Orthodontics exclusively and affirmed to detect WSLs in a lower percentage than poor oral hygiene and gingivitis. WSLs were present in only 12.5% of the patients, corresponding mostly to 12-15 years. Lesions usually appeared after 9 months of treatment (46.3%), poor hygiene being the main cause declared. All respondents give oral hygiene instructions, before and during treatment, not based on patient's caries risk (57.7%). Fluoride varnishes and gels were widely applied in the practice and fluoride mouthrinses for individual use at home. When WSLs appeared during treatment the most frequent decision was to warn patients parent-guardian (53.7%) with premature removal of brackets as a residual choice (0.5%). Patients with WSLs after brackets removal were referred to general dentists in 34.2% of the cases while bleaching or resin infiltration were strategies not selected by 75% and 40.2% of the respondents, respectively. **Conclusions** Spanish orthodontists observe WSLs related to multibracket treatment mainly in adolescents and in a low percentage. Their management strategy is based on professional fluoride



application during treatment. WSLs detected after brackets removal are referred to the general dentist for treatment.

0212

## Systematic Review of Carious Lesion Segmentation Using Deep Learning Techniques

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**Objectives** This systematic review aimed to evaluate studies using deep learning (DL) for caries segmentation in 2D and to investigate the performance of the different methods. As an essential field of computer vision, segmentation aims to select in an image pixelwise regions of objects of interest. Many traditional machine learning and computer vision methods attempt to solve tooth and carious lesion segmentation, such as cluster-based, threshold-based, and boundary-based methods. However, these traditional geometry-based methods tend to achieve undesirable results due to the complex appearance of human teeth and the presence of artefacts that can be both metallic and kinetic. To circumvent the obstacles inherent in traditional methods, segmentation techniques based on deep learning are increasingly used in dentistry.

**Methods** Literature searches was performed in MEDLINE, Embase, IEEE explore, and Web of science until December 2023. The following search criterion was the individualized strategy used for each database: (Machine learning OR deep learning) AND segment\* AND (cari\* OR decay OR dental cavity OR pulp\*). **Results** After screening 863 articles, 17 studies were eligible and included. Databases were composed of bitewing radiograph (n = 4), periapical radiograph (n=6), panoramic radiographs (n=7). The sample sizes used ranged from 105 to 10090 per study, while in n=4 studies, data augmentation lead to a training set ranged from 800 to 11,114 image. Pre-processing (adjusting contrast, filters) was used in n=10 studies. Pre train was near systematic (n= 15). External validation was in n=13. U-Net was most used for caries segmentation (n= 8 studies) with a F1-score from 0.53 to 0.94.

Carious lesion was segmented according to its depth in n=5 studies (outer half of enamel/inner half of enamel/ outer half of dentin/inner half of dentin/ inner third of dentin or shallow/moderate/deep), and pulp was segmented in n=3. Segmentation was used as a step towards classification in n=4 studies. One study predicted pulp exposure. Reference or ground truth for training in automatic segmentation rely on the constitution of databases segmented manually by experts.

**Conclusions** Although automatic segmentation provides good accuracy in carious lesion assessment, depth is assessed with less accuracy.



### 0213

# Effects of NPs on Dental Caries Variables in Snus Users

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**Objectives** Today, there are several different types of smokeless nicotine-containing products, such as nicotine pouches (NPs) available on the market. These products share the same use and systemic nicotine exposure as snus. While previous studies have not demonstrated any negative effects of traditional snus usage in relation to dental caries, little is known about the effects caused by the usage of NPs. The objective of this study was to compare the impact on dental plaque acidogenicity and number of cariogenic microorganisms in dental plaque and saliva after the use of regular snus and after 4 weeks of substitution of snus with NPs.

**Methods** The present study was an open-label, two-armed, randomized, longitudinal study. Daily snus users were required to completely substitute their snus use with ZYN (either Dry or Moist) NPs. A total of 23 subjects were randomized to use ZYN Dry, while 22 subjects were randomized to ZYN Moist. The subjects visited the clinic after 4 weeks of regular snus use and then after 4 weeks of using ZYN. Data regarding plaque acidogenicity were collected at different tooth surfaces before and after a mouthrinse with 10% sucrose and followed for 60 min. Saliva and plaque samples were collected to count the number of *Streptococcus mutans* (*S. mutans*) and *lactobacilli*.

**Results** There were no significant differences in dental plaque acidogenicity parameters between visits for either the ZYN Dry group or the ZYN Moist group when compared to the regular snus period for any of the tooth surfaces. Additionally, there were no significant changes in the percentages of *S*.

*mutans* or *lactobacilli* in dental plaque or saliva between the two visits for either the ZYN Dry or ZYN Moist groups.

**Conclusions** NPs seem to have the same effect on plaque acidogenicity and number of cariogenic microorganisms in dental plaque and saliva as traditional snus.

### 0214

### Tubule Occlusion by Stannous Fluoride-Containing Toothpastes for Sensitivity Treatment

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**Objectives** To investigate dentine tubule occlusion of an experimental Sensodyne toothpaste formulation containing stannous fluoride (SnF<sub>2</sub>) versus other commercially available formulations with SnF<sub>2</sub> using focused Ion Beam Scanning Electron Microscopy (FIB-SEM) and Serial Block Face-SEM (SBF-SEM). **Methods** 12 Polished human dentine discs were divided into 3 treatment groups and 1 control group (n=3). A toothpaste slurry was prepared by mixing 0.3 g of toothpaste with 1 ml of artificial saliva (AS). The



dentine discs were then brushed with the slurry for 30 seconds and left immersed in it for 90 seconds. Subsequently, they were rinsed with deionized water for 1 minute and placed in AS in a culture well, where they were kept for 12 hours at 37.5 °C. Following this incubation period, the discs were removed from the AS, dried overnight, and prepared for scanning. For SBF-SEM 0.5 by 0.5mm blocks were cut out from each disc by a low-speed diamond saw and were embedded in resin and glued to a pin and placed in the SBF-SEM where 1000 slices (with a thickness of 60nm) were cut by a diamond knife in a microtome. Backscattered electron images were taken simultaneously producing an imaging depth of approximately 60µm. The rest of the discs were FIB-sectioned to reveal the cross-sections of the tubules using a FEI Helios 650 I FIB/SEM instrument.

**Results** Analysis of occlusion depths using FIB-SEM sections and SBF-SEM revealed that the experimental Sensodyne toothpaste exhibited superior tubule occlusion at a depth of 50 $\mu$ m compared to the other SnF<sub>2</sub>-containing formulations. Analysis from SBF-SEM data along with top-down SEM imaging demonstrated that it had occluded more than half of the tubules at the surface following a single application.

**Conclusions** This in vitro study has shown that the Sensodyne formulation containing  $SnF_2$  produces significantly higher occlusion at the surface and at 50µm depth compared to other  $SnF_2$ -containing formulations.

### 0215

### Socio-Economic Status, Treatment Approach and Recurrence of Childhood Caries

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**Objectives** Social inequalities are associated with poor oral health. The aim of the present study is to assess the effect of socioeconomic levels on the number of caries, the use of general anesthesia (GA) and the recurrence of caries after treatment.

**Methods** This 4-year prospective cohort study was completed in a private dental practice. Dental charts were reviewed for 1739 patients between 2-10 years old who had comprehensive dental care by four dental practitioners. To participate in the study, patients had to attend the recall appointment with the dentist or the hygienist. Patients with severe medical conditions were not included. The sample for this study included198 children. The practitioners provided information on the number of caries each participant presented at baseline, the type of treatment (conventional versus GA), the frequency of follow-up visits and the occurrence of new caries. A questionnaire including oral hygiene and eating habits was completed for each participant.

**Results** Of the 198 children,177(89.3%) had private health insurance (group 1), the remaining 21 (10.7%) benefited from social insurance (group 2). At baseline, 51% of the children in group1 had no caries, 21% had 1-3 caries and 28% presented more than 4 caries. Almost all children in group 2, presented more than 4 carious lesions. 13% of the children from group1 and 72% from group 2 received GA for treatment, the remaining received conventional dental treatment. At follow-up, almost all children belonging to group 2 (95%) and 36% belonging to group 1, presented new caries. Significant differences were found regarding oral hygiene habits. However, no differences were found on eating habits.



**Conclusions** Socioeconomic inequalities play an important role on the initial number of caries, the choice of treatment (GA vs conventional treatment) and the occurrence of new caries.

### 0216

## **Different Fluoride Treatments of Early Erosion**

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**Objectives** The growing prevalence of dental erosion, particularly in young population, generates the need for further research. Several recommendations in managing early lesions exist, yet there is no optimal treatment proposal. Aim of this study was to assess and compare the effect of different fluoride compounds *in vivo*.

**Methods** Fifty young CD-1 mice were evenly distributed into five groups per ten mice and provided with *ad libitum*: water only (group 1); acidic drink only (group 2); acidic drink only in addition to a fluoride treatment (groups 3, 4 and 5) applied twice per week. The treatments were non-metal fluoride, NaF (0,5 mol/l, pH 8, ppm F 9500), and two metal fluorides: SnF<sub>2</sub> (0,5 mol/l, pH 2,6, ppm F 9500) and TiF<sub>4</sub> (0,5 mol/l, pH 1,2 ppm F 9500). After six weeks mandibular molars were dissected out and analyzed in scanning electron microscope (SEM), thereafter embedded, ground transversely and analyzed in SEM again. Dental substance loss was recorded.

**Results** Preliminary results indicate that the lingual tooth height in teeth treated with NaF was lower compared to the other two treatments. In the metal fluorides group,  $SnF_2$  exhibited thicker coating layer on the eroded tooth surface compared to  $TiF_4$  (ongoing analyses), associated with plausible better protective effect. Additionally, altered pulpal response was observed in the different treated groups.

**Conclusions** This study demonstrates a better protective effect of metal fluoride compounds on eroded teeth versus the NaF. Additionally,  $SnF_2$  might shield the eroded surface better that  $TiF_4$ . The very protective mechanism is yet to be understood. Such standardized and well controlled *in vivo* study may be a valuable contribution to preventive strategies in prohibiting and halting the progression of early erosive lesions.

### 0218

### Reduction of Bacterial Loads in Dental Plaque by $H_2O_2$ Photolysis

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**Objectives** Hydroxyl radical, one of the reactive oxygen species, is generated from hydrogen peroxide  $(H_2O_2)$  under light irradiation (i.e.,  $H_2O_2$  photolysis). The hydroxyl radical has a strong oxidative power, which could be applicable to kill bacteria. Previously, we reported that  $H_2O_2$  photolysis treatment could exert a bactericidal effect against planktonic bacteria and *in vitro* single/multi-species biofilms. Since this treatment aims to be a new adjunctive caries treatment, assessing the capability of  $H_2O_2$  photolysis to reduce bacterial loads in dental plaque (i.e., *in vivo* biofilms) is essential. Thus, to identify the potential of  $H_2O_2$  photolysis as the adjunctive caries treatment, the bactericidal effect against dental plaque collected from volunteers was investigated.

**Methods** Twelve healthy volunteers harboring cariogenic bacteria were recruited and wore a removable splint with hydroxyapatite discs for 5 days to collect biofilms. After the test period, the bactericidal assay of H<sub>2</sub>O<sub>2</sub> photolysis was performed on formed biofilms. Then, suspensions of some treated biofilms were cultured, and viable bacteria were evaluated by colony counting. The proportion of cariogenic bacteria was also evaluated using quantitative real-time polymerase chain reaction (q-PCR). Volunteers wore the splint with discs containing treated biofilms for additional 5 days to observe the re-growth of biofilms after treatments. The protocol was approved by the Swedish Ethical Review Authority (Dnr 2021-03933). **Results** The treatment with H<sub>2</sub>O<sub>2</sub> photolysis showed about a 3-log reduction in total bacteria and total *Streptococci* compared to the control (i.e., no-treatment). On the other hand, there were no significant differences in the re-growth between treatments. Additionally, q-PCR analysis found that there were no significant differences regarding the proportion of cariogenic bacteria.

**Conclusions** This study demonstrated that  $H_2O_2$  photolysis could work on *in vivo* biofilms. Although this is an ongoing study, the current results suggest that  $H_2O_2$  photolysis has the potential as a new adjunctive caries treatment.

#### 0219

#### **Oral Immune Profile and Dental Decay: a Case-Control Study**

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**Objectives** Dental decay is the most common oral disease worldwide, linked to the onset of oral dysbiosis. However, the inflammatory changes associated with this dysbiosis remain still poorly explored. The aim of this study was to compare the immune salivary changes in healthy young adults with or without active carious lesions using an electrochemiluminescence ELISA technology.

**Methods** Thirty-four patients (18-30 years old) underwent oral exams and provided unstimulated saliva samples. A multiplex ELISA assay from MSD technology was used to detect nine salivary cytokines (IL-1 $\beta$ ,IL-2,IL-4,IL-6,IL-10,IL-12p70,IL-17A,IFN- $\gamma$ ,TNF- $\alpha$ ,) with femtogram-level sensitivity. The patients were divided into two groups based on the absence (Gr1, n=17) or presence (Gr2, n=17) of active carious lesions. Statistical analyses of the data were done using Mann-Whitney test for quantitative variables and Fisher exact test for qualitative variables.

**Results** No difference was observed between the two groups regarding average age (25.35±3.22 vs 23.71±3.55, p=0.193), salivary flow (p=0.889), plaque index (p=0.216) and gingival inflammation (p=0.481). Salivary concentration of all cytokines was higher in patients with caries, the



difference was significant for five of them: IL-2 (p=0.041), IL-6 (p=0.048), IL-10 (p=0.013), IFN- $\gamma$  (p=0.024) and TNF- $\alpha$  (p=0.016).

**Conclusions** Oral health reflects a complex interplay between the host immune response and diverse microbial communities within distinct oral niches. This study explores the potential of salivary cytokines as biomarkers for caries development. Saliva's accessibility and non-invasiveness for collection make it a valuable tool. We aim to establish a comprehensive oral immune profile to identify specific salivary signatures associated with oral health and disease.

Cytokines levels (fg/mL)

	IL-1β	IL-2*	IL-4	IL-6*	IL-10*	IL-12p70	IL17A	IFN-γ*	TNF-α*
Mean Gr1	2.19E+05	9.75E+01	3.25E+01	1.28E+04	3.26E+02	2.19E+02	5.20E+02	4.94E+01	1.88E+03
SD	1.00E+05	4.34E+01	1.46E+01	1.55E+04	2.92E+02	7.67E+01	4.40E+02	2.22E+01	1.30E+03
Mean Gr2	2.73E+05	1.52E+02	5.02E+01	1.90E+04	1.18E+03	3.64E+02	2.62E+03	1.53E+02	5.39E+03
SD	8.47E+04	1.24E+02	4.28E+01	1.45E+04	1.20E+03	3.18E+02	4.39E+03	1.74E+02	8.27E+03

\*p<0.05

# 0220

# Cerium(III) Chloride Pretreatment Reduces Initial Caries Biofilm Formation in Vitro

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**Objectives** The incorporation of cerium instead of calcium into the crystal lattice of hydroxyapatite appears to increase the resistance of enamel to caries lesion initiation and progression. The effect on initial biofilm formation is not yet known. The aim of this study was to assess the effect of cerium(III) chloride (50%CeCl<sub>3</sub>) pretreatment of hydroxyapatite (HA) discs on subsequent growth of a 3 species caries-biofilm.

**Methods** Twelve 9.5 mm diameter hydroxyapatite discs were divided into three groups (n=4) and treated for 1 minute with either 50% CeCl<sub>3</sub>, ultrapure water (control), or 0.02% chlorhexidine digluconate (CHX) and washed twice in ultrapure water for 1 minute. Samples were incubated in artificial saliva at 21°C for two hours and then placed in an active attachment caries biofilm model comprising *Actinomyces naeslundii*, *Schaalia odontolytica*, and *Streptococcus mutans* and cultured anaerobically at 37°C for 4 hours before being fixed in 2.5% glutaraldehyde and examined using scanning electron microscopy (SEM) and energy dispersive x-ray analysis (EDX) in high-vacuum mode.

**Results** SEM-micrographs at a magnification up to 50,000x showed net-like or spherical precipitates on the surface of all CeCl<sub>3</sub> samples but not on the control or CHX samples. Samples treated with CeCl<sub>3</sub> also showed signs of acid attack possibly due to the low pH (2.6) of the CeCl<sub>3</sub> solution. Rods and cocci were



found on all controls, but only on 2 of 4 CHX samples. 1 of the 4 CeCl<sub>3</sub> samples harbored isolated cocci. EDX-analyses confirmed the presence of cerium in all CeCl<sub>3</sub> samples with atomic percent (At%Ce) ranging from 0.1 to 0.4 for areas without visible precipitates and up to 4.1 for areas with precipitates. **Conclusions** CeCl<sub>3</sub>-treatment before pellicle formation results in the development of precipitates on the surface of HA and appears to have potential to inhibit initial biofilm growth on HA compared to CHXtreated or untreated controls.

0221

# Development of an Ex-Vivo Model to Study Dental Carious Lesions

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**Objectives** An entire tooth culture model has been developed to investigate the pulp regeneration potential upon its interaction with pulp capping materials. This study aims at extending this model for studying the interaction of materials with cariogenic bacteria and the target cells.

**Methods** Third molars extracted for orthodontic reasons were collected under sterile condition. Occlusal cavities were performed and human saliva and S.mutans suspension were applied to the coronal tooth surface to establish a biofilm. A home-made system was employed to immerse the radicular part of the tooth in supplemented MEM medium for a 3-week tooth culture period, preserving dentin-pulp complex activity. Throughout this period, the cavities were incubated alternatively in a nutrition medium (10% sucros) and fasting periodes (1% sucrose) with measurement of pH variations. After 3 weeks, the biofilm was harvested and analyzed using optical microscopy and Gram staining. Demineralization of hard tissues was assessed using X-ray radiograph, visual examination and autofluorescence technology (Soprolife®). Finally, histological sections were prepared to evaluate the dentin-pulp complex and cariogenic bacteria progression in the dentin using immunofluorescence (DAPI).

**Results** A decrease of pH to 5.5 was observed after 6h. Visual observation and Gram staining confirmed the presence of bacteria and biofilm production. While no demineralization was observed using X-ray, both visual observation and auto-fluorescence analysis revealed a modification in the enamel and dentin. Finally, histological sections confirmed a hard tissue disorganization and carious progression through the presence of bacteria in the dentin tubules.

**Conclusions** These preliminary results suggest that the entire tooth culture model holds promise in simulating the carious lesion progression and the subsequent dentin-pulp response. By preserving the dentin-pulp activity and producing a biofilm, this model represents a suitable tool in investigating vital pulp therapy under similar clinical conditions.

# 0222

# Nanoceramic Composite and Giomer With Finishing/Polishing Systems: Biofilm Formation

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**Objectives** This in vitro study aimed to evaluate the effects of different finishing and polishing systems on the biofilm formation of a nanoceramic composite and giomer.

**Methods** Nanoceramic composite (Ceram-X Spheretec One, Dentsply Sirona) and giomer (Beautifill II, Shofu Inc.) were investigated. 120 disc-shaped specimens (diameter:4 mm, height: 2 mm) were prepared using teflon mold and divided into 6 groups according to the finishing and polishing system: 1) FP1: Mylar strip (control group), 2) FP2: diamond bur, 3) FP3: bur+multiple-step system consisted of OptiDisc (Kerr Corp), 4) FP4: bur+OptiDisc followed by Occlubrush (Kerr Corp), 5) FP5: bur+OptiDisc followed by Diapolisher diamond paste (GC Europe), 6) FP6: bur+OptiDisc followed by Enamel Plus Shiny paste (Micerium S.p.A).Bacterial biofilm structures were generated by adherent *Streptococcus mutans* on the test models (n=5). Then, the biofilm formation levels were detected spectrophotometrically at 620 nm after being stained by crystal violet for biofilm formation analyses. Scanning electron microscopy (SEM) was also used to evaluate the surface morphology and biofilm formation levels. Two-way ANOVA and Bonferoni tests were used for statistical analysis (p<0.05).

**Results** Regarding the finishing and polishing systems, for nanoceramic composite, the groups polished with polishing pastes (Group FP5 and Group FP6) showed significantly lower biofilm formation than Group FP2 (p<0.05). For giomer composite, Group FP4 and Group FP5 showed lower biofilm formation than Group FP2 (p<0.05). Regarding the restorative materials, for Group FP6, giomer showed significantly higher biofilm formation than nanoceramic composite (p<0.05). SEM revealed that lower biofilm formation the surface of Group FP5 than Group FP2 for both of restorative materials. (Figure)

**Conclusions** The findings suggested the importance of selecting appropriate finishing and polishing techniques customized to specific materials to minimize biofilm accumulation.

# 0223

### Antimicrobial Effects of Some Restorative Materials for Direct use.

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**Objectives** Secondary caries is still a challenge worldwide. Dental materials may contribute positively or negatively to the risk of secondary caries. Increased or decreased bacterial adhesion depending on material and surface, antimicrobial and/or remineralizing effects, and change of pH close to restoration are all factors that have caught research interest. Previous studies have shown inconclusive evidence for restorative materials' ability to either induce or prevent the development of secondary caries. The aim of the present study was to investigate 1 experimental and 4 direct restorative materials regarding differences in pH-affecting properties, adherence of biofilm, fluoride leakage and surface topography. **Methods** Sixty-three standardized specimens: one experimental, three contemporary composites and one resin-modified glass ionomer, respectively, were produced and incubated (48 hours, 37°C) in a multispecies bacterial suspension (*S. mutans, S. mitis, S. salivarius, S. sanguinis* and *L. acidophilus*) at pH 4.5, 5.5 and 7.0. Two control groups were used. Biofilm was collected throughout the trial and analysed with qPCR. Assays' pH and fluoride concentration were monitored. Atomic force microscopy was used to





evaluate surface topography. The results were statistically evaluated (a=0.05).

**Results** The findings of the present study displayed that two of the tested materials had an impact on overall bacterial growth at different pH; not significant, however. Significant effects on specific strains at different pH were observed (i.e., *S. mutans* and *L. acidophilus*) for 3 of the materials tested. The smoothness of the surface was pH-dependent. *L. acidophilus* exhibited significantly lower attraction to smoother materials. No relation between fluoride release and bacterial growth could be observed. The tested experimental material did significantly affect the pH of the assays.

**Conclusions** The composition and surface roughness of dental materials for direct use seem to be of importance for the growth of cariogenic bacteria at different pH.

### 0224

### **Dentine Protection by Stannous Fluoride-Containing Toothpaste**

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**Objectives** Exposed dentine in the oral environment is at risk from mechanical damage due to brushing or mastication as well as chemical dissolution due to acidic food or bacterial attack. Stannous fluoride (SnF<sub>2</sub>) in toothpaste forms a barrier over exposed dentine, protecting it from mechanical and chemical attacks. The objective of this study was to evaluate the protection offered by two commercially available toothpastes containing SnF<sub>2</sub> compared to an experimental Sensodyne toothpaste formulation containing SnF<sub>2</sub> using nanoindentation and scanning electron microscopy (SEM).

**Methods** 32 human dentine samples were divided into 4 treatment groups, one per toothpaste, and one artificial saliva (AS) control group (each n=8). The samples underwent brushing twice daily for 2 minutes over 4 days and were stored in AS between brushings. Following this, 3 samples were extracted for surface imaging using SEM to confirm the formation of protective layers, while 5 samples were subjected to nanoindentation using a Berkovich tip. Subsequently, the samples were immersed in 15 ml of 1 wt.% citric acid solution (pH 3.8) for 2 minutes to assess the resistance of the protective layers formed by each toothpaste against acid challenge. This involved repeating the nanoindentation process to measure hardness and calculate percentage changes, as well as reimaging the samples to observe any surface changes.

**Results** Nanoindentation data showed that the layer formed by the experimental Sensodyne toothpaste formulation containing SnF<sub>2</sub> was harder than the dentine control and commercial formulations. It also had a significantly smaller hardness reduction after the citric acid challenge.

**Conclusions** Following 4 days of brushing, the experimental Sensodyne formulation formed the hardest layer with superior acid resistivity. Therefore, it may provide better protection against the mechanical, chemical, and abrasive challenges within the oral cavity.



#### 0225

### Evaluation of Color Stability of 3 Different Single-Shade Composite Materials

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**Objectives** The aim of this study was to evaluate and compare the effect of coffee and a whitening mouthwash on color stability of three single-shade resin composite materials.

**Methods** 3 single-shade resin composites (Tokuyoma Omnichroma-OMN, Kulzer Charisma Diamond One-ONE, FGM Vittra Unique-UNQ) were tested. From each composite 10 disk-shaped (5 x 4 mm) were prepared (n = 10) samples. Each group was then divided into two subgroups (n=5); coffee and distilled water immersion. Color measurements were made at initial, first day and 7th day using a clinical spectrophotometer (VITA Easyshade) according to the CIELab color system. After 7 days of coffee immersion, all samples were immersed in whitening mouthwash (Listerine Advanced White) and shaked continuously for 60 seconds, rinsed under running water for 30 seconds. Then were placed in distilled water. After this 4-week bleaching cycle, color measurements were made. One-way analysis of variance (One-way ANOVA), Tukey post-hoc test and independent t-test statistical analyses were used to evaluate color changes ( $\Delta$ E) and significance level was set as p ≤ 0.05.

**Results** According to the data obtained, after one day of immersion in coffee, Group OMN 7,58(0,24)<sup>a</sup> was significantly less colored than the other groups. After one week of coffee immersion, Group UNQ 12.83(0.66)<sup>b</sup> was significantly more colored. After whitening mouthwash, Group OMN 7.6 (0.45)<sup>a</sup> whitened the most and Group UNQ 11.23 (0.43)<sup>c</sup> whitened the least.

**Conclusions** The use of coffee causes discoloration of composite restorations. Whitening mouthwashes without hydrogen peroxide can contribute slightly to whitening by removing superficial staining without extra whitening effect on composite restorations. The effect is lower than other professional teeth whitening methods. It can therefore be considered as a complementary treatment to prevent recurrent tooth and restoration discoloration.

#### 0226

### What Are the Three-Dimensional Characteristics of Incisor Symmetry?

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**Objectives** Our study aimed to investigate the tridimensional (3D) symmetry of the four maxillary incisors. A clinical trial involving 59 participants aged 20 to 25 was conducted to assess the symmetry of these crucial dental structures.

**Methods** Geomagic Control X<sup>®</sup> (3D System, USA) software was employed to scrutinize STL files, focusing on the labial surface of the incisors. After segmentation of the model, the reference labial surface was flipped and adjusted to ensure alignment with the corresponding controlateral labial surface. Positive deviation values indicated differences (in  $\mu$ m) observed in areas where the tested incisor protruded more than the reference incisor. Negative deviation values indicate areas where the tested incisor was less prominent than the reference incisor. Statistical analyses were performed on positive and negative



deviations for each incisor, utilizing XLStat® (Addinsoft, France).

**Results** Teeth with high symmetry showed variations along incisal edges, while anatomically diverse teeth displayed differences at transitional line angles. Quantitatively, no significant difference in 3D symmetry was found between central and lateral incisors (p = 0.539), nor were there any sex-related differences (central: p = 0.643, lateral: p = 0.271). Orthodontic factors exhibited no significant impact on symmetry (central: p = 0.532, lateral: p = 0.962), and no correlation was observed between dominant hand usage and brush pressure.

**Conclusions** Our 3D analysis aligns with existing 2D literature, revealing minimal instances of identical incisor dimensions. Comparable deviations in length and width are observed in both central and lateral incisors. Tridimensional symmetry remains consistent across orthodontic treatment status and gender, suggesting its independence from such parameters. However, the influence of wear on asymmetry within this cohort remained inconclusive.

### 0227

# Tooth Discoloration Induced by Hydraulic Calcium Silicate Cements After Pulpotomy.

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**Objectives** To compare coronal discoloration 1 and 2 weeks, 1 and 3 months after full pulpotomy in anterior teeth using different hydraulic calcium silicate cements (HCSCs).

**Methods** A coronal pulpotomy was performed in eighty anterior extracted teeth. In half of them the pulp chamber was filled with blood and the rest with serum. Specimens were further divided into five experimental groups according to the HCSC used (n=8): 1) Control group; 2) Biodentine; 3) ProRoot WMta; 4) NeoMta2 and 5) Neoputty. Color parameters (L\*a\*b\*) were determined with VITA Easyshade spectrophotometer before HCSCs placement (T0), after 1 week (T7), 2 weeks (T2w), 1 month (T1m) and 3 months (T3m). Colour change was calculated by  $\Delta$ E00. $\Delta$ E00 values among HCSCs were compared by Kruskall-Wallis and Mann-Whitney tests and the influence of time by Friedman and Wilcoxon tests(p<0.05).

**Results** Similar  $\Delta$ E00 were detected for all the HCSCs tested at different evaluation times when they were placed over serum. Moreover, only teeth treated with Biodentine exhibited a significant higher  $\Delta$ E00 after 1 and 3 months, in comparison with one-week measurements. Regarding specimens filled with blood only specimens treated with Neoputty and Prorroot WMta showed significantly higher  $\Delta$ E00 at 1 week and 1 month evaluation, respectively. The increase in  $\Delta$ E00 was significant for Biodentine after 1 month and for Proroot WMTA, after 1 and 3 months.  $\Delta$ E00 remained similar for NeoMTA2 and Neoputty specimens in presence of blood.

**Conclusions** All HCSCs exhibited perceptible  $\Delta$ E00 values after 1 week that were not clinically acceptable. Colour changes increased with time, especially for those cements that were in contact with blood, except for NeoMTA2 and Neoputty. After 3 months all HCSCs exhibited a similar color change.



#### 0228

## Color Comparison of Overlays Made With E.max<sup>®</sup>Press and E.max<sup>®</sup>CAD

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**Objectives** Ceramic overlays are part of modern tissue preservation, adhesive and aesthetic dentistry. Materials composition, production processes and indications are some of the factors behind the development of different types of ceramics. E.max<sup>®</sup>CAD blocks and E.max<sup>®</sup>Press ingots by Ivoclar Vivadent enable the design of such dental restorations. But clinical observation seems to reveal a difference in color, and therefore in aesthetic results.The aim of this in vitro study was to compare the color of lithium disilicate overlays produced by hot-press and CAD-CAM techniques at different design stages.

**Methods** Flat occlusal veneers (n=4) were fabricated from low-translucency (LT) and high-translucency (HT) A3-shaded E.max<sup>\*</sup>Press ingots and E.max<sup>\*</sup>CAD blocks. Color measurements were recorded using a spectrophotometer (CM-2600d, Konica Minolta) after each stage (production, staining, fitting, "try-in" and bonding to in vitro models) and compared using the CIELab color system. Color differences between each material of the same translucency were calculated using the  $\Delta E_{cmc}$  formula.

**Results** Immediately after production, a color difference was noted between E.max<sup>\*</sup>Press and E.max<sup>\*</sup>CAD overlays ( $\Delta E_{cmc}$ =5.2 for HT and  $\Delta E_{cmc}$ =2.2 for LT). Staining increased the chroma (C\*) and decreased the lightness (L\*) of all overlays, reducing the color difference between them. Color measurements after the "try-in" and bonding stages were relatively similar.

**Conclusions** The colorimetric results confirmed the difference in shade perceived by the observer between E.max<sup>\*</sup>Press and E.max<sup>\*</sup>CAD. This difference could be explained by their structure and production process involving various firing cycles. However, the experience of the dental technician is an important factor in the aesthetic harmonization of indirect partial restorations. Colored glycerin gels also enable the practitioner to enhance the final aesthetic result. Nevertheless, the color difference may be minimal compared to the clinical reality and visual sensitivity of each observer.

### 0229

### Evaluation of Immediate Bond Strength of Paste-Type RMGI Cements

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**Objectives** Paste-type resin-modified glass ionomer (RMGI) cements are widely used because of advantages such as their ease of use. The immediate adhesion of cements is important for clinical performance, making it an important evaluation criterion. Therefore, the purpose of this study was to evaluate immediate bond strength of RMGI cements.

**Methods** FujiCEM Evolve (FCE; GC), Riva Cem Automix (RCA; SDI), RelyX Luting Plus Automix(RX; 3M ESPE) were evaluated. Bovine dentin surfaces were polished with 600-grit SiC paper. Adherend surfaces of stainless-steel rods were sandblasted.

RMGI was mixed, placed on the rod, and bonded to the bovine tooth. Then, 10N load was applied for 10



seconds and excess cement was removed.

For immediate bond strength evaluation, the specimens were incubated at 37 °C 90%R.H. for 3 minutes (n=5). For 1day bond strength evaluation, the specimens were incubated at 37 °C 90%R.H. for 1 hour and then immersed in 37 °C distilled water for 1 day (n=10).

Tensile bond strength (TBS) was measured by universal test machine (SHIMADZU AG-I). [Crosshead-speed 1mm/min, Wilcoxon rank sum test, p<0.05]

**Results** FCE showed the highest immediate TBS among the three products. RCA and RX had very low immediate bond strength. One day bond strength of FCE and RX were higher than immediate strength. One day bond strength of FCE was equivalent to that of RX. On the other hand, RCA did not show increased bond strength after one day.

**Conclusions** FCE showed highest immediate bond strength among other products. Therefore, it is suitable for restorations where high bond strength is required, such as low-retention preparations. In addition, it is suggested that FCE may have a high durability for external factors and be expected to bring good clinical result.

TBS/MPa (S.E.)	FCE	RCA	RX
3 min	2.5(0.2) A	0.4(0.1) B	0.8(0.1) B
1 day	5.7(0.5) a	0.4(0.1) b	6.3(0.8) a

Different letters indicate significant differences (p<0.05).

0230

# Root-Conditioning Effect on Bond Strength of an Experimental S-PRG Sealer

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**Objectives** To evaluate the effect of root canal pretreatments with dimethyl sulfoxide (DMSO) and/or ethanol (EtOH) on the push-out bond strength of an experimental prereacted glass containing (S-PRG)-root canal sealer.

**Methods** Single root canals of 42 extracted human premolars were decoronated 1-mm above the cemento-enamel junction and instrumented using Protaper rotary instruments (Dentsply Maillefer, Ballaigues, Switzerland), up to Protaper F4. Canals were irrigated with 5 mL of 2.5% sodium hypochlorite after each instrumentation. Fiber post-preparation burs (size #3, 3M ESPE RelyX, St. Paul, USA) were used to standardize the canal diameter, and a final rinse of 1mL 17% ethylenediaminetetraacetic acid (EDTA) was applied for 1 min, followed by 5ml distilled water and dried with paper point. Teeth were distributed into six balanced groups (n=7). Groups consisted of root canal pretreatments with 1.5µL of 100% ethanol (EtOH), 100% DMSO, 50% DMSO /water (DMSO/H2O) or ethanol (DMSO/EtOH), and 50% ethanol/water (EtOH/H2O) for 60s.and filled with the experimental S-PRG sealer (Shofu Inc, Kyoto, Japan. Groups pretreated with water only served as control. Filled roots were water-stored (37C/7 days), and after that sectioned horizontally (1-mm thickness) and subjected to push-out bond strength testing using a



universal testing machine. Failure modes (adhesive/mixed, cohesive) were evaluated with SEM. Data were analyzed using one-way ANOVA and Tukey's post-hoc test ( $\alpha$ =0.05).

**Results** No significant difference was observed between pretreatment or no-treatment groups at the coronal or middle root canal section (*p*>0.05). DMSO/H2O and 100% (EtOH) pretreatments significantly increased the push-out bond strength at the apical region compared to other treatments (p<0.05). Failure analysis confirmed increased cohesive failures with pretreatment.

**Conclusions** The utilization of DMSO/H2O and 100% EtOH root-canal pretreatments in combination with the experimental S-PRG root sealer improved bonding at the apical region, resulting in a more homogenous bonding interface throughout the root canal.

### 0231

### Biomineralization of Cellulose Nanocrystal Scaffolds for Bone Tissue Applications

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**Objectives** This study aimed to biomineralize cellulose nanocrystals (CNC) scaffolds and evaluate their biocompatibility with osteoblast cells as a potential bone graft substitute.

**Methods** CNC-reinforced gelatin scaffolds were produced using a casting solution method followed by freeze-drying. An ether-derived compound, 1,4-butanediol diglycidyl ether, was used for crosslinking to promote the formation of covalent bonds between gelatin and CNC. The CNC scaffolds were then cut into  $\emptyset$  12 mm discs (n = 21) of 3 mm thickness. Before mineralization in simulated body fluid (SBF), the CNC scaffolds were alternately soaked in calcium chloride and sodium phosphate solutions for 15 min each. The samples were then mineralized in 1.5-fold 20 ml SBF at 37° C for 24, 48, 72, and 96 h. The Calcium (Ca<sup>2+</sup>) and Phosphate (PO<sub>4</sub><sup>3-</sup>) ion concentrations in the SBF were measured by inductively coupled plasma-optical emission spectrometer (ICP-OES) at all time points. The mineralized CNC scaffolds were also characterized by scanning electron microscope (SEM) and energy dispersive x-ray spectroscopy (EDS) analysis. The MC3T3-E1 osteoblast cell proliferation was assessed on samples mineralized for 96 h after 24 h of culture.

**Results** ICP-OES analysis showed a significant (p < .001) decrease in the Ca<sup>2+</sup> and PO<sub>4</sub><sup>3-</sup> concentration in the mineralization solution at all time points compared to fresh SBF. Consequently, this resulted in a notable increase in the weight of the CNC scaffolds by 50% at 48 h and later time points. Also, SEM-EDS analysis of the surface and cross-section of the CNC scaffolds showed the presence of Calcium-Phosphate compositions on the surface and inside the scaffolds. Compared to the control, more than two-fold osteoblast cell proliferation was observed on the mineralized CNC scaffolds.

**Conclusions** Biomineralized CNC scaffolds are not only biocompatible, but they can also enhance the proliferation of osteoblast cells.



### 0232

# Initial Paste pH of New Hybrid-RMGI Liner/Base/Pulp-Protectant Material

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**Objectives** A low, acidic initial pH is a necessary (but not sufficient) factor needed to facilitate tooth adhesion. The aim of this study is to measure/compare the early-stage pH of an experimental hybrid-RMGI material from Solventum to commercially available liner/base/pulp-capping materials. **Methods** For initial pH measurements, a pH electrode was calibrated with three pH buffers. For each material, all stages prior to light curing were followed according to the manufacturers' IFU preparing 2 mL of material. The mixed material was transferred to a capped 10 ml syringe-tube. The pH probe was submerged in a cup of DI water and gently removed leaving a thin layer of the DI water on the surface of the pH probe bulb. The probe was gently submerged into the mixed paste and stabilized for 30 sec. Subsequently, the pH was recorded every 30 sec for 5 min. After the last measurement, the probe was removed, cleaned, and recalibrated.

**Results** The mean values for pH measured at 1,3,5 minutes along with the resulting standard deviations (n=3) are shown below. Data was analyzed using one-way ANOVA with 95% confidence Tukey's method. The pH of the DI water, which could not be tested accurately via the pH probe, was 5.0 via a pH strip. **Conclusions** The pH of the experimental hybrid-RMGI material at 1,3,5 minutes was low, around 3.6-3.7, and statistically similar to VBP, ABA, and FLP. LLE showed a pH around 5.4 similar to DI water and did not seem to have the potential to impact the pH. LLE was also not statistically similar to any other material. TLC showed a pH around 10.5 and PVD showed a pH around 11.7. The 1 min mark of PVD was statistically similar to the 3 min and 5 min mark of TLC.

### 0233

# SEM Evaluation of Polishing Gel Based on Perlite and Hydroxyapatite

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**Objectives** To evaluate the qualitatively effect of a polishing gel based on perlite and hydroxyapatite (Reslience<sup>®</sup>) on different tooth surfaces through the Scanning Electron Microscope (SEM) and through X-ray microanalysis (EDS - Energy Dispersive X-ray Spectrometry).

**Methods** 4 surface chosen: a natural tooth, a tooth with composite, a tooth with ceramic crown and a tooth with amalgam. Ultrasound scaling. A notch was made to divide the crown into two surfaces (test/control). The control side was isolated with adhesive tape. The test side was treated with Resilience® gel with cup on a low speed handpiece for 20 seconds and rinsed. Samples were observed to SEM (Supra 40, Zeiss ©, Germany). Three surface roughness indices (Rq,Ra,SA) were evaluated throught Fiji software (ImageJ), the EDS microanalysis was carried out.

**Results** Excepting for the amalgam restoration, the tested gel led to a smoother, homogeneous surface regarding the natural tooth, composite resin and ceramic crown.



The EDS analysis showed different atomic distribution according to the specific sample tested **Conclusions** SEM observations and the analysis of roughness indices demonstrated the effectiveness of Resilience© in 3 out of 4 cases. This polishing gel led to a smooth and homogeneous surface and was able to occlude the dentinal tubules.

### 0234

# Fatigue Resistance of Root Dentin After Laser Treatment

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**Objectives** Laser technology has emerged as a potential method for root canal disinfection. However, its impact on mechanical properties of root dentin remains uncertain. This study aimed to assess effects of Erbium or Diode laser irradiation, delivered through modified glass-fiber tips, on root dentin fatigue strength.

**Methods** Single-rooted teeth were used to prepare dentin beams (0.9x0.9x12 mm), which were divided into four testing groups: (1) Er:YAG 2940nm (PIPS; Fotona), (2) Er,Cr:YSGG 2780nm (RFT2; Biolase), and (3) Diode 960nm (Endo, Biolase) with 4) non-irradiated beams as controls. Laser disinfection followed established protocols for endodontic treatments using a dedicated root canal set up for laser application on the inner surfaces of root dentin beams. Irradiated beams were tested under 4-point-flexure at quasistatic loads (n=12) and then under cyclic loads (n=25). The stress-life fatigue behavior was evaluated using the staircase method at 4Hz and apparent endurance limits were calculated at 10<sup>7</sup> cycles. Fractured surfaces were evaluated using SEM. Monotonic data were analyzed by one-way ANOVA, and cyclic-loaded data were analyzed by Kruskal-Wallis on Ranks ( $\alpha$ =0.05).

**Results** Flexural strength results ranged between 151MPa to 121MPa for control and RFT2 respectively with no significant difference between the groups (p>0.05). The control group had the lowest apparent endurance limit (32.65MPa), while PIPS disinfection showed the highest endurance limit (37.97 MPa). A comparison of fatigue life distributions did not show significant difference among the test groups (p>0.05). Laser application induced surface alterations on dentin, as observed in SEM images.

**Conclusions** Laser application in root canals do not affect the fatigue strength of dentin, indicating its safety for root canal disinfection when applied with appropriate protocols.

0409

# Impact of Prolonged Cleaning Bath Times on 3D-Printed Resin Properties

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**Objectives** This study aimed to investigate to what extent prolonged cleaning bath times affect important material parameters of DLP printing resins.

**Methods** Test specimens (shape and dimensions according to the underlying standards) made of a total of three occlusal splint materials (VOCO V-Print splint (VPS), VOCO V-Print splint comfort (VPSC) and



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DETAX FREEPRINT splint 2.0 (FRS)) and two denture base materials (VOCO V-Print dentbase (VPD) and DETAX FREEPRINT denture (FRD)) were first cleaned according to the manufacturers' instructions (MI). For additional test groups storage times in isopropanol were prolonged by either 6, 15 or 60 min. Subsequently, the test specimens were subjected to various material tests to determine the mass-related water absorption capacity (WA, n=9-10/group), Vickers hardness (HV, n=11-12/group) and fracture toughness (FT, CNB method, n=11-14/group). Effects of relative parameter changes with respect to mean material properties determined for respective MI test groups were identified using two-way ANOVA. **Results** With respect to mean WA and HV measured for MI test groups, all materials showed a significant (p<0.05) yet varying degradation after dwell times in isopropanol prolonged by 60 min. WA increased (2% for VPSC to 20% for FRS and VPD) and HV decreased (20% for FRS to 70% for VPSC) for all materials. Meanwhile, it was found that only materials VPS, VPSC and FRD showed a significant decrease (10-, 20and 10%, respectively) in FT due to over-exposure to isopropanol. Changes partly manifested after short amounts of over-exposure. However, the most distinct changes for all material properties were found between 15 and 60 minutes.

**Conclusions** Deviations from the manufacturers' instructions during post-processing of 3D-printed splints or denture bases can lead to severe changes in material properties at the object surface. Dwell times in ultrasonic cleaning with isopropanol exceeding the recommended times by 15 min or more led to a significant degradation.

### 0235

### Analysis of Resin-Based Dental Materials Able to Release Monomers

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**Objectives** First, to provide an exhaustive list of all the resin-based dental materials sold in the market in 2023 and detail their monomer composition and second, to evaluate the repartition of BPA derivatives in their manufacturing in relation with their applications.

**Methods** a search on manufacturers' websites was performed to reference a list of resin-based dental materials currently on the market. The following categories of dental materials were selected : restorative composite resins and adhesive systems, orthodontic composite resins and adhesive systems, core build up composites, sealants, restorative resin modified glass ionomer cements and luting glass ionomer cements and composites. Then, their monomer composition was determined from material safety data sheets and completed with a search on instruction for use or on PubMed database.

**Results** Among the 543 material compositions exploitable, 382 contained BPA derivatives. Among them, 56.2% contained BisGMA, 28% BisEMA, the most frequently reported. A total of 59 monomers of which 6 BPA-derivatives were found. 309 materials contained UDMA and 292 TEGDMA. Finally, less than one third of materials identified contained no BPA derivatives. These proportions vary, depending on their applications with materials dedicated to dental care of young populations containing the highest proportions of BPA-derivatives monomers.

Conclusions Manufacturers should be required to indicate systematically the exact complete chemical



composition of their products. The long-term effects on human health of the different monomers identified including BPA-derivatives monomers is a source of concern. For children and pregnant or lactating women arises the question to take a precautionary principle and avoid the use of resin-based dental materials likely to release BPA by opting for alternative materials.

### 0236

# Gingival Keratinocyte Adhesion on Atomic Layer-Deposited Hydroxyapatite Coated Titanium

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**Objectives** The aim of this study was to evaluate the effects of the atomic layer deposited hydroxyapatite (ALD-HA) coating on human gingival keratinocyte (HGK) adhesion, spreading, growth, and hemidesmosome formation on the titanium surface.

**Methods** Grade 2 square-shaped titanium substrates were prepared (n=62). The HA coating was done by first depositing with ALD CaCO3, which was hydrothermally converted to HA. Half the substrates were ALD-HA coated, while the other half was used as non-coated control (NC). The ALD-HA coating underwent surface characterization through scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) analysis. The initial cell adhesion and hemidesmosome formation of HGKs were evaluated after a 24-hour cultivation period. The cell proliferation was detected by cultivating cells for 1, 3 and 7 days. In addition, the levels of adhesion proteins integrin  $\alpha$ 6 and  $\beta$ 4 were detected with the Western Blot method. Furthermore, high resolution imaging of cell areas and adhesion protein signals was established using a confocal microscope.

**Results** SEM-EDS analysis demonstrated the formation of HA crystals on the ALD-HA surfaces. The relative cell attachment was significantly higher (p< 0.05) on the ALD-HA surface compared to NC after 1 and 3 days of cell culture. No significant difference was found in integrin  $\alpha$ 6 or  $\beta$ 4 expression. The microscope evaluation showed significantly wider cells with peripheral hemidesmosome expression on ALD-HA surfaces compared to the NC (p= 0.0001). The signal of laminin  $\gamma$ 2 on the cell bottom layer was significantly higher on ALD-HA-coated surfaces compared to NC (p< 0.001).

**Conclusions** Based on the findings of this in vitro study, the ALD-HA coating enhances the attachment of HGKs and promotes the expression of adhesion proteins on coated titanium surfaces. The results of this study indicate that ALD-HA coating has good potential for improving mucosal attachment on implant surfaces.



### 0237

# Effects of ERM on PDLF With MTA and SuperEBA

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**Objectives** The purpose of this study was to evaluate the effects of epithelial rest of Malassez' (ERM) cells on periodontal ligament cementogenesis and osteogenesis with MTA and modified zinc oxide-eugenol cement (SuperEBA), with regard to apicoectomy.

**Methods** In in vitro studies, human periodontal ligament fibroblasts (HPLFs) and ERM were used. As retrofilling materials, MTA and SuperEBA were used. Experiment was divided into 6 groups: PLDFs as control group, PLDFs with MTA as MTA group, PDLFs with SuperEBA as SuperEBA group, PLDFs co-cultured with ERMs as ERM group, PDLFs with MTA co-cultured with ERMs as MTA+ERM group, and PDLFs with SuperEBA co-cultured with ERMs as SuperEBA+ERM group. HPLFs of each group at 7 days were analyzed using qRT-PCR with target genes of *SPON1, RUNX2, RANKL*, and *OPG* (n=5). Wound healing assay was carried out (n=5). In in vivo studies, after endodontic treatment and root-apex amputation of first molars of rabbit, MTA and SuperEBA were used as root-end filling materials. Two weeks after surgery, paraffin sections were stained and observed with Hematoxylin-Eosin and immunohistochemically, with primary antibody of anti-pan cytokeratin for detection of ERM cells. The data were analyzed by one-way ANOVA with post-hoc Tukey's multiple comparison test (*p*<0.05).

**Results** In in vitro studies, *SPON1* mRNA expressions of ERM group and MTA+ERM groups were significantly lower than those of control group and MTA groups. mRNA expressions of *RUNX2* and *OPG* in ERM group and MTA+ERM groups showed tendency lower than the control group and MTA group. In wound healing assay, HPLFs migration of MTA+ERM group showed a tendency to slow down compared with MTA group.

**Conclusions** These results indicated that ERMs may inhibit hard tissue formation. Therefore, it is suggested that inflammatory tissue which provoke proliferation of ERMs is necessary to be removed completely.

### 0238

# Development of Physical-Crosslinking Hydrogel as Filling Material for Biomedical Purposes

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**Objectives** Hydrogels as fillers materials are widely used in dentistry. Hydrogels' tunable properties (mechanical, chemical, biocompatible) and their similarity to the extracellular matrix (ECM) of oral tissues (OT) are at the core of their constant use in medical and dental applications such as endodontic and periodontal regeneration, OT healing, etc. Hydrogels consist of polymer chains, injected into the body in liquid form and converted into a solid hydrogel using chemical or physical crosslinking agents. The chemical reaction byproducts and free radicals involved in crosslinking may cause unintended interactions with OT, such as inflammation and cellular apoptosis. furthermore, fast gelation may produce



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a hydrogel with non-homogeneous viscosity. In the current work we developed a physically-crosslinked hydrogel that can elicit a minimal inflammatory reaction with non-toxic auto-crosslinking ability. **Methods** The hydrogels consisted of a tripartite combination: polyanion (hyaluronic acid (HA)), polyampholyte (gelatin), and cationic cellulose nanocrystals (cCNCs) as the crosslinking agent in different concentrations (3,5,7%). The zeta potential, FTIR spectroscopy, and structure recovery were evaluated at 37°C to assess hydrogel physical properties. Cellular cultures studies, including viability, proliferation, and ECM fiber organization, were used to estimate cytotoxicity and biocompatibility of the hydrogels.

**Results** The HA carbonyl bands shifted to 1616 and 1412 cm<sup>-1</sup> when mixing cCNCs and HA, demonstrating the intended interactions between the positively charged cCNCs' ammonium groups and the negatively charged HA's carboxyl groups. Rheological tests showed post-injection recovery of entangled HA networks. They maintained their properties after freeze-drying and re-dispersion, indicating viscoplastic behavior with high yield stress. Proliferation results showed normal growth at all cCNC concentrations after 24,48, and 72 hours of culture compared to controls. Collagen and elastin deposition was verified using immunofluorescent labeling.

**Conclusions** In light of its stability and biocompatibility, the formulated hydrogel offers a new platform to address oral and periodontal tissue regeneration and rehabilitation.

### 0239

### Counteracting the Effect of Bacterial Lipopolysaccharide on Dental Pulp Stem-Cells

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**Objectives** Drug-loaded non-resorbable polymeric nanoparticles (NPs) are proposed as an adjunctive treatment for pulp regenerative strategies. The present *in vitro* investigation aimed to evaluate the effect of NPs loaded with tideglusib (TDg-NPs) on the viability, morphology, migration, differentiation and mineralization potential of human dental pulp stem cells (hDPSCs) in the presence of bacterial lipopolysaccharide endotoxin (LPS).

**Methods** Cell viability, proliferation, and differentiation were assessed using a MTT-based assay; cell migration evaluation, cell cytoskeleton staining analysis, Alizarin Red S staining and expression of the odontogenic related genes by a real-time quantitative polymerase chain reaction (RT-qPCR) were also performed. Cells were tested with and without previous stimulation with LPS at different time points. One-way ANOVA and Tukey's test were employed for statistical analysis (p<0.05).

**Results** Adequate cell viability was encountered in all groups and at every tested time point (24, 48, 72 and 168 h), without significant differences among the tested groups (p>0.05). The analysis of cell cytoskeleton showed some nuclear alteration in cultures with undoped NPs after LPS stimulation. These cells exhibited an in blue diffuse and multifocal appearance. Some nuclei looked fragmented and condensed. hDPSCs after LPS stimulation but in the presence of TDg-NPs evidenced less nuclei changes. LPS induced down-regulation of alkaline phosphatase, osteonectin and collagen1 gene markers, after 21d. LPS significantly half-reduced the cells production of calcium deposits in all groups (p<0.05), except in the group in which hDPSCs were cultured with TDg-NPs where the decrease was only about 10%. **Conclusions** LPS induced two effects in cultured hDPSCs, *i*) lower mineral deposition and *ii*) lower F-actin



fibers content together with cytoskeletal disorganization and nuclei alterations. These effects were counteracted by TDg-NPs. Grant PID2020-114694RB-I00 and Grant PID2020–115887GB-I00 funded by MCIN/AEI 10.13039/501100011033.

### 0240

# Effects of ResolvinE1 and Maresin1 on PDL Fibroblasts With LPS

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**Objectives** The purpose of this study was to explore the effects of ResolvinE1 (RvE1) and Maresin1 (MaR1) on inflammatory response and bone remodeling ability of PDL fibroblasts under inflammation existence. **Methods** 

*In vitro* studies, human periodontal ligament fibroblasts (HPDLF) were incubated with mineralization medium. For LPS group, HPDLF were incubated with 1000ng/ml LPS. For RvE1 group, HPDLF were incubated with 1000ng/ml LPS and 0.1nM RvE1. For MaR1 group, HPDLF were incubated with 1000ng/ml LPS and 0.1nM MaR1. For control group, HPDLF were incubated with only mineralization medium. Effects of RvE1 and MaR1 on HPDLF (n = 5/group) were evaluated by ALP activity, alizarin red S staining, and qRT-PCR. qRT-PCR was performed targeting mRNA of *IL-1β*, *IL-6*, *RANKL*, *OPG*, *RUNX2*, and *PLAP-1* gene as markers. *In vivo* studies, the mesial pulp of the mandibular first molars of Wistar rats was removed and the cavity was opened for 6 weeks to induce periapical periodontitis. Then the root canal was treated with GIC. At 7 days after treatment, the mandible of each rat was extracted and processed for paraffin-embedded sectioning, then the samples were evaluated by H-E staining and immunohistochemical staining with IL-1β and IL-6 antibodies. The data were analyzed by one-way ANOVA analysis with post-hoc Tukey's multiple comparison test (p < 0.05).

**Results** *In vitro* studies, ALP activity, and the expression of bone-related genes of RvE1 and MaR1 groups were significantly higher than LPS group, and the expression of inflammation-related genes of RvE1 and MaR1 groups were significantly lower than LPS group. *In vivo* studies, IL-1β and IL-6 positive areas in immunohistochemical staining were reduced in both experimental groups.

**Conclusions** These results suggested that RvE1 and MaR1 reduce inflammatory response and promote bone remodeling ability of PDLF.

# 0241

# A Doped Hydrogel Overcomes Inflammatory Environment: an Osteoblasts/Macrophages Co-Culture

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**Objectives** The objective of this *in vitro* investigation was to evaluate the synergistic effect of osteoblasts and M1 macrophages differentiation, by direct crosstalk, in osteogenesis and osteoclastogenesis when cultured in a NP12 peptide loaded 3D collagen scaffold.

Methods A 3D collagen injectable tissue scaffold was created and NP12 peptide was loaded (50 nM). The cell-specific role and cell differentiation were investigated through osteoblast and proinflammatory macrophage-specific gene markers, phosphatase alkaline production and by histological tissue analyses. At least three independent studies were analyzed per experimental group. Data were analyzed for normalization and statistical significance was analyzed using Student's t tests (P<0.05). Results When macrophages were exposed to NP12, the M1 macrophages tended to express a higher proinflammatory phenotype after 48h. Osteoblasts cultured in NP12 doped scaffolds after 24h had a diminished pro-inflammatory expression, but after 48h RANKL and TNFa and were about 50% higher and alkaline phosphatase production was lower (10-times reduced) than in those osteoblasts not exposed to NP12. Further, when osteoblasts and macrophages were cultured together, an alkaline phosphatase elevated production (about 50% higher) and a decreased expression of most of the inflammatory markers (IL1B and TNF were 10-times reduced) was encountered in the presence of NP12 at 24h or 48h, if compared to cells that were not exposed to NP12. Osteoblasts curbed the osteoclastogenic differentiation of macrophages, reducing their pro-inflammatory lineages and the release of signaling factors. The osteoblast within the 3D coculture demonstrated increased ALP activity but express RANKL significantly different than the osteoblasts cultured with macrophages in a 3D collagen matrix with NP12. Conclusions NP12 in contact co-culturing has an anabolic effect on bone tissue in a bacteria-derived inflammatory environment. Osteoblasts and M1 macrophages in co-culture at the NP12-loaded scaffold reduced M1 pro-inflammatory phenotype and induced osteogenesis. Grant PID2020-114694RB-I00 funded by MCIN/AEI 10.13039/501100011033.

#### 0242

### Fluoride Varnishes: Efficacy to Deposit Fluoride Into Dental Enamel

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**Objectives** The in-vitro study estimated the fraction of the total applied fluoride (TAF) that is taken up by enamel (FU, fluoride uptake) when using varnishes for caries prevention.

**Methods** TAF: Varnishes were applied with the applicators provided by the manufacturer or a microbrush on defined areas of tared glass slides and dried. The applied dry varnish (ADV) was weighed with an analytical balance. The applied wet varnish (AWV) was estimated from volatile matter (VM) and ADV. TAF was calculated from the AWV and the labelled fluoride concentration (LFC) of the products. FU: Varnishes were applied on bovine enamel, dried, and incubated in artificial saliva for 4h. After varnish removal, loosely-bound fluoride was dissolved by soaking 24h in 1M KOH and measured with an ionselective electrode. Structurally-bound fluoride was etched from the same specimens with 0.1M HClO<sub>4</sub> for 15 minutes. FU is the sum of loosely and structurally-bound fluoride. The fraction of deposited fluoride (FDF) is the percentage of FU from TAF.



**Results** TAF in varnish layers varied from 94 to 1100  $\mu$ g/cm<sup>2</sup>. Between 8.6 and 21.6 $\mu$ g/cm<sup>2</sup> FU was found in bovine enamel after 4 h.

**Conclusions** Large differences in the total applied fluoride quantities for the different varnishes were measured. From 1 to 23% of the TAF was taken up by the enamel.

	ADV [mg/cm <sup>2]</sup>	VM [%]	AWV [mg/cm <sup>2]</sup>	LFC [ppm]	TAF [µgF/cm²]	FU [µgF/cm²]	FDF [%]
	mean±SD	mean±SD	mean		mean±SD	mean±SD	mean
Fluor Protector S (Ivoclar Vivadent)	3.22±0.57	73.5±0.00	12.16	7700	93.7±16.6	21.58±4.30	23.0
Duraphat Suspension (Colgate)	11.39±2.32	27.9±0.28	15.79	22600	356.9±72.8	10.07±1.04	2.8
MI Varnish (GC)	14.56±5.04	32.2±0.56	21.47	22600	485.3±168.2	8.57±2.44	1.8
Profluorid Varnish (VOCO)	13.10±2.60	23.8±0.54	17.20	22600	388.6±77.2	11.62±1.28	3.0
Clinpro White Varnish (3M ESPE)	33.74±9.82	16.3±0.27	40.32	22600	911.2±265.1	9.40±2.42	1.0
Bifluorid 10 (VOCO)	5.20±1.52	77.8±0.24	23.42	47000	1100.8±320.9	14.40±2.29	1.3

# 0243

# **Drug-Doped Nanogel for Dentin Remineralization**

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**Objectives** This study targets to assess the remineralization capability of conditioned dentin infiltrated with polymeric nanoparticles (NPs) doped with tideglusib (TDg) (TDg-NPs).

**Methods** Dentin conditioned surfaces were infiltrated with NPs and TDg-NPs. Bonded interfaces were created, stored for 24 h and submitted to mechanical challenging. Resin-dentin interfaces were evaluated through nanohardness, Masson's trichrome staining microscopy, and Raman analysis. ANOVA and Student-Newmann-Keuls were employed to ascertain for differences (p<0.05).

**Results** At the hybrid layer, dentin interfaces treated with TDg-NPs after 24 h (0.55±0.07GPa) and mechanically loaded (0.49±0.08GPa) attained the highest nanohardness (P<0.05). Any sample treated with TDg-NPs attained the highest *Hi* among all groups of study, at the bottom of the hybrid layer (P<0.05), ranging from 0.62±0.07GPa (dentin treated with TDg-NPs mechanically loaded) to 0.72±0.12GPa (dentin treated with TDg-NPs after 24 h). Active remineralization underneath the hybrid layer was detected in all



groups, after TDg application and load cycling, inducting new dentinal tubuli formation. Raman analysis confirmed the increase in mineralization, enriched carbonate apatite formation, and improved crosslinking and scaffolding of the collagen.

**Conclusions** Mechanical loading on the specimens obtained after TDg-NPs dentin infiltration inducts an increase of mineralization at the resin/dentin interface, indicating remineralization of peritubular and intertubular dentin with augmented crystallographic maturity in crystals. Enriched collagen quality was produced, generating an adequate matrix organization to promote apatite nucleation, TDg-NPs infiltration. Grant PID2020-114694RB-I00 funded by MCIN/AEI 10.13039/501100011033.

### 0244

# Calcium Hydroxide-Releasing Materials on Long-Term Collagen Degradation

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**Objectives** Collagen degradation in dentin is influence by the activation of host-derived enzymes under varying pH conditions. This study investigated the effects of calcium hydroxide-releasing or S-PRG-containing alkaline materials on host-derived enzymatic degradation and elastic modulus of coronal dentin.

**Methods** Sound human molar dentin beams (0.3×3×7mm) were demineralized in 0.5 M ethylenediaminetetraacetic acid (EDTA) and rinsed in distilled water at 4 °C for 2 hours under constant stirring. Following drying in a vacuum desiccator for 72 hours, beams were distributed into five groups (n=10/group) based on dry mass. Mimiciking a clinical scenario, occlusal surfaces were placed in contact with material blocks (1×3×7mm) prepared from four materials: (1) Bio-C Repair, (2) S-PRG sealer (3) Orbis MTA, and (4) TheraCal. Untreated beams served as control. Specimens were incubated in 0.5 ml artificial saliva and aged in a water-shaking bath (37°C with 60 rpm speed) for up to 6 months. Dry mass and elastic modulus (E) were reassessed, and aliquots of incubation media were analyzed for hydroxyproline (HYP) to quantify total collagen degradation. Data were analyzed using Kruskal-Wallis tests (α=0.05).

**Results** Bio-C exhibited the highest cumulative HYP release (23.3 µg HYP/mg dry dentin), representing a nine-fold increase compared to the control group (2.5 µg). Additionally, Bio-C showed the highest dry mass loss, reaching 62% at 6 months, significantly differing from the control, S-PRG, and TheraCal groups (p<0.05). Elastic modulus values followed a similar trend. At three weeks, Bio-C showed a dramatic decrease in E, showing a significant difference from control and TheraCal groups (p<0.05). By the end of the experiment, both Bio-C and Orbis showed significant differences between initial and final E values (p=0.002).

**Conclusions** Calcium hydroxide-releasing materials were associated with increased degradation of the collagen matrices. This could potentially compromise the long-term treatments.



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#### 0245

### Maxillary Lateral Incisor Agenesis and Anterior Bolton Tooth Size Discrepancy

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**Objectives** To determine whether cases with congenitally missing maxillary lateral incisor (uni- or bilateral) present with anterior Bolton tooth size discrepancies when space closure is carried out. **Methods** This was a cross-sectional case control study in which anterior Bolton tooth size discrepancies between patients with maxillary lateral incisor agenesis and those without dental anomalies was evaluated. All patients from the archives of an orthodontic clinic were searched to find patients that complied with the following inclusion criteria: isolated maxillary lateral incisor agenesis (without other dental anomalies); panoramic radiographs available; dental casts available with all anterior teeth including permanent canines erupted. From the 3'876 patients screened, 41 cases were selected based on inclusion criteria. A random sample of 41 control patients without dental anomalies were subsequently selected for comparison. Anterior Bolton tooth size discrepancy analyses were performed for all patients under the following assumptions: 1) simulated unilateral space closure with mesialisation of the canine and first premolar (for unilateral agenesis cases); 2) simulated bilateral space closure with mesialised of both canines and first premolars (for uni- and bi-lateral agenesis cases). Independent sample t-tests were undertaken to compare discrepancies between agenesis and control patients.

**Results** From the 41 total agenesis patients included, 19 presented with unilateral and 22 with bilateral agenesis. Simulated unilateral space closure resulted in a Bolton mandibular excess of 0.9mm, while simulated bilateral space closure in a mandibular excess of 0.8mm in unilateral agenesis cases and no excess in bilateral agenesis cases. These discrepancies were statistically significant (p<0.05) for the unilateral agenesis group.

**Conclusions** When performing space closure in maxillary lateral incisor agenesis cases, one may finish treatment with an anterior Bolton mandibular excess in unilateral agenesis cases, both when closing the space unilaterally, or when deciding to extract the contralateral tooth and close spaces bilaterally.

### 0246

### **Tooth Color Changes After Debonding of Clear Aligner Attachment**

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**Objectives** The aim of this in-vitro study was to evaluate the effects of different burs used in the debonding phase of clear aligner attachment on tooth color.

**Methods** 4 mm conventional rectangular resin attachment was bonded to the center of the buccal surfaces of 36 extracted bovine teeth, and were randomly divided into three groups according to different bur types used for removal resin (n=12); Group 1: 12-bladed tungsten carbide bur (Komet, Germany); Group 2: 24-bladed tungsten carbide bur (Komet, Germany); Group 3: 12-bladed titanium nitrate-coated attachment resin removal carbide bur (Komet, Germany). Burs were used with low-speed handpiece. Color measurements were taken from the middle surfaces of the teeth before bonding (T0) and after removing the attachments (T1) with VITA Easyshade V (VITA Zahnfabrik, Germany). Attachment debonding duration was also measured. Dependent sample t-test and Wilcoxon test were used for evaluation of L\*,



a\*, b\* changes. ANOVA test and Bonferroni test were performed to compare  $\Delta E$  measurements and debonding duration between the groups.

**Results** Statistically significant differences were found in L\* values between all groups, and a\* values between group 1 and 2 (p<0.05). In all groups, L\* values were significantly decreased after attachment removal. In groups 1 and 2, a\* values increased significantly.  $\Delta E$  values were significantly different within the groups (p<0.05) with the most pronounced color change observed in group 2 (p=0.017). The attachment removal duration was significantly higher in group 2 than group 1 (p<0.001) and group 3 (p<0.001).

**Conclusions** Resin removal with 12-bladed titanium nitrate-coated attachment resin removal carbide bur led to least color alteration. The 24-bladed tungsten carbide bur caused the most color alteration and the longest resin removal phase. Visible and clinically unacceptable tooth color alterations were observed after resin removal of clear aligner attachments regardless of the usage of different burs.

### 0247

### Sagittal Cephalometric Characteristics in Females With Turner Syndrome

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**Objectives Objectives**: The primary aim of this meta-analysis was to assess the sagittal cephalometric characteristics in females with Turner Syndrome (TS) as compared to non-syndromic females. **Methods Methods**: A literature search was carried out using six electronic databases to identify controlled studies investigating the sagittal lateral cephalometric characteristics in females with TS, with the last search performed in February 2024. Cephalometric measurements analyzed in three or more studies were put to meta-analysis, using the random-effects model. Subgroup meta-analyses were subsequently carried out based on karyotype (45,X karyotype, mosaic, isochromosome). Risk of bias in the included studies was evaluated with the modified AXIS tool.

**Results Results**: From the initial 195 records identified, seventeen studies and eleven sagittal cephalometric measurements were analyzed. 417 unique patients with TS, coming from 10 different European countries, participated. All the sagittal linear measurements compared – namely S-N, N-Ba, Go-Gn, Go-Pg, and ANS-PNS - were significantly reduced in those with TS. Concerning the six angular measurements compared, the A-N-B angle showed no difference between the groups, whereas the S-N-A, S-N-B and S-N-Pg angles were significantly reduced, and the N-S-Ba and the N-S-Ar angles significantly increased. The subgroup meta-analyses for karyotype consistently revealed greater differences for the 45,X karyotype group than those of the mosaic and isochromosome karyotypes.

**Conclusions Conclusions**: The sagittal lateral cephalometric characteristics of females with TS differ significantly from those of non-syndromic females, with the 45,X karyotype showing the greatest deviation. Bimaxillary retrognathia, and reduced anterior cranial base, maxillary and mandibular lengths, were observed, without this resulting in any difference in the sagittal intermaxillary relationships for females with TS, in comparison to controls. While informative, the results of this meta-analysis should be considered in conjunction with the respective moderate to high risk of bias of each study.



#### 0248

### Zoledronic Acid Modulate Inflammatory Response Induced by Orthodontic Force

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Objectives Force applied during the orthodontic movement promotes the release of inflammatory and angiogenic mediators. Zoledronic acid (ZOL) modulates inflammatory response. Aim was to evaluate inflammatory and angiogenic response under orthodontic force after ZOL administration. Methods C57BL/6J mice with six-week-old (6w\_ZOL) and twelve-week-old (12w\_ZOL) received ZOL or PBS (6w\_PBS and 12w\_PBS). Maxillary right side received force, left side was control side. After 12 days of orthodontic force IL-10 and VEGF were evaluated by LUMINEX analysis. COX2 and PGE\_EP2 expression was analysed by immunohistochemistry assay. ANOVA, Pearson correlation were applied by JMP ( $\alpha$ =0.05). Results Quantitative digital analysis (QuPath software) showed that ZOL modulates the inflammatory mediator COX2 under loading, levels were higher in 6w PBS than in 6w ZOL, 12w ZOL and 12w PBS (p<0.05). PGE\_EP2 presented a higher count to 6w\_PBS without significance (p>0.05). IL-10 was modulated by ZOL on control side, the higher levels were observed in 6w\_PBS comparison with 6w\_ZOL, 12w\_ZOL and 12w\_PBS (p< 0.05). The movement side showed higher levels in 6w\_PBS group than 12w\_ZOL (p=0.0124). VEGF levels showed higher values on the control side to the 6w\_PBS among all other groups (p<0.05). The movement side presents higher levels to 6w\_ZOL\_ than 12w\_ZOL and 12w\_PBS (p<0.05). A strong correlation between VEGF, PGE\_EP2 (p=0.0237) IL-10 (p=0.0323) was observed in 12w\_PBS group. A strong correlation between displacement and IL-10 (p=0.0430) in 12w\_ZOL group. Conclusions COX2 decreased expression in experimental groups on the movement side. Levels of IL-10 and displacement teeth were lowest in 12w\_ZOL which presents a strong correlation between teeth displacement and IL-10. 12w\_ZOL presents lower levels of VEGF, and this angiogenic mediator has a correlation with PGE\_EP2 and with IL-10, indicating that ZOL decreased the levels of VEGF affecting the PGE\_EP2 and IL-10 protectors' inflammatory mediators. ZOL modulated most expressively the 12-weekold mice and decreased anti-inflammatory cytokine, vascular endothelial factor, and teeth displacement.

GROUP	AGE	Orthodontic mechanical loading implementation	Euthanasia
6w_PBS	6 weeks	1 week after infusion	12 days after orthodontic mechanical loading
12w_PBS	12 weeks	1 week after infusion	12 days after orthodontic mechanical loading





12w_ZOL	12 weeks	1 week after infusion	12 days after orthodontic mechanical loading
6w_ZOL	6 weeks	12 weeks after infusion	12 days after orthodontic mechanical loading
Orthodontic force	0.35 N	Applied in the maxillary first molars on the right side	Maxillary first molars on the left side used as control side, without force.
Drug administration	45µg/Kg of ZOL	Zometa®, Novartis Biociências S.A., São Paulo, Brazil.	Volume of 0.05mL of medication.
LUMINEX® assay	High light sensitivity cytokine kit	HCYTOMAG-60K-05; Milipore, Bilerica, MA, EUA	
Immunohistochemistry	Envisco + Dual Link System- HRP	Dako-Agilient Techonologies, Santa Clara, CA USA	
Quantitative analysis immunohistochemistry	QuPath version 0.5.0	https://qupath.github.io- universidade de Edinburgh, Reino Unido	

6w\_PBS: six-week-old mice group treated with phosphate-buffered saline; 12w\_PBS: twelve-week-old mice group treated with phosphate-buffered saline; 12w\_ZOL: twelve-week-old mice group treated with zoledronic acid; 6w\_ZOL: six-week-old mice group treated with zoledronic acid, analysed under late phase of medication.



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#### 0249

### Influence of Head Position on Perceived Smile Arc Curvature

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**Objectives** Smile arc curvature is often assessed on patient facial photographs. The purpose of this study was to determine to what extent the anteroposterior inclination of the head influences smile arc curvature assessment on frontal photographs.

**Methods** Sixty-three young adult individuals were included in this study. Five standardized facial frontalview photographs with posed smile, under 5 different anteroposterior inclinations (-20°, -10°, 0°, +10°, +20° using a cervical range of motion device) were taken of each individual. On each photograph two curves were determined, one following the shape of the lower lip and the other following the incisal edge of the maxillary anterior teeth from canine to canine (smile line), using GIMP software. The curvature of the lower lip and the curvature of the smile line were approximated using a quadratic function on the traced points. The two curves were then compared for concordance based on the maximum curvature of the obtained functions and a score was calculated whereby 0 denoting a consonant smile (perfect concordance between the lower lip and smile line) and 2 a non-consonant smile.

**Results** Among the 63 included participants, 59 of them were finally analyzed with 4 excluded due to lack of sufficient tooth exposition in the photographs to permit smile line assessment. The analysis of the data revealed that the perceived smile line was more consonant (concordant with lower lip curvature) with a - 20° head anteroposterior inclination (score 0.146), and the least consonant with +20° anteroposterior inclination (score 1.326). Differences between different head inclinations were statistically significant (p<0.05).

**Conclusions** When assessing the smile arc curvature on facial frontal photographs, one should be aware that the anteroposterior inclination of the head in the photograph may influence this assessment. Three-dimensional imaging may thus be beneficial in this regard.

0251

### Success Rates of a CAD-CAM NiTi Orthodontic Fixed Retainer

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**Objectives** This study aims to assess the success rate of a CAD-CAM nickel titanium wire (Memotain®) used as a fixed orthodontic retainer, over a one-year period.

**Methods** A retrospective study was conducted on 338 CAD-CAM nickel titanium (Memotain®) fixed retention wires in 205 patients, bonded by a single experienced operator between January 2017 and December 2020. Follow-up visits were scheduled at 6- and 12-months post-bonding. At each follow-up visit, events (defined as debonding, breakage, retainer loss, or tooth displacement) were classified by tooth, and success or failure of the retainer was determined based on the presence or absence of these events.

**Results** For the mandibular arch at 6 months, the success rate was 85%, with debonding (n=46) being the only event observed. At 12 months, the success rate was 77%, with debonding (n=30), wire breakage (n=5) and retainer loss (n=18) having occurred. For the maxillary arch, the overall success rate was 83% at 6


months and 78% at 12 months. Debonding was the most common event observed over the 12-month observation period (n=29), followed by retainer loss (n=20) and wire breakage (n=3). The overall success rates per type of tooth in the upper arch were 86% for the premolars, 96% for the canines, 95% for the lateral incisors and 93% for the central incisors. For the lower arch the success rates were 92% for the premolars, 97% for the canines, 96% for the lateral incisors and 94% for the central incisors. **Conclusions** CAD-CAM nickel titanium wires (Memotain<sup>®</sup>) showed promising results with lower failure rates for the mandibular arch compared to success rates reported in the literature for conventional fixed retention, indicating their potential for enhancing retainer reliability.

0254

## Does the First Visit Influence Current Attitudes Towards Dental Interventions?

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**Objectives** The purpose of the study was to analyse the influence of the first dental visit to patient attitudes towards dental interventions.

**Methods** The study included 407 respondents who filled in the modified "Children's dental fear" questionnaire. Four age groups were included: 15-20, 20–25, 25–30, and 30-40 year olds. Questions were related to experiences during the first dental visit in the childhood, and current attitudes towards dental interventions. The answers were scored from 1 (not afraid at all) to 5 (very afraid). The statistical analysis was done using the chi-square test.

**Results** Age distribution: 15-20: 18%; 20-25: 57%; 25-30: 12%; 30-40: 13%. The presence of fear (24%) in the adulthood is associated with an unpleasant experience (32%) during the first visit to the dentist (p<0.05). Routine dental examination was the reason for the first visit for 55% of respondents, while 45% attributed it to pain. The cause of the visit did not influence development of dental fear. Rotary instruments were the main cause of fear at early age for 66% of respondents, and 60% stated that fear was still present. During their initial visit, 56% and 40% found sounds and smells in the dental office unpleasant, a feeling reflected by 49% and 33% of respondents respectively to this day. Forty-two percent of respondents said that going to the dentist on a regular basis helped to overcome the fear. **Conclusions** The experience at the first dental visit might have a great impact on future behaviour in the dental office.



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## 0255

# Impact of MIH and Dental Caries on Children's OHRQoL

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**Objectives** To assess the impact of Molar Incisor Hypomineralization (MIH) on the Oral Health Related Quality of Life (OHRQoL) of schoolchildren. Secondary aims included to evaluate the impact of dental caries and presence of hypomineralized second primary molars (HSPM) on the OHRQoL scores. **Methods** This cross-sectional study assessed children aged between 5 and 12 years old. Two calibrated examiners scored the presence and characteristics of MIH and HSPM (EAPD criteria) and dental caries (number of teeth ICDAS 5-6). Children were asked to answer the Children Perception Questionnaire (CPQ<sub>8-10</sub>ESP). Adjusted Poisson regression analysis was used to evaluate the impact on OHRQoL scores and independent variables (child's age, gender, severity of MIH, presence HSPM and dental caries) ( $\alpha$ =5%).

**Results** A total of 523 children were included. The presence of HSPM was associated with MIH (p < 0.001). Children with MIH showed significantly higher CPQ<sub>8-10</sub>ESP total scores (p = 0.026), as well as in oral symptoms (p = 0.0174), functional limitations (p = 0.009), and social well-being domains (p = 0.045). Poisson regression analysis confirmed that MIH, HSPM, and presence of dental caries (ICDAS 5-6) negatively impacted OHRQoL (p < 0.001). Subgroup analysis of children with MIH showed that severe MIH was positively associated with higher OHRQoL scores (p < 0.001).

**Conclusions** A significant negative impact on OHRQoL scores were found in children with MIH. The scores were also affected by presence of dental caries and HSPM.

	Univariate Analysis		Adjusted Analysis	Adjusted Analysis				
	IRR (95% CI)	P-value	IRR (95% CI)	P-value				
Variable								
Gender								
Male (ref)	-	-	-	-				
Female	1.29 (1.24-1.35)	<0.001*	1.26 (1.21-1.32)	<0.001*				
Age (Years)	·							
Continuous	0.92 (0.91-0.94)	<0.001*	0.95 (0.94-0.96)	<0.001*				
мін				1				



Absence (ref)	-	-	-	-				
Presence	1.27 (1.22-1.33)	<0.001*	1.25 (1.19-1.31)	<0.001*				
HSPM								
Absence (ref)	-	-	-	-				
Presence	1.18 (1.11-1.27)	<0.001*	1.08 (1.00-1.15)	<0.001*				
Caries Experience (nui	Caries Experience (number of teeth with ICDAS 5-6)							
0 (ref)	-	-	-	-				
1-3	1.07 (1.03-1.12)	<0.001*	1.08 (1.03-1.13)	<0.001*				
>3	1.64 (1.55-1.73)	<0.001*	1.49 (1.40-1.58)	<0.001*				

# Salivary Microbiome Profile and Adipocytokine Levels in Adolescents With Obesity

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**Objectives** Overweight and obesity is associated with non-communicable diseases including oral health diseases such as periodontitis and caries. This study aimed to investigate oral health, salivary microbiome profile, and levels of adipocytokines in overweight adolescents.

**Methods** Forty-five adolescents with obesity (mean age 14.24 years) and fifty-two with normal weight (mean age 13.79 years) were clinically examined and body mass index (BMI) was calculated. The mean BMI for the obesity group was 36.7 and for the control group 19.6. Stimulated saliva samples were collected, and the microbiome composition was analyzed using 16S rRNA gene sequencing. The salivary levels of insulin and the adipocytokines adiponectin, total PAI-1, resistin, IL-1b, IL-6, IL-8, TNFa, and MCP-1 were analyzed using multiplex assay.

**Results** Oral health parameters, including GBI% DS, PI and PD>4 displayed positive correlations with obesity. Of the salivary adipocytokines measured, only insulin levels were found to be significantly higher (p= 0.0002) in the obesity group compared to the normal weight group.

A total of twelve amplicon sequencing variants (ASVs) including *Rothia mucilaginosa*, *Actinomyces sp., Abiotrophia defectiva*, *Lactococcus piscium*, *Capnocytophaga sp., Corynebacterium durum*, *Streptococcus salivarius*, *Lacticaseibacillus sp., Abiotrophia defectiva*, *Streptococcus parasanguinis*, *Prevotella sp.* and *Stenotrophomonas sp.* were positively correlated with the obesity group. Moreover, the applied supervised method, sparse partial least squares discriminant analysis (sPLS-DA), revealed a positive correlation between the adiponectin levels and decayed surfaces in the



## obesity group.

**Conclusions** In conclusion, adolescents with obesity exhibit elevated levels of periodontal inflammation compared to their normal-weight counterparts. Additionally, they have a distinct microbiome profile as well as higher salivary insulin levels.

## 0257

## Comparing Radiographic and Genetic Analyses in Children With Amelogenesis Imperfecta

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Objectives The aim of the study was to identify genetic variants in Slovenian children with various nonsyndromic forms of AI, propose radiographic parameters for evaluating enamel characteristics, and assessing whether there is a correlation between the radiographic parameters and genetic etiology. Methods A blood sample was collected from 24 AI children and a whole exome sequencing was performed on each AI patient and affected/unaffected participating family members. Panoramic radiographs (OPTs) were assessed using the open-source platform Fiji ImageJ to determine three parameters: an enamel angle (EA), a dentin angle (DA), and an enamel/dentin mineralisation ratio (EDMR) on lower permanent second molar buds of both AI patients and a control group consisting of 24 children without AI. Two observers independently assessed the measurements. Statistic tests including nonparametric PERMANOVA and the Mann-Whitney U test were used to evaluate differences between groups with and without the identified pathological variant regarding EA, DA and RMSD together and individually. Results Pathological variants were detected in three AI-related genes: in the ENAM gene in eight families (40%), in the AMELX gene in three (15%), and in the MMP20 gene in two (10%). Among these, four variants were novel. Comparing AI patients to control group, hypomineralization and hypoplastic regions were observed, indicating enamel quantity and quality deviations with high reproducibility. The correlation of all three parameters together, as well as individually for DA and EDMR based on the identified pathological variant, was statistically significant with p-values < 0.05.

**Conclusions** This study highlights a novel interpretive tool's potential in diagnosing developmental enamel defects, offering insights into the genetic basis and radiographic features of AI.



## Advantages of Three-Dimensional Imaging - an in-Vitro Study on Glass-Ionomer-Cements

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**Objectives** The investigation of surface roughness is of importance in many fields of dentistry. However, there are still different methods to investigate surface roughness which are not comparable. The aim of the present study is to investigate if there are differences in surface roughness between measuring a line of the surface (Ra) and measuring the whole surface (Sa).

**Methods** For this purpose, 50 samples were analyzed using a three-dimensional, optical surface measurement. Sa was analyzed using a picture field measurement (4mm x 4mm), while Ra was determined as lines with a length of 4mm at different points of the surface. For each sample, five measurements were taken each: horizontal, vertical, from the bottom right hand corner to the upper left hand corner, from the bottom left hand corner to the upper right hand corner and zick-zack. In sum, 1300 measurements were taken.

**Results** We could show that surface roughness was higher using Sa as measurement instead of Ra, except for zick-zack lines.

Surface roughness measured with Sa had a broader range than measured with Ra.

**Conclusions** Surface roughness is influenced by the kind of measurement itself. Improvements like measuring areas (Sa) instead of lines (Ra) may prevent errors. The present results support the assumption that surface roughness should be analyzed using Sa with disclosure of the measured size in future studies. Although Sa represents a higher surface roughness, it may better represent valid value of surface roughness.

## 0259

## Methodological Pilot Study for Dental Plaque and Calculus Microbial Characterization.

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**Objectives** A pilot study was conducted to present a modified methodology for microbial characterization at different taxonomic levels of human dental plaque and calculus.

**Methods** A no-smoker, healthy volunteer, with a good oral hygiene, no drugs taken in the last 3 months, and abstained from eating and drinking in the 2 hours before test, was selected. Dental plaque was collected with sterile paper cones from the buccal surfaces of incisors and molars. Tartar deposits were removed from the lingual and buccal surfaces of the lower incisors with a currette. Plaque and calculus samples were individually stored in sterile eppendorfs and sent for genomic analyses. Total microbial DNA



extraction from dental plaque was performed with DNeasy PowerSoil Pro kit (Qiagen) directly from the sterile cone. Total microbial DNA extraction from one part of dental calculus was performed with the same kit with a modified protocol. The remaining calculus samples were incubated overnight with EDTA and proteinase K to dissolve the inorganic fraction. DNA was amplified with universal bacterial primers, then sequenced with an Illumina MiSeq platform. Data were statistically analyzed (p<0.05). **Results** A total of 97.335 read counts were performed. Dominant phyla in plaque samples (53%) Firmicutes, 29% Actinobacteria, 13% Proteobacteria and 5% others) and in calculus (54% Actinobacteria, 22% Firmicutes and 18% Proteobacteria and 6% others) were characterized. Dominant families in plaque were 35% Streptococcaceae, 13% Actinomycetaceae and 12% Micrococcaceae while in calculus were 21% Actinomycetaceae, 20% Micrococcaceae, 17% Streptococcaceae and 11% Corynebacteriaceae. Streptococcus (35%), Rothia (12%) and Actinomyces (11%) were identified in plaque, while Actinomyces (20%), Rothia (19%), Streptococcus (17%) and Corynebacterium (11%) in calculus.

**Conclusions** A modified characterization protocol of dental plaque and calculus was presented as to better define oral microbiota. Further studies with a larger number of patients are currently ongoing.

## 0260

## SARS-CoV-2 From Pediatric Dental Clinic Wastewater: Insights Into Asymptomatic Children

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**Objectives** Asymptomatic COVID-19 in children poses a public health challenge due to potential for rare severe cases and risk of transmission. However, information on asymptomatic cases among children was unknown. It was hypothesized that wastewater from pediatric dental clinics could contain traces of the virus from saliva of asymptomatic children. To assess effectiveness of detecting SARS-CoV-2 RNA in wastewater from a pediatric dental clinic to estimate the number of local asymptomatic cases in children. **Methods** This prospective longitudinal observational study was conducted at Meikai University Hospital, the sole dental hospital in Saitama Prefecture, Japan. The study focused on the Pediatric Dental Clinic, where most patients were under 10 years old. Wastewater samples were collected every Saturday, total 60 samples from Week 11 of 2021 to Week 21 of 2022. The samples underwent concentration, extraction, and purification to isolate viral RNA, which was then tested for SARS-CoV-2 RNA using real-time RT-PCR. The study explored the correlation between the weekly count of cases in children under 10 in Saitama Prefecture (the exposure) and the detection of SARS-CoV-2 RNA in wastewater (the outcome). It also identified the SARS-CoV-2 subtypes present in the wastewater.

**Results** SARS-CoV-2 RNA was detected in the wastewater. Out of 58 samples analyzed, 30.5% (17/58) tested positive and 69.5% (41/58) were negative. Two samples were excluded due to sampling errors and failures in detection process. Among under-10 population of Saitama Prefecture, which numbered 571,180 at baseline, there were 81,780 cumulative cases during survey period. The study period saw three pandemic waves (the 4th, 5th, and 6th, associated with Alpha, Delta, and Omicron variants, respectively), though the 4th wave was less pronounced. A significant association was found between the number of



cases and SARS-CoV-2 RNA positivity in wastewater (Fisher's exact test, p < 0.001). The Omicron variant was identified in a sample from Week 8, 2022.

**Conclusions** Wastewater analysis from a pediatric dental clinic offers valuable insights into presence of asymptomatic COVID-19 among children. This method can complement data from clinical pediatrics, enhancing our understanding of spread and prevalence of the virus in this demographic.

## 0262

#### Non Syndromic Bilateral Single Rooted Mandibular Primary First Molars

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**Objectives** The aim of this case report was to present non syndromic, bilateral single rooted mandibular primary first molars of two patient.

**Methods** Case 1. Systemically healthy four-year-old boy presented to the clinic complaining of pain. Intraoral examination revealed that severe early childhood caries. Radiographic examination showed that both mandibular primary first molars had a rare single root and single canal morphology.

Case 2. Systemically healthy six-year-old girl presented to the clinic complaining of pain. Intraoral examination revealed that multiple carious lesions. Radiographic examination showed that the right mandibular primary first molar had a single root with single canal morphology, while the left mandibular primary first molar had a single root with two-canal morphology.

**Results** In the literature, very few cases have been reported for mandibular primary first molars with single root and single canal. No other case report has been found in the literature involving a single root with two-canal mandibular first primary molars. The presence of deep caries lesions on the relevant teeth in both cases suggests that endodontic treatment and extractions may be necessary in the rehabilitation of these teeth and reveals the importance of radiographic examination.

**Conclusions** It is important to increase the awareness of clinicians about this different morphology of mandibular primary first molars. Modifications may be required to decrease risk of complications in pediatric dentistry practices such as endodontic treatment and extraction.

#### 0263

## Delayed Replantation of Avulsed Tooth: a 3-Year Follow-up

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**Objectives** Appropriate emergency management and a treatment plan are important for a good prognosis of tooth avulsion. Replantation is the treatment of choice, but cannot always be carried out promptly. The aim was to report a case of delayed replantation of avulsed permanent central incisor with a 3 year follow-up.

**Methods** The patient was a 10 year-old male who suffered an avulsion of permanent maxillary right central incisor. According to the patient, the tooth was placed in milk immediately after injury. As



emergency treatment, the tooth was replanted 3 hours after the accident and immobilized with a rigid wire splint in another institution. After presenting to the Clinic for Preventive and Pediatric Dentistry the day after, the splint was replaced with a flexible one. Endodontic treatment was initiated one-week post replantation, and splint was removed after 2 weeks. Corticosteroid and calcium hydroxide paste were used as intracanal dressing for 2 weeks each, prior to definitive obturation with a sealer and guttapercha. **Results** At one-year follow-up, replacement root resorption was noted. After 3 years, the tooth was extracted due to the complete resorption, and an adhesive bridge was made. **Conclusions** Inadequate treatment during the first visit can have a negative impact on the prognosis and survival of a replanted tooth. This case shows that, despite improper initial treatment and late replantation, extraction was delayed for three years. During that time, new bone was formed, child has become more mature, and a semi permanent replacement for the missing tooth was placed.

## 0264

# Non- or Minimal-Invasive Fixed Prostheses Replacing Canines: 23-Year Clinical Follow-up

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**Objectives** Three patients, two females and one male, required fixed prostheses to replace the lost canines for esthetics, function, and comfort. All patients refused dental implants and severe tooth reduction such as full coverage fixed partial dentures.

**Methods** Three designs of fixed prostheses, an adhesive acrylic pontic, two indirect resin-composite proximal veneers, and a porcelain fused to metal partial coverage bridge (PFMPCB) were assigned for each patient according to the patient's desire, esthetics, and bite force. After the patient approval, all the prostheses were fabricated and bonded to tooth abutments using 4-META/MMA-TBB and PMMA powder resin (Super-Bond C&B).

**Results** Proximal veneers, an adhesive pontic, and PFMPCB have successfully functioned and remained esthetics for 23-, 20-, and 19-year after placement, respectively. No debonding, caries, or periodontal pocketing occurred. The outer layer of the acrylic pontic was detached after placement for 20 years and 5 months and was replaced with an indirect resin composite veneer. The PFMPCB was detached due to a fracture at the mesial connector in year 20. All patients were satisfied with the outcomes.

**Conclusions** This clinical evaluation suggests that non- and minimal-tooth reduction fixed prostheses using 4-META/MMA-TBB resin bonded to enamel to provide a hybridized layer and tags can resist long-term multi-directional loading of both the upper and lower canines.

0265

# Clinical Rehabilitation of Periodontally Compromised Teeth: a 6-Year Follow-Up

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Objectives The aim of this case study was to evaluate the improvement of periodontal health and esthetic status in a patient treated with non-surgical therapy and lithium disilicate laminate veneers. Methods A 30 year old female patient was presented with advanced periodontal disease, clinical attachment 3-4mm loss, probing depth 7-8 in anterior teeth and tooth mobility grade 1 and 2. Radiographic examination and clinical parameters were registered before treatment. The patient underwent non-surgical periodontal treatment (NSPT) and administration of systemic antibiotic. At 3 and 6 months after reevaluation, sites with PD>3mm underwent supra-subgingival (SPR) scaling and root planning. After achieving stable results, mini invasive approaches were used to perform esthetic rehabilitation. The incisive teeth were restored with IPS e.max Press LT, color A2, laminate veneers. Cementation of veneers was performed with Permashade <sup>™</sup>LC Veneer Cement, color A2. **Results** At 9 months, there was no sign of disease progression, decreased tooth mobility, and improved clinical parameters, gain in CaL, PD less than 5mm, no BoP. At 1 year slightly improved parameters, mainly tooth mobility.

At 6 years follow up evaluation, the clinical parameters were stable and esthetic outcome of the lithium disilicate restorations was very good in regard to color match and marginal integrity.

**Conclusions** Satisfactory results can be achieved by noninvasive NSPT treatment and mini invasive prosthetic approaches to obtain esthetic rehabilitations.

#### 0266

## Tooth-Supported Overdenture With Ball and Socket Attachments - Case Report

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**Objectives** The object of this clinical case report is to present an alternative treatment option with a tooth-supported overdenture with ball attachments for a partially edentulous patient with two intact natural teeth and with certain limitations for other prosthetic or implant treatment.

## Methods Case report

A 58-year-old female patient with a partial edentulism on the upper jaw with intact canines, pathological mobility of teeth 11, 12, 21, 22 and tooth migration (Godon's phenomenon) of teeth 16-17 looked for our help. For optimal prosthetic results tooth-supported overdenture was a treatment plan of choice. Teeth with mobility and pathological migration were extracted and canines were endodontically treated. Preparation of the canines, including coronectomy and intraradicular preparation to accommodate ball attachments, was performed. After gingival retraction impression was taken (elite HD+, Zhermack). Ball attachments were casted using matrix and patrix 1.7mm from Bredent. In the next visit attachments were cemented (GC FujiCEM™ 2), sleeves were placed on top of them and functional impression with individual tray was taken (3M Impregum™ Soft). Central relation was registered with occlusal rims followed by try-in step. Overdenture was invested and regular snaps (yellow) were used as retentions inside the matrices and delivered to the patient.

**Results** The treatment resulted in good aesthetics and functional outcomes, with good retention and stability of the denture.

**Conclusions** Tooth-supported overdenture is an optimal treatment option for partially edentulous patients and it can restore function and aesthetics. With precision attachments good stability and retention of the denture can be achieved. The prophylaxis that can be accomplished is significant – with



preservation of natural teeth atrophy of alveolar bone is reduced; the sensory function of periodontal ligament is saved and it's regulating the physiological way of masticatory force transmission and crown-to-root ratio is enhanced, prolonging the survival of abutments.

## 0267

# Cervical Dystonia Relief & Postural Improvement: TMJ Intervention, Cupping Therapy, Physiotherapy

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**Objectives** The aim of this case report is to present the effect of TMJ intervention on decreasing dystonic symptoms and improving posture.

**Methods** A 30-year-old female subject diagnosed with cervical dystonia was referred to the clinic. Initially, she showed severe and regular dystonic contractions, affecting her posture. The subject underwent a new treatment protocol called IDTT (Integrative Dynamic TMJ Treatment) that was described by the author. Following the application of a soft intraoral appliance called IDTA (Integrative Dynamic TMJ Appliance), the subject underwent 40 sessions of traditional cupping therapy and physiotherapy exercises, with the modification of the appliance in each treatment session. Pain, dystonic contractions, and other dystonic symptoms were assessed using a visual analog scale. Video recordings were kept for the objective assessment of dystonic contractions, and posture analysis was conducted using a mobile application called APECS-AI Posture Evaluation and Correction System® (APECS mobile application) (New Body Technologies SAS, Grenoble, France).

**Results** After the 40 treatment sessions, significant improvements were observed in the patient's pain symptoms, with a 90% reduction according to the VAS scale. Moreover, 80% reduction in dystonic contractions and a visible improvement in posture were observed.

**Conclusions** The implementation of IDTT, merging traditional cupping therapy and physiotherapy techniques with a focus on TMJ intervention, led to diminished dystonic contractions, lessened complaints associated with dystonia, and enhanced posture throughout a 1-year follow-up period in this particular case.

## 0268

# Gingival Overgrowth Induced by Amlodipine – a Case Report

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**Objectives** Amlodipine, a dihydropyridine calcium channel blocker is commonly prescribed for cardiovascular conditions and may cause gingival overgrowth as a side effect. This case presentation illustrates the 1-year follow-up of a case of gingival overgrowth induced by amlodipine treated with phase-I periodontal therapy and gingivectomy.

**Methods** A 36-year-old female patient with hypertension referred to our clinic. Upon intraoral examination and review of the patient's medical history, gingival overgrowth induced by amlodipine was diagnosed. Following consultation with a cardiologist, the patient's medication was switched from amlodipine to



irbesartan. Prior to gingivectomy, the patient underwent a 6-month phase-I periodontal therapy. During this period, a significant reduction in gingival overgrowth was observed. The patient's oral hygiene was closely followed, and recommendations were provided accordingly. Following the completion of phase-I therapy, a decision was made to proceed with gingivectomy. Local anesthesia was administered to the area. During the operation, a No. 15 scalpel, Kirkland knife, and curved scissors were utilized. The operation was completed with checking the gingival esthetic. The wound area was left for secondary healing. After a month, in line with the aesthetic expectations of the patient, it was decided to close the diastema in teeth numbered 11-21 and to correct the size morphology of lateral teeth numbered 12-22 with composite.

**Results** Healing was controlled in the 1 week, 1 month, 3 months, 6 months post-surgery. There was no problem in the healing process. Oral hygiene recommendations were suggested after surgery and diastema closure treatment.

**Conclusions** It has been observed that phase-I periodontal therapy and gingivectomy are effective in the treatment of gingival overgrowth induced by amlodipine. These methods have effectively improved gingival health and alleviated symptoms. Additionally, a multidisciplinary approach is emphasized for effectively managing medication side effects.

0269

# Mucogingival Surgery for Gingival Recession-a Case Report

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**Objectives** Gingival recession is defined as the apical displacement of the gingival margin relative to the enamel-cementum junction, resulting in exposure of the root surface. Gingival recession triggers excessive dentinal sensitivity, root caries, and aesthetic disturbances. This case report presents a 9-month follow-up of the treatment of a patient with localized gingival recession using connective tissue graft + lateral positioned flap technique.

**Methods** Intraoral examination of a 60-year-old male patient presenting with sensitivity complaint to our clinic revealed Miller Class 2 gingival recession on the buccal aspect of tooth number 16. After completion of phase 1 treatment, oral hygiene education was provided to the patient. For the treatment of gingival recession, under local anesthesia, a sulcular incision was made on the affected tooth followed by a horizontal incision from the edentulous area adjacent to the tooth. A half-thickness flap was raised with a vertical incision starting distal to tooth number 13 and reaching the oral mucosa, and the flap was mobilized. After de-epithelialization of the gingiva on the crest of the edentulous area, a connective tissue graft of approximately 5x7 cm was harvested. The graft was sutured to the recession area with 6-0 monofilament sutures. The flap was laterally positioned towards the distal of tooth number 16 and sutured with 6-0 monofilament sutures. The patient was prescribed antibiotics, anti-inflammatory drugs, and mouthwash.

**Results** The area was checked at the first week postoperatively, and no complications were encountered. The sutures were removed at week 3. Complete closure of the recession and resolution of the patient's complaints were observed at the 2-month follow-up. Healing was evaluated at 4, 6, and 9 months, with no recurrence observed.

**Conclusions** The combination of connective tissue graft and lateral positioned flap techniques yields clinically favorable results in Miller Class 2 gingival recessions.



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## 0270

## One-Year Clinical Follow-Up: Office Type Vital Bleaching

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**Objectives** To follow-up of six patients who were treated with in-office vital bleaching for one year, taking into consideration their daily routines, and observe to evaluate color longevity.

**Methods** Tooth shades were measured with the VITA Classical Shade Guide (Vita Zahnfabrik, Bad Säckingen, Germany). The bleaching process with Opalescence Boost 40% (Ultradent, South Jorden, USA) was performed according to the manufacturer's instructions. The activator and whitening solution were mixed 25 times on each side. Before the application, plaque removal was performed in each patient and the tooth surfaces were cleaned. OpalDam gingival barrier was used for soft tissue isolation. 1 mm thick whitening gel was applied directly to the labial areas of the teeth with black mini tip. In each patient, a total of 2 applications were performed on the same day for 20 minutes per application.

**Results** At the end of the one-year follow-up, it was found that there was some external discoloration in the patient group who were treated with bleaching, however it did not return to the initial color before the bleaching procedure. None of the patients complained about their current tooth color and there was no any dissatisfaction. It was observed that 2 patients with more discoloration were tobacco products users. **Conclusions** Many conditions such as daily routines, diet and especially the use of tobacco products are important factors in maintaining the preservation of tooth color in people who have received bleaching treatment.

## 0271

## Application of Clear Silicone on Class IV: Case Report

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**Objectives** Anterior restorations are challenging for dentists to operate. Mostly trauma patients have fractured anterior tooth that needs to be restored. After trauma if tooth is vital most of the time Class IV restorations needed. On the other hand, esthetic perspective is another factor. Natural tooth morphology and shade selection is important to achieve better esthetics. To achieve natural tooth morphology even skilled operators, need to use dental devices instead of free-hand composite modelling.

**Methods** Patient referred to Ege University Faculty of Dentistry with esthetic complaint from fractured tooth 11. On the radiographic examination no extraordinary symptoms detected and the tooth is vital. After impression a cast model is obtained. Then wax-up of fractured tooth is made. Newly developed light cured clear resin is used to obtain palatal index. Shade selection is performed with button try-in technique. A3 for dentin and A1 for enamel is selected. Finishing and polishing is performed with discs (3M-Sof-lex) and Optragloss (Ivoclar).

**Results** Wax-up and application of resin based clear matrices help dentists to achieve natural tooth morphology of tooth 11. Both patient and dentist is satisfied from the final restoration.

**Conclusions** Wax-up and application of resin based clear matrices help dentists to achieve natural tooth morphology of tooth 11. Both patient and dentist is satisfied from the final restoration.



#### **Replacement of Implant-Supported Maxillary Cemented and Mandibuler Hybrid Prostheses**

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**Objectives** Implant supported fixed prostheses can be designed by screw-retained, cement-retained and hybrid type. The aim of this study was to present mandibular implant-supported hybrid prosthesis opposed to maxillary implant-supported cement-retained fixed prosthesis.

**Methods** A sixty two years old male patient was applied to University of Gazi, Faculty of Dentistry, Department of Prosthodontics with the complaint of his existing prosthesis. Clinical and radiographic evaluations were performed. It was observed that the patient has a full arc implant supported cemented prosthesis in the maxilla and an implant supported hybrid prosthesis in the mandible. In clinical evaluation of the existing prosthesis porcelain chipping and functional loss were observed. Radiographic examination revealed eight implants in maxilla and five implants in mandible. According to clinical and radiographical evaluations and patient's expectations replacement of the prostheses was planned. Opentray maxillary and mandibular impressions were made with polyvinyl siloxan. Infrastructures and veneers were fabricated and their adaptation were tried in patient's mouth. Occlusion and aesthetics of the prosthesis were checked and adjustments were performed. Then final prostheses were fixed in patient's mouth. The patient was called for a follow-up appointment after a year.

**Results** At 1 year follow-up was clinical and radiographic evaluations were performed. No functional, phonetic, or esthetic problems were noted except porcelain chipping at left mandibular canine crown restoration. There were no bone loss around the implants.

**Conclusions** Present case report allowed to follow up the use of implant-supported hybrid and cementretained prostheses together. Implant-supported hybrid and cement retained prostheses satisfied patient's requirements for esthetics, phonetics, oral hygiene, and oral comfort.

#### 0274

#### Retention Forces in One-Piece Mini Dental Implant-Retained Overdentures: 10-Year Follow-up

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**Objectives** To evaluate the retention forces of one-piece mini dental implants (MDIs), retaining mandibular implant overdentures (IODs) with ball/O-ring attachments after 10 years in-vivo. The null hypothesis was, that there would be no differences in the retention forces at implant loading compared to the 10-year follow-up in the male or the female part. Furthermore, the effect of implant position on retention forces was analyzed.

**Methods** Twenty patients received new complete dentures, which were converted into implant overdentures (IODs) through stabilization with four MDIs (Condent GmbH; diameter: 1.8 mm) placed in the interforaminal region and loaded immediately. Directly post-op (baseline), at the 1-year, 5-year and 10year follow-up, the retention forces were assessed with a validated strain gauge at each implant site. The evaluation of the retention forces was performed at the male and the female parts separately. For the



statistical analysis, linear regression models were used in which alpha was adjusted for multiple testing using the Bonferroni-Holm method. Fourteen patients with a total number of 56 implants were finally followed-up.

**Results** At the male part, the retention forces increased significantly in implant sites 32 and 34 after 10 years compared to the baseline (Table 1). At the female part, retention forces decreased significantly over time. After replacing the O-ring inserts, baseline values could be reestablished and no significant changes in retention forces were recorded at the 10-year follow-up (Table 2). No difference in anterior and posterior implants could be determined.

**Conclusions** The null hypothesis was rejected. In the male parts, retention forces slightly but significantly increased in implant sites 32 and 34. In the female parts, retention forces demonstrated a decrease initially after one year, primarily due to O-ring wear. By exchanging the O-ring inserts, baseline retention forces could be reestablished after 10 years, with no discernible differences between anterior and posterior implants.

Implant site	Follow-up	Participants (n)	Mv (N)	SD (N)	P value
	BL	14	2.6	1.0	x
22	1 year	13	3.8	0.9	0.001
32	5 years	14	3.9	0.4	<0.001
	10 years	14	3.8	1.7	0.041
	BL	14	2.4	0.9	x
24	1 year	13	4.0	1.3	0.002
34	5 years	14	3.5	0.4	<0.001
	10 years	14	3.5	1.3	0.012
	BL	14	2.8	1.1	x
10	1 year	13	3.8	1.0	0.033
42	5 years	14	4.1	0.4	<0.001
	10 years	14	3.4	1.3	0.144
	BL	14	3.0	1.9	x
11	1 year	13	4.0	0.9	0.124
44	5 years	14	4.1	0.5	0.050
	10 years	14	3.2	0.9	0.649

Table 1 Retention forces at the male part

Mean values (Mv) and standard deviations (SD) of retention forces at the male part (in Newton) in all implant sites at baseline (BL) and at 1-, 5- and 10-year follow-up visits as well as P values for the comparison of 1-, 5- and 10-year follow-up with baseline (Wald Test, random-effects linear regression).





## Table 2 Retention forces at the female part

Implant site	Follow-up	Participants (n)	Mv (N)	SD (N)	P value
	BL	14	4.9	2.2	Х
20	1 year	13	2.9	0.7	0.001
52	5 years	14	4.1	1.7	0.416
	10 years	14	4.6	1.7	0.775
	BL	14	4.7	2.1	X
24	1 year	13	2.6	0.9	<0.001
54	5 years	14	3.4	1.0	0.065
	10 years	14	4.4	0.7	0.663
	BL	14	4.4	1.9	Х
40	1 year	13	2.9	0.7	0.006
42	5 years	14	4.6	1.5	0.814
	10 years	14	4.3	1.3	0.907
	BL	14	4.7	2.3	X
11	1 year	13	2.7	0.8	0.005
44	5 years	14	3.9	0.7	0.301
	10 years	14	4.3	1.2	0.615

Mean values (Mv) and standard deviations (SD) of retention forces at the female part (in Newton) in all implant sites at baseline (BL) and at 1-, 5- and 10-year follow-up visits as well as P values for the comparison of 1-, 5- and 10-year follow-up with baseline (Wald Test, random-effects linear regression).

# 0275

## Management of Gnatodiaphyseal Dysplasia, a Systematic Review.

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**Objectives** to identify the dental and maxilla-facial management for patients with gnatodiaphyseal dysplasia (GDD) and propose guidelines for practitioners in their care.

**Methods** An electronic search on Pubmed, Cochrane and Embase databases attempted to inventory all relevant studies regarding dental and maxillofacial management. The search was also expanded to fibrous dysplasia (FD), a similar disease. Papers published in English or French were identified after a review of their titles, abstracts, and full text. The inclusion criteria were studies measuring the dental



and/or maxilla-facial management of GDD patients. Studies with no full text available or on patients with oral cancer or oral radiotherapy

**Results** Only 12 studies were identified concerning GDD, 23 concerning FD. Management of osseus lesions and facial deformation had been surgical for 90% of patients treated for GDD. Monitoring and surgery of FD and GDD lesions depends on their stability and width and the age of the patient. For patients with GDD 59% of mandibular and 57% of maxillary rehabilitations of the loss of substance induced by the surgery was by a fibular or iliac graft. Success rate of the fibular graft at 9 months was 100% and it was 60% for the iliac graft at 6 years. 3 implant-supported prosthesis, 3 removable resin prosthesis and 1 obturator had been made for dental rehabilitation of patients with GDD.

**Conclusions** Dental and maxillo facial management of GDD has been few documented. Treatments are complex, multidisciplinary, and evolving with patient age and lesions.

## 0276

# Effect of Retention Hole Size of 3D-Printed Zirconia Artificial Teeth

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**Objectives** The purpose of this study was to analyze how the retention hole size of 3D-printed hollow zirconia artificial teeth affects the shape accuracy.

**Methods** Data sets for the different hollow artificial teeth resembling a mandibular right first molar were created (Geomagic Design X, 3D systems) with a wall thickness of 1.0 mm. On the designed artificial tooth surface, measurement planes which are mesiobuccal plane (MB), mesiolingual plane (ML), distobuccal plane (DB), and distolingual plane (DL) were created. While the outer geometry was identical, retention holes with diameters of either 3.0 mm or 6.0 mm were implemented. For each group, n=10 artificial zirconia teeth were fabricated using a 3D printer (SZ-1100, Sk Fine) and fired (debinding and sintering). Then, the teeth were scanned using a laboratory scanner (D2000, 3Shape) to obtain the fabrication data of all the specimens. After that, the design data and fabrication data were aligned and the deviation values of each measurement points were calculated using a software (GOM Inspect, GOM). Mann-Whitney U-test was used to analyze differences in shape accuracy between the zirconia artificial teeth test groups. The significance level was  $\alpha$ = 0.05.

**Results** Measured deviations at all measurement planes ranged from -59.2 µm to 104.0 µm. For each measurement plane, there was no statistically significant difference between ML and DL. On the other hand, 6.0 mm had lower deviation at both MB and DB, and statistically significant differences were found at both MB and DB. Thus, 6.0 mm had higher accuracy than 3.0 mm at both MB and DB. This suggests that the accuracy was higher for the 6.0 mm, which has a larger retention hole.

**Conclusions** The size of the retention hole of the artificial tooth affects its shape accuracy, suggesting that the larger its diameter, the higher the shape accuracy of the zirconia artificial tooth.



## CAD/CAM Onlays vs Crowns: 1-Year Results of a Multicenter Randomized-Controlled-Clinical-Trial

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**Objectives** To assess the overall survival rate of all-ceramic chairside onlays and single crowns on vital and non-vital posterior teeth after 1 year.

**Methods** One hundred and twenty patients (18-80 years of age) were recruited at the University of Geneva and in a Swiss private practice and received 120 all-ceramic restorations on vital and non-vital premolars and molars. After screening and inclusion, 6 patients dropped out due to withdrawal for personal reasons. Finally, 114 patients/teeth were included. The preparation design for vital teeth was randomized between a minimal-invasive, defect-oriented onlay design and a conventional crown preparation. Non-vital teeth randomly received either an endocrown or a metal post and resin composite core build-up and a conventional crown. Restorations were milled (Cerec, Dentsply Sirona) out of 3 materials: lithium-disilicate glass-ceramic (E.max CAD, Ivoclar Vivadent), hybrid-ceramic (VITA ENAMIC, VITA Zahnfabrik) and lithium-aluminosilicate glass-ceramic reinforced with lithium-disilicate (N!ce, Straumann). A total of 6 study groups (n=20 each) was obtained according to the combination of the two preparation designs and the three restoration materials. Cementation was performed either with pre-heated resin composite (Tetric, Ivoclar Vivadent) for onlays and endocrowns, or a dual-cure, self-adhesive universal resin cement (Relyx unicem, 3M ESPE) for conventional crowns.

Patients were followed up at 2 weeks and 1 year after cementation. Clinical (technical and biological) and radiographic data were recorded. The overall survival of the restorations was assessed with Kaplan Meier survival statistics (SPSS Statistics 29, IBM).

**Results** All restorations survived, hence, the 1-year survival rate was 100% with no differences regarding the preparation designs, restorative material or tooth vitality. No technical or biologic complication occurred.

**Conclusions** All-ceramic defect-oriented onlays/endocrowns and conventional all-ceramic crowns exhibit excellent short-term outcomes for the restoration of vital and non-vital posterior teeth.

## 0278

## Printers Affect the Dimensional Stability of Casts in Biodegradable Resins

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**Objectives** To evaluate the effect of 3D printer on the dimensional stability of printed casts in different biobased resins by comparing to that of casts in dental model resin.

**Methods** STL file of a dentate maxillary model (R-STL) was used to fabricate diagnostic casts in a dental model resin (KM), a soy-based model resin (SB), and a corn-based model resin (CB). The casts were printed either with a DLP or an LCD 3D printer (n=10). Each cast was digitized with a laboratory scanner



the day after fabrication, and once every week for the next 4 weeks to generate C-STLs. C-STLs were superimposed over the R-STL and RMS values were automatically calculated for different regions (anterior, posterior, entire arch, soft tissue, and entire cast). Generalized linear model analysis was used to evaluate data within each region ( $\alpha$ =.05).

**Results** Dimensional stability of the casts was affected by the model resin, printer, and the interaction between these factors ( $P \le .004$ ). DLP printer mostly led to lower RMS (P < .001). KM had the highest RMS in the anterior when DLP and in the posterior when LCD printer was used ( $P \le .047$ ). In addition, it had the lowest RMS in the anterior when DLP printer was used (P < .001). SB had the highest RMS in the anterior when LCD printer was used (P < .001). SB had the highest RMS in the anterior when DLP printer was used (P < .001). SB had the highest RMS in the anterior when DLP printer and the lowest RMS in the anterior and soft tissue when DLP printer and in the soft tissue and entire cast when LCD printer was used (P < .001). CB had the highest RMS in regions other than the anterior when DLP was used, and had the lowest RMS in the entire arch when LCD was used (P < .008).

**Conclusions** Maxillary diagnostic casts fabricated by using tested soy-based resin and DLP printer may be more reliable to replicate the intraoral situation compared with other resin-printer pairs tested. Dimensional stability of tested casts did not change over the course of one month.

## 0279

## Influence of Denture fit on Patient Perception and Denture Quality

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Objectives This pilot study investigates whether the fit of maxillary complete dentures is correlated with patient satisfaction and oral health-related quality of life (OHRQoL) and with objective denture quality Methods Twenty participants with an edentulous maxilla were recruited. Master models were made from conventionally border-molded impressions, scanned, and saved in STL format to serve as reference anatomies. Participants' existing dentures were scanned. Both files were imported into a software program for comparison, measuring deviations in millimeters. Deviation measures included root mean square (RMS), average (AVR), average positive (AVR+) and negative (AVR-) deviations. Denture satisfaction and OHRQoL were assessed using a visual analog scale and OHIP-Edent questionnaire, respectively. Denture quality was evaluated by an experienced clinician through a questionnaire assessing factors such as tooth selection, arrangement, border extension, stability and retention. Correlations between the denture's quantitative fit deviations, denture satisfaction, OHRQoL, and clinician assessments scores were analyzed using Spearman's rho and two-tailed Pearson correlation tests (p<0.05). Results Nineteen patients aged 66y±13 completed the study. Deviations of the existing prosthesis to the reference were quantitatively described: AVR -0.37±0.18, RMS 1.13±0.26, AVR+ 0.22±0.14, AVR- -0.74±0.22. A significant negative correlation was found between RMS (r= -0.527, p=0.020) and the clinical objective evaluation of the borders, a positive correlation between AVR- (r=0.474, p=0.04) and the clinical evaluation of border extensions. A signification correlation was also found between patient denture satisfaction (r=-0.646, p=0.003) and the clinician overall denture quality evaluation. No significant correlation was found neither between the quantitative deviations of fit and total OHIP scores nor denture



## satisfaction.

**Conclusions** Clinical denture quality assessment seems to better predict patient satisfaction than a quantitative evaluation of fit. Neither OHRQoL nor denture satisfaction seem to be affected by a reasonably close denture fit. Other factors may play crucial roles in influencing the patient perception of the prosthesis.

## 0280

## A Novel Methodology for Evaluating the Wear of Stud Attachments

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**Objectives** Retention loss and stud attachment wear of the two implant-retained mandibular overdentures are still considered the main treatment complications. Recently, wear-resistant stud attachment systems have been proposed. However, an objective methodology to clinically evaluate the abutment wear of novel stud attachments is still needed. The presented pilot study aimed to introduce and test a potential methodology for objectively assessing the surface wear of a stud attachment. **Methods** Ten patients rehabilitated with mandibular implant-supported overdentures on two Novaloc attachment abutments were annually monitored. Micro-computerized tomography (m-CT) was used to quantitatively evaluate the amount of wear and wear characteristics when the abutment surface wear was clinically detected. After the image reconstruction and segmentation, surface models of the worn and referential (intact) abutment were obtained. The maximum distance between the surface models, volume loss, and the significantly worn surface area were assessed. Further, laser confocal profilometry and scanning electron microscopy (SEM) of the worn abutment surface were performed to determine the wear pattern. The fit of the prosthesis intaglio surface was assessed using a silicone material.

**Results** One abutment wear was clinically detected and further evaluated using the proposed methodology. The evaluated parameters from the analyzed m-CT images indicated significant attachment surface wear. The maximum deviation was 28 µm, with a significantly worn surface area of 0,88 mm<sup>2</sup>, representing 7% of the region of interest (ROI). Volume loss was 0.081 mm<sup>3</sup>. SEM and confocal laser profilometry suggested a wear pattern possibly associated with prosthesis rotational movements around the attachment. This may have resulted from the increased gap between the prosthesis intaglio surface and mucosa in the left posterior area.

**Conclusions** The presented methodology could be regarded as a future state-of-the-art approach for objectively evaluating stud attachment system wear.



## Fatigue Strength of Cobalt-Chromium Alloys Fabricated by Additive Manufacturing

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**Objectives** Removable partial denture (RPD) frameworks made of cobalt-chromium (Co-Cr) alloys by additive manufacturing (AM) have been used. However, the influence of the fabrication techniques on the fatigue strength of Co-Cr alloys remains to be fully elucidated. The purpose of this study was to evaluate the fatigue strength of Co-Cr alloys used in RPD framework fabricated by AM compared to conventional casting.

Methods Co-Cr alloy specimens were fabricated under the following conditions (each condition: N=10); AM was fabricated using a selective laser melting machine (LUMEX Avance-25) in powder bed fusion, and CAST was cast using a high-frequency centrifugal casting machine (Denko Auto Sensor MD-201). Static and dynamic flexural strengths were measured in both a universal material testing machine (AG-I 20kN) and fatigue testing machine (EHF-F05). The cyclic fatigue test was performed by the staircase method in water at 37 degrees, with a load of 10<sup>6</sup> cycles and 10 Hz. After mechanical test, the specimens were observed under a scanning electron microscope (SEM; SU6600). The flexural strengths between experimental conditions were statistically analyzed using Mann-Whitney's U test ( $\alpha$ =0.05). Results The static flexural strengths for AM and CAST were 1472±41 MPa and 1173±53 MPa, respectively, and a statistically significant difference was observed between the two conditions (p < 0.05). The fatigue strength for AM and CAST was 54±8% and 42±4% compared to the static flexural strength, respectively. The CAST specimens after tests were observed to cracks and there were grains in the crack, indicating an intergranular fracture was occurred, while the AM were observed a striation after fatigue test. As AM in additive manufacturing provides superior flexural strength due to strong grain boundary bonds. Conclusions Co-Cr alloy fabricated by AM showed higher static flexural and fatigue strengths than casting one, suggesting that the AM-fabricated framework could have more durability.

## 0282

## Clinical Performance of Mandibular Implant-Supported Overdentures on Novel Attachment System

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**Objectives** The study aimed to evaluate the clinical performance of mandibular overdentures retained by a novel stud attachment system Novaloc.

**Methods** A prospective randomized controlled study design was adopted to test the attachment system. Nineteen edentulous patients with mandibular overdentures retained by two implants were randomly allocated into one of two groups differing in the attachment type: Locator (n=9) or Novaloc (n=10). Periimplant hygiene (Silnes and Loe plaque-index), soft tissue conditions (Gingiva-index, Sulcus bleedingindex, pocket probing depth), and patient satisfaction obtained with a standardized questionnaire were compared. Biological (implant loss, peri-implant inflammation) and technical complications (retention loss, replacement of nylon or PEEK matrices, acrylic tooth fracture, relining of the prosthesis) were



assessed. Non-parametric tests were used to determine differences between both experimental groups (P<0.05). Survival rate was calculated at the annual follow-ups.

**Results** At a 2-year baseline, the implant and prosthesis survival rates were 100%. Both treatment options improved patient satisfaction, which was comparable in both groups. There was no significant difference in soft tissue and hygiene conditions. The need for matrix replacement was the most frequent technical complication observed in 50% of both groups, still, not exceeding the clinically acceptable maintenance rate. One case of attachment wear was observed in the Novaloc group, however, no signs of retention loss were observed. Acrylic teeth fracture and abutment loosening were observed in 5%.

**Conclusions** After 2-years of clinical service, implant-supported mandibular overdentures retained by Locator or Novolac attachment systems showed promising and comparable clinical results with improved patient satisfaction. The Novaloc attachment system can be regarded as a viable treatment option. However, more long-term clinical trials are needed.

## 0394

# Precision of Implant Surgical Guides in Computer-Assisted Dental Surgery

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Objectives In this *in vitro* study, the precision of implant surgical guides and the dependence of the technique was investigated, which is divided into "*guided*" and "*fully guided*". The project was digitally designed and manufactured using 3D printing. A model was designed and the corresponding drill template with associated implants was created using the coDiagnostiX<sup>™</sup> planning program. Methods Three groups were formed. Each group was divided into "*novice*", who had no experience in placing implants, "*advanced*", who had 15 years of experience and "*expert*", who had 30 years of experience. The entire project was digitally designed and manufactured using 3D printing. A model was designed and the corresponding drill template with associated implants was created using the coDiagnostiX<sup>™</sup> planning program. The models were produced in a standardized manner. The implants were placed by each operator in five models, three "*guided*" and three "*fully guided*". DVT was made and the planning position could be compared with the achieved position.

**Results** The results after statistical analysis with the program R Core Team showed that the comparison of the two techniques "guided" to "fully guided" is statistically significant for all three measured 3D values, apical, basal and angulation. All values refer to the deviation from the planned situation. Median basal values are 0.90mm for "guided" and 0.56 mm for "fully guided". Apically, the values are 1.13 mm median for "guided" and 0.73mm for "fully guided". The median values for "guided" in relation to "angulation" are 2.40 degrees and for "fully guided" 2.00 degrees.

**Conclusions** The null hypothesis based on the data was confirmed here. The practitioner makes no difference in this case. Therefore, experience makes no difference in the use of templates. The initial hypothesis was refuted. In further studies, however, the parameter of time should also be applied; a study already conducted suggests that this provides essential differences between practitioners with different levels of experiences.



## Bacterial Adhesion on the Crown-Abutment Cement Margin

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**Objectives** The purpose of this study was to investigate the formation of *A*.

*actinomycetemcomitans* and *S. mutans* biofilms on the cement margin of screw-retained monolithic zirconia crowns luted to titanium base abutments.

**Methods** Screw-retained monolithic zirconia anterior crowns (IPS e.max ZirCAD Prime, Ivoclar Vivadent) were cemented with dual-curing composite-based cement (RelyX Ultimate, 3M Espe) on titanium base abutments (Ti-base, GH 2.0mm, AH 5.5mm, Camlog) and then attached to oral implant replicas (Conelog 4.3, Camlog) according to manufacturer's instructions. Specimens were individually packed and sealed in pouches for 72-hours, and sterilized in an autoclave (1.1 bar, 121°C, 20.5min). Subsequently, specimens (n=3/group) were exposed to two different bacteria, *S. mutans* (NCTC 10449)

and *A.actinomycetemcomitans* (ATTC 29523), for 18-hours and 24-hours incubation time respectively. After washing and fixation procedures, specimens were investigated with scanning electron microscopy (SEM); cement margin gap and bacterial biofilm formation were evaluated.

**Results** SEM evaluation displayed the presence of bacterial biofilm on all surfaces and materials (zirconia, titanium and composite-based cement margin). A distinct cement margin gap, »120 µm in size, was observed at the abutment-crown interface. Lower total bacterial units were observed for A. *actinomycetemcomitans* in comparison to *S.mutans*.

**Conclusions** Bacterial biofilm was confirmed to develop on the cementation interface, which is located in the critical transmucosal part and can adversely affect the biological stability of peri-implant tissues. The cementation protocol needs to be improved in order to reduce the cement margin gap.

#### 0396

# One-Piece Mini-Implants Retaining Mandibular Overdentures: 10-Year Clinical and Radiological Outcomes

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**Objectives** *Objectives:* To report the 10-year implant survival/success and peri-implant outcomes of onepiece mini dental implants (MDIs) retaining mandibular implant overdentures (IODs), including marginal bone-level alterations (ΔMBLs), clinical peri-implant parameters, and technical and biological complications.

**Methods** *Material and Methods:* Twenty participants with horizontally atrophied mandibles received new, complete dentures at baseline; subsequently, four MDIs (diameter 1.8 mm) in the interforaminal region were placed. The dentures were converted into implant overdentures (IODs) retained by O-ring attachments immediately after the implant placement. The 10-year follow-up comprised radiological



assessment of  $\Delta$ MBLs, peri-implant parameters, as well as biological and technical complications. A parametric regression analysis was used to compare  $\Delta$ MBLs during 0-5 years after implant placement to 5-10 years. Random-effects linear regression analyses were performed analyzing the effect of gender, implant position, and age on  $\Delta$ MBLs.

**Results Results**: Fourteen participants with a total number of 56 implants attended the 10-year follow-up examination. The implant survival rate was 100%. The overall mean  $\Delta$ MBL after 10 years was -1.12±0.80 mm (Table 1). Fourty-nine implants were classified as successful and 7 implants with a satisfactory survival due to a  $\Delta$ MBL 2 - 4 mm. A significant influence of the time after implant placement on  $\Delta$ MBL (p<0.001) was demonstrated, with stable MBLs after 5 years (mean  $\Delta$ MBL<sub>5-10 years</sub>: 0.06±0.64 mm). The prosthetic survival rate was 93%.  $\Delta$ MBLs were not influenced by implant position and gender. However,  $\Delta$ MBLs were significantly smaller in subjects older than 65 years (mean difference: 0.6mm; p=0.031). **Conclusions** *Conclusions:* One-piece MDIs with O-ring attachments, retaining mandibular IODs, offer a reliable and successful treatment option for mandibles with horizontal bone loss after 10 years, with high implant- and prosthetic survival rates. Advanced age may have a beneficial effect on the peri-implant bone stability.

Implant position	3 months	6 months	12 months	3 years	5 years	10 years
34	-0.58 ± 0.62	-0.68 ± 0.66	-0.64 ± 0.62	-1.00 ± 0.88	-1.26 ± 0.89	-1.42 ± 0.88
32	-0.61 ± 0.42	-0.79 ± 0.62	-1.03 ± 0.67	-1.19 ± 0.70	-1.43 ± 0.73	-1.06 ± 0.53
42	-0.70 ± 0.52	-0.69 ± 0.61	-0.71 ± 0.79	-0.96 ± 0.79	-1.13 ± 0.73	-1.04 ± 0.58
44	-0.54 ± 0.39	$-0.49 \pm 0.43$	-0.56 ± 0.62	-0.68 ± 0.73	-0.89 ± 0.75	-0.95 ± 1.08
Overall	-0.61 ± 0.49	-0.66 ± 0.58	-0.74 ± 0.68	-0.96 ± 0.78	-1.18 ± 0.78	-1.12 ± 0.80

Table 1. Overview of mean marginal bone-level alterations

Mean marginal bone-level alterations ( $\Delta$ MBL) and standard deviations (SDs) overall, and in every implant position (all participants pooled) at each follow-up appointment (0, 3, 6, 12, 36, 60, and 120 months).

# 0397

# Clinical and Radiographic Outcomes of Titanium Implants With Ceramic Coating: 2-Year Results

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**Objectives** To evaluate the success rates, the marginal bone loss (MBL) and peri-implant indexes, of 68 titanium implants with bioceramic coating (Cerid<sup>®</sup>).

**Methods** 34 patients (21 Female, 13 Male) were consecutively enrolled in this study and treated with at least one implant with zirconia coating. A total of 68 Myplant bio (Hager & Meisinger GmbH, Neuss, D)



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were inserted. Implant length ranged from 6.6 to 11mm. 50 implants with diameter 3,5mm and 18 implants with diameter 4.0mm. 41 were in Maxilla, while 27 in Mandible. After submerged healing period of 3-5 months, abutments in ceramic niobium layer (Niob) with cone-morse connection were used for the prosthetic loading. Patients were scheduled for follow-up at the implant loading, 6 months, 1 year and annually. The distance between the implant shoulder the closest mesial and distal bone-implant contact (MBL) using standardized periapical radiographs, modified plaque index (mPI), modified sulcus bleeding index (mSBI), were assessed. Technical complications, were also recorded. All patients were submitted in maintenance therapy.

**Results** At 3-5 months follow-up, 67 implants were clinically osseointegrated and loaded, 1 implant (diameter 3,5mm, length 6,6) was removed in posterior Maxilla for mobility. All implants were restored with full occlusal contact. 20 implants were used to restore 4 edentulous maxilla and 1 edentulous mandible (4 implants in each arch). 18 implants were loaded with single crowns, 29 implants with 12 bridgework. At mean follow-up of 30 months (range 20-36), no other implants were lost and the cumulative success rate was 98,6%. Radiographic MBL evaluating both interproximal surfaces was 0.47 mm (range + 0,35 -1,10). The majority of implants presented healthy peri-implant soft tissue conditions (mPlI=1, mSBI<1). No mechanical complications related to implant components occurred. **Conclusions** The 2-Pieces titanium implant with cone-morse abutment connection did not produces relevant microgap, influencing successfully the peri-implant soft and hard tissues stability. The 2-Pieces Ceramic Implants could combine the biocompatibility of ceramic implant with the technical advantages of titanium implant.

#### 0398

## Correlation of Two Primary Implant Stability Assessment Techniques: a Meta-Analysis

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**Objectives** The conflicting evidence regarding the correlation between Maximum insertion torque (MIT) and implant stability quotient (ISQ) values of dental implant primary stability underscores the need for further assessment. This study aimed to evaluate the association between MIT and ISQ values at implant placement by synthesizing previous research findings.

**Methods** A bibliographical search was conducted on PubMed, Cochrane Library, Embase, and Scopus databases up to July 2023 without publication date restrictions. All clinical studies reporting the correlation coefficient (r) between ISQ and MIT values at the time of implant placement were included. Meta-analysis was carried out using the Fisher r-to-z transformed correlation coefficient as the outcome measure. A Random effect model was fitted to combine the r value between MIT and ISQ values. Statistical analyses were performed using Jamovi software (Version 2.3).

**Results** Initial searches yielded 2307 studies, of which 109 articles underwent full-text evaluation after title and abstract screening. Ultimately, 53 studies were included in the review and meta-analysis. Sample sizes were cluster-adjusted using the Cochrane method for clustering analyses. The overall estimated correlation coefficient between MIT and ISQ values was 0.56 (95% CI: 0.46 to 0.66, p value< .001), but with considerable heterogeneity (Tau<sup>2</sup>= 0.148, I<sup>2</sup>=92.49%). Subgroup analyses were performed based on jaw type (maxilla/mandible), implant characteristics (design, diameter, and length), and bone density, with no important differences between subgroups.

Conclusions The meta-analysis indicated a significant moderate positive correlation between MIT and



ISQ values at implant placement. Further research is warranted to explore additional factors influencing this correlation and to optimize its clinical application.

## 0399

## Volumetric Changes in Immediate vs. Early Implants: 3-Year RCT Outcomes

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**Objectives** One aim of this randomized controlled clinical trial (RCT) was to compare peri-implant soft tissue changes in immediately placed (IP) vs. early placed (EP) Bone Level Tapered implants (BLT, Straumann AG) restored with two different all ceramic buccally micro-veneered restorations after 3 years of follow-up

**Methods** A preliminary analysis of 28 patients (out of 60) rehabilitated with 28 implants with immediately (IP) or early implant placement (EP) protocols with a follow-up of 3 years was carried out. All implants were restored with buccally micro-veneered zirconia (n=14) (Lava Plus, 3M) or lithium disilicate (n=14) (E.Max CAD, Ivoclar Vivadent AG) and bonded to a Ti-base abutment (Variobase, Straumann AG). Cast models from alginate impressions were taken at baseline (BL) and 3-year follow-up visits. Models were scanned (IScan D104, Imetric 4D Imaging Sàrl, Switzerland) and converted to STL files. For the volumetric analysis an area of interest (AOI) was defined (Figure) and the STL data of BL and 3-year follow-up were superimposed with a software (GomInspect 2018, Gom, Germany) to then evaluate peri-implant soft tissue changes and midfacial recessions

**Results** At 3 years follow-up, no significant differences in volume loss between the two groups were found. Yet, a tendency to a slight increase in mean volume loss was found for IP (8.25 mm<sup>3</sup> ±7.22 mm<sup>3</sup>) compared to EP (5.89 mm<sup>3</sup> ±7.00 mm<sup>3</sup>). When comparing the two restorative materials, the mean volume loss for the zirconia group was 6.02 mm<sup>3</sup> (±8.53 mm<sup>3</sup>), while for lithium disilicate it was 4.70 mm<sup>3</sup> (±5.70 mm<sup>3</sup>), showing no statistically significant difference. In terms of midfacial recession, both time of placement (EP=0.75mm ±0.42 mm vs. IP=0.68 mm ±0.62 mm) and material (Emax 0.73 mm ±0.56 mm vs. zirconia 0.65 mm ±0.50 mm) were not statistically different

**Conclusions** Preliminary data indicate that immediate and early implant placement protocols showed similar loss of soft tissue volume 3 years after crown insertion. The restoration material did not have an influence on soft tissue volume loss

## 0400

## Clinical Evaluation of a+PRF Membranes for Gingival Soft Tissue Augmentation

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## **Objectives Objectives:**

This pilot study aims to assess the effectiveness of Advanced + Platelet-Rich Fibrin (A+PRF) membranes solely for vertical soft tissue augmentation in partially edentulous patients characterized by a thin gingival biotype.

## **Methods Methods:**

Eight patients (6 females, 2 males), aged 39 to 68, underwent treatment at a dental clinic in Riga, Latvia. Twelve sites, comprising 6 free-end edentulous ridges and 6 interdental spaces, were evaluated. Partially edentulous patients with thin gingiva measuring less than 3mm were included. Surgical procedures involved subcrestal dental implant placement (1-2mm below the bone) followed by the application of double-folded A+PRF membranes consisting of 3 layers on top of the implant. Soft tissue thickness was measured occlusally using a periodontal probe both before and 3 months after procedure. For statistical analysis, t-tests were used, and statistical significance was set at a p-value of <0.05.

## **Results Results:**

A statistically significant increase in gingival soft tissue thickness was observed, with a mean difference of 1.25 mm (SD 4.75 mm, p < 0.05). When comparing soft tissue gain between 6 free-end edentulous ridges (mean 0.9167 mm) with 6 interdental spaces (mean 1.5 mm), there was no statistically significant difference in soft tissue gains between the two groups.

## **Conclusions Conclusions:**

There was clinically significant increase in gingival soft tissue thickness using A+PRF membranes as the sole material, indicating promising results in their effectiveness in enhancing peri-implant soft tissue dimensions. These finding should be further evaluated with a larger sample size.

## 0401

# Individualized Healing Significantly Improves Pink Esthetics Around Immediate Single Implants

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**Objectives** We aim to compare hard and soft tissue parameters resulting from utilizing AHA or PR *vs* round healing abutments (RHA) on immediately placed single implants, by a systematic review of the currently available literature.

**Methods** A systematic search was conducted in four databases to select two armed studies investigating AHA or PR *vs* RHA on single, immediate implants in any region of the jaw in healthy adult subjects, comparing their effects on implant survival (IS), marginal bone loss (MBL), pink esthetic score (PES), and patient satisfaction measured with visual analogue scales. A random effects model was applied to pool mean differences (MD). Confidence intervals (CI) were calculated with 1-alpha=95%.

**Results** Based on the meta-analysis of 18 studies, the shape of the healing abutment does not affect IS, MBL or patient satisfaction. The pooled comparison of AHA or PR *vs* RHA showed statistically significantly higher PES for the AHA/PR group at 1-year follow-up, including one study with 8 months follow-up, based



on the comparison of 344 implant sites in seven studies. MD (95% CI) was 2.13 (0.70; 3.57). The AHA group contributed by only two studies, due to this low number, no statistically significant differences were found in its subgroup analysis.

**Conclusions** Utilizing different shapes of the healing abutments showed no significant effect on IS, MBL, and satisfaction, but the PR group resulted in significantly better PES, therefore immediate provisionalization is recommended, especially in the esthetic region, and further standardized studies are needed to evaluate the effect of AHA and PR.

## 0402

## Sodium Bicarbonate Physically Removes Plaque by Disrupting its Mechanical Stability

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**Objectives** Dental biofilms, including dental plaque, constitute intricate microbial communities attached to various surfaces of the oral cavity. These biofilms generate a matrix of polysaccharides, eDNA and lipoteichoic acid, providing mechanical stability and protection from antimicrobials. Plaque bacteria are known to be the primary causative drivers of oral diseases, such as caries and periodontal disease. Prevention and treatment of dental biofilms involves a multifaceted approach, including mechanical removal through brushing and flossing combined with the use of toothpaste and mouthwash, and professional cleaning by dentists. Dentifrices with sodium bicarbonate (NaHCO3) concentrations of up to 67% have been shown clinically to remove and reduce dental plaque biofilm to a greater extent than non-bicarbonate containing pastes, even in hard-to-reach areas of the mouth. This study aimed to investigate the underpinning mechanism of action of NaHCO3 treatment on the mechanical properties of oral biofilms.

**Methods** Particle tracking microrheology was used to quantify the viscoelastic properties of *Streptococcus mutans* biofilms grown under shear conditions pre- and post-treatment with 67%w/w NaHCO3 in water. This was combined with confocal imaging to visualize the structural changes in biofilms.

**Results** Under shear conditions, *S. mutans* developed a robust biofilm, exhibiting viscoelastic properties with heterogeneity in stiffness throughout its different layers. The layers closest to the substratum were found to be firmer than the upper layers, with the elastic modulus ranging from about 70Pa at the bottom to about 1Pa at the top surfaces. Treatment with 67%w/w NaHCO3 effectively removed the softer upper layers, resulting in a 40% decrease in biovolume, leaving behind the stiffer bottom layer with an average stiffness of ~70Pa. However, subsequent repeat treatment softened the remnant biofilm and further reduced the biovolume by 80%.

**Conclusions** This suggests that 67%w/w sodium bicarbonate removes *S. mutans* biofilms by softening the matrix and disrupting the mechanical stability and structural integrity of biofilms.



## Inhibitory Effect of Common Plant Flavonoid Cyanidin on Dental Biofilm

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**Objectives** This study aimed to investigate the effect of a key pigment component present in red barriers and fruits, cyanidin, on oral streptococci including commensal species and the main cariogenic pathogens, *Streptococcus mutans and Streptococcus sobrinus*.

**Methods** Minimum inhibitory concentrations, viability test, and biofilm susceptibility assay were determined to assess the antimicrobial and antibiofilm effect of cyanidin on oral streptococci. The structural analysis of biofilm was made by scanning electron microscopy (SEM) and confocal laser scanning microscopy (CLSM). The proportion of water soluble (WSG) and water insoluble glucans (WIG) in biofilms was determined by anthrone method. Lactic acid assay was also performed to investigate the effect of cyanidin on acidogenicity of moo-species and mixed multispecies streptococcal biofilm. **Results** Biofilm inhibitory assay combined with microscopic analysis revealed a strong antibiofilm activity of cyanidin against both *S. mutans and S. sobrinus*, while it remains non-toxic for their cell viability. Essentially, cyanidin does not kill commensal streptococcal species such as *Streptococcus sanguinis*, *Streptococcus oralis*, *Streptococcus gordonii*, and *Streptococcus mitis*, the first colonisers of the tooth surfaces and the main antagonists of cariogenic bacteria. At the same time, dual-species biofilm of *S. mutans* and *S. sanguinis*, as well as mixed multispecies streptococcal biofilm revealed to be more susceptible to cyanidin treatment and less acidogenic in comparison to monospecies *S. mutans* biofilm.

**Conclusions** These observations provide promising insights into the antibiofilm properties of common plant flavonoid cyanidin, while laying out a framework for future therapeutic strategies targeting virulence factors of complex dental biofilms.

## 0404

## Marginal and Internal Adaptation of Recent Bulk-Filling Restorative Strategies

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**Objectives** The aim of this study was to compare both external and internal adaptation of restorative systems applied in class II cavities by using simplified protocols, before and after fatigue. **Methods** Forty-eight human teeth were divided in six groups (n=8). Dentinal fluid simulation was performed before restoring the class II cavities (depths: 3mm proximal and 1.5mm occlusal) : Group 1 - Universal adhesive (Clearfil Universal Bond Quick) and nanohybrid flowable composite (Clearfil Majesty ES Super Low Flow), Group 2 - Universal adhesive (Clearfil Universal Bond Quick) and nanohybrid composite (Clearfil Majesty ES standard), Group 3 - Bulk fill self-adhesive composite (Surefil One), Group 4 – Alkasite dual cured material (Cention Forte), Group 5 - Universal adhesive (Adhese Universal) and nanohybrid composite resin (Tetric Powerfill) and Group Control (CT) - glass ionomer (Equia Forte). Marginal adaptations were observed with scanning electron microscopy (SEM) and compared before and



after a fatigue test consisting of repeated thermal (500 cycles) and mechanical cycles (200'000 cycles). Samples were then cut mesio-distally and internal adaptation was evaluated using SEM again. ANOVA and Fisher's LSD post-hoc test ( $\alpha$ =0.05) were used to compare the differences among groups. **Results** Regarding the external adaptation after loading (Fig. 1), Cention Forte and Equia Forte HT were statistically equivalent and presented the highest percentages of continuous margins (58 and 53%, respectively), followed by Clearfil Majesty ES Standard (32%) and Tetric Powerfill (27%), with Surefil One (8%) and Clearfil Majesty ES Flow Super Low (7%) showing the worst results. In terms of internal adaptation (Fig. 2), Cention Forte (Fig.3, 85%) and Clearfil Majesty ES Standard (74%) resulted in significantly higher values, while Tetric powerfill (56%) and Equia Forte HT (44%) showed significantly lower results, followed by Clearfil Majesty ES Flow Super Low (33%) and eventually Surefil One (17%). **Conclusions** For the restoration of class II cavities, this in vitro study showed comparable marginal adaptation for glass inomer Equia Forte and alkasite dual cured Cention Forte. Regarding the internal adaptation, this latest material presented the highest percentages of continuous margins.

## 0405

# Mechanical and Wear Properties of Novel Ion-Releasing Restorative Materials

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**Objectives** To compare the mechanical properties and wear resistance of different novel ion-releasing direct restorative materials.

**Methods** Bar shaped specimens (1x1x12 mm, n=15) were prepared from three bulk-fill dual-cure resincomposites [Activa Bioactive (ATA), Beautifill Bulk Restorative (BBRE), and Cention Forte (CFE)], as well as from two self-cure dental materials [Resin-composite Stela (SLA) and a glass-hybrid restorative Equia Forte (EFE). Three-point flexural strength (FS) was evaluated after 24h. For three-body wear test (3BW), samples (n=2) were prepared and evaluated after 200,000 cycles, with the test repeated five times. The worn surfaces were evaluated for roughness using a profilometer and inspected by Scanning Electron Microscopy (SEM). Vickers hardness (VH) (n=25) was evaluated after 1 and 30 days of storage (water). Two-way ANOVA and Bonferroni post-hoc tests were used to analyse differences in 3BW and VH, while one-way ANOVA and Bonferroni post-hoc tests were applied to assess the FS and surface roughness ( $\alpha$ =5%).

**Results** Differences in FS were found among materials (p<0.001): EFE ( $38.5\pm6.8$ )<sup>a</sup> < ATA ( $92.5\pm7.2$ )<sup>b</sup> < CFE ( $97.2.0\pm8.2$ )<sup>b</sup> <BBRE ( $108.7\pm8.1$ )<sup>c</sup> and SLA ( $114.3\pm12.2$ )<sup>c</sup>. For 3BW and VH, the difference occurred among materials and within the materials over time, (all with p<0.001). Only the VH of CFE remained unchanged over time, and it exhibited the lowest mean wear but similar to BBRE. Surface roughness was also different after wear among the materials (p<0.001): EFE ( $3.1\pm1.0$ )<sup>a</sup> > CFE ( $1.8\pm0.2$ )<sup>b</sup> >ATA ( $1.4\pm0.2$ )<sup>c</sup> > SLA ( $1.3\pm0.3$ )<sup>cd</sup> > BBRE ( $1.2\pm0.2$ )<sup>d</sup>.

**Conclusions** The evaluated materials performed differently. BBRE and SLA showed the highest FS and VH, along with the lower roughness values. ATA displayed the lowest hardness and poorest wear test performance, while EFE had the lowest FS and highest roughness values, followed by ATA in FS, and wear results. While CFE seems to have the better performance against wear over time.



# Zirconium Oxynitrate Etchant Improves Dentin Bonding Properties: 5-Year Evaluation

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**Objectives** The aim of this study was to assess, using microtensile bond strength test (µTBS) and in situ zymography, the influence of an experimental metal salt-based zirconium oxynitrate etchant [ZrO(NO3)2]-ZON, in conjunction with two simplified adhesives, on dentin bonding properties and endogenous enzymatic activity after 5 years of artificial aging.

**Methods** Coronal dentin surfaces (n=8) were treated with either a traditional 37%  $H_3PO_4$  etchant (PA) or ZON. Subsequently, a single-component etch-and-rinse adhesive (ExciteF, Ivoclar-EF) or a universal adhesive (Adhese Universal, Ivoclar-AU) was applied, followed by composite build-up and µTBS testing. Additional teeth (n=5) were subjected to in situ zymography to evaluate dentinal gelatinolytic activity. Tests were conducted at baseline (T0) and after a 5-year aging period (T5). Data were statistically analyzed ( $\alpha$ =0.05).

**Results** The dentin conditioner, adhesive system, and aging significantly influenced bond strength and enzymatic activity (p<0.05). In terms of bond strength, ZON exhibited higher values compared to PA, AU outperformed EF, while bond strength decreased in all the groups after 5 years. The groups treated with ZON also showed significantly lower levels of enzymatic activity compared to PA at both T0 and T5 (p<0.05).

**Conclusions** The experimental etchant, combined with simplified adhesive systems, demonstrated higher bond strength immediately and even after 5 years of aging, potentially due to reduced collagen enzymatic degradation. The effect was particularly notable with AU, possibly due to enhanced chemical bonding.

# 0407

## Preliminary Assessment of Polymer Mixtures Designed for Self-Limited Dental Burs Manufacture

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**Objectives** The objective of this study was to identify an effective polymer mixture for manufacturing polymeric dental burs, with the specific goal of addressing primary dental caries. The process involved various combinations of polymers meeting the requirements for such instruments, while ensuring greater compatibility with tooth structure.

**Methods** Four different mixtures were tested: two containing polymer mixtures of Bis-GMA/TEGDMA/UDMA (R1, R2), and the other two containing Bis-GMA/PMMA/MMA (R3, R4). Incorporating nanoparticles into the polymer matrix has become crucial to enhance polymer biocompatibility and promoting teeth surface remineralization. Therefore, each mixture was then supplemented with a powder filler consisting of 5% glass with BaF<sub>2</sub> and 0.5% graphene with silver particles (synthesized in research laboratory of Babes Bolyai University, Raluca Ripan Institute for Research in Chemistry, Cluj-Napoca, Romania). Considering that the distinctive cutting property of the polymer relies on the contrast in hardness among various tooth tissues, the Vickers hardness and ultramicroscopic structure using Scanning Electron Microscope (SEM) analysis of the four new polymer mixture recipes were assessed, aiming to identify key features essential for the development of experimental self-limited dental burs. All datasets underwent statistical analysis using the One-Way ANOVA test.

**Results** In laboratory conditions, the average Vickers microhardness values obtained for the four tested materials did not exhibit statistically significant differences (p>0.05). Regarding the SEM analysis, the samples based on Bis-GMA, exhibited an uniform and compact polymeric matrix without pores. Upon the addition of fillers, an intriguing microstructure emerges with larger BaF<sub>2</sub> particles evenly dispersed within the compact matrix. Additionally, nanostructural components such as graphene with Ag, were observed to be well-dispersed within the polymer matrix, appearing indistinguishable from other microstructures. **Conclusions** Overall, while there wasn't a robust correlation observed between the filler amount and Vickers microhardness, filler materials tended to demonstrate higher microhardness values.

#### 0408

## Anti-Candida Effect of Crosslinked Chlorohexidine Loaded HPMC Films.

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**Objectives** This study is aimed at investigating the effects of mucoadhesive polymer films loaded with chlorohexidine diacetate (CXD) on *Candida albicans* and *Candida glabrata* for potentially, topically treating oral Candida infections.

**Methods** The films were prepared by solvent-casting 2% hydroxypropyl methacrylate (HPMC; K4M [MWt 86,000] and K15M [MWt 120,000]) crosslinked with polyethylene glycol. CXD was added (1g to 100ml of mixture). The films were protected by a backing layer (ethylene cellulose). The dried films were cut into disks (10mm diameter). Drug release was measured by UV spectrometry of samples collected every 20min for 2hrs, and every 1hr afterward for total of 7hrs of disks submerged in 6ml deionised water. . Planktonic *C. albicans* and *C. glabrata* cultured in a liquid medium were exposed to CXD serial dilutions to identify the minimum inhibiting concentration (MIC) then drug release samples were tested to confirm the duration of the therapeutic effect.

**Results** The K4M HPMC films exhibited a release of CXD above 20 µg/ml until 180 minutes. MIC of CXD was 15.7 µg/ml and 3.9 µg/ml for *C. albicans* and *C.glabrata* respectively. Samples collected at different time points from the mucoadhesive films consistently inhibited *C. albicans* growth for 180 minutes



while C. glabrata was inhibited for 240 minutes.

**Conclusions** K4M HPMC films crosslinked with 1% polyethylene glycol can potentially sustain a therapeutic effect for at least 3 hours. Further objective is to test the efficacy of the films on fungal biofilms. The results will provide insight into the clinical potential of the system in the management of oral candida infection and beyound.

CHX (1%) releasing from K4M+PEG (1%) films in 6ml water

Concentration (µg/ml, time: min)	0	20	40	60	80	100	120	180	240	300	360	420
Sample 1	0	330.83	205.78	153.79	82.25	54.33	29.32	23.99	8.05	4.35	3.16	1.60
Sample 2	0	384.65	208.59	146.90	79.00	45.07	37.73	36.77	10.01	4.85	3.30	1.86
Sample 3	0	440.45	207.72	130.33	70.57	58.21	24.72	22.32	7.63	4.69	2.97	2.01
Average	0	385.31	207.37	143.68	77.27	52.54	30.59	27.69	8.56	4.63	3.14	1.82
Standard Deviations	0	54.81	1.43	12.05	6.02	6.75	6.59	7.90	1.27	0.25	0.16	0.20

## 0410

## Fiber-Reinforced Direct Extensive Composite Restorations in Premolar and Molar Teeth

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**Objectives** The aim was to assess the influence of incorporating micro- and millimeter-scale short-fiber composite (SFC) on the fracture behavior of large direct restorations. Additionally, the study investigated the effect of tooth size on the loading performance of restorations.

**Methods** A total of 120 premolars and molars were used to create MOD cavities with missing lingual walls. Four different groups of direct composite restorations were made (n=15/group). The first group restored with flowable conventional composite (Gaenial Universal Injectable, GC) without fiber reinforcement. The second group (bilayered-structured) made of micrometer-scale SFC-core (everX Flow, GC) with a surface layer (1 mm) of conventional composite (Gaenial Injectable). The third group made of plain SFC (everX Flow) without any surface coverage. The forth group (hybrid) made of mixing both micro-and millimeter-scale SFCs (everX Flow and everX Posterior) without any surface coverage. Following the fabrication of these restorations, specimens were stored in water for 12 months and then underwent quasi-static loading until fracture. The fracture mode was subsequently evaluated using optical microscopy and SEM. Two-way analysis of variance (ANOVA) was used to statistically examine the data, and it was followed by the Tukey HSD test ( $\alpha$ =.05).

**Results** Restorations in premolars exhibited statistically significant lower fracture-resistance values than those in molars, except for the plain SFC group (p<0.05). The application of SFC as core or plain restorative material demonstrated superior performance in fracture-resistance compared to non-fiber reinforced restorations (Group 1). ANOVA analysis revealed that molar restorations made from a mixture



of everX Flow and Posterior (Group 4) displayed significantly higher fracture-resistance values (2280 ±375 N) (p<0.05) compared to all other tested groups.

**Conclusions** The volume of SFC used in large MOD cavities significantly impacts the loading performance of direct composite restorations

0411

# Impact of Retraction Paste on Universal Resin Cement Bond Strength

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**Objectives** Blood deteriorates the bond strength of resin cements. AlCl3-based retraction pastes are an effective haemostatic but might also influence dentin bond strength if an unintended contamination occurs. This potential influence was investigated for a universal resin cement.

Methods 3M<sup>™</sup> Astringent Retraction Paste (ARP) was applied to bovine dentin for 2min and rinsed off (water spray, 10sec). Untreated dentin samples served as control. 3M<sup>™</sup> Scotchbond<sup>™</sup> Universal Plus Adhesive (SBU+) was applied to half of the samples and left uncured. 3M<sup>™</sup> RelyX<sup>™</sup> Universal Resin Cement (RUV) was used to cement pretreated steel rods (4mm diameter) under standardized pressure (20g/mm<sup>2</sup>). After wiping off the excess cement, glycerine gel was applied, and self-cured samples were stored for 10min under pressure at 36°C. Light-cure samples were cured for 4 x 10sec using a 3M<sup>™</sup> Elipar<sup>™</sup> S10 LED Curing Light.

Shear bond strength was measured after 24h storage (36°C, 100% rel. humidity) on a universal testing machine (Zwick Z010; 8 groups n=6; crosshead speed 0.75mm/min). Data was analysed by One-Way ANOVA separated for adhesive / self-adhesive mode (Tukey; p<0.05). Groups sharing the same letter within one column do not show statistically significant differences.

**Results** The presence of ARP on dentin showed no significant influence on the bond strength of RUV when used with SBU+ as well as for RUV used in self-adhesive mode.

**Conclusions** Unintended contamination with ARP did not deteriorate the bond-strength of RUV when rinsed off properly with water.

Contamination	Cement curing	SBS (MPa) 24h				
		Self-adhesive mode (no adhesive)	Adhesive mode (with SBU+)			
None	Self-cure	24,6 ±5,7 A	27,0 ±3,7 a			
ARP		24,0 ±2,9 A	30,6 ±6,2 a			
None	Light-cure	22,4 ±3,3 A,B	24,0 ±7,3 a			
ARP		17,2 ±1,7 B	28,0 ±7,9 a			



## Combined Effects of Laser/Remineralization Agents on Orthodontic Bracket's Bond Strength

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**Objectives** To evaluate the effects of a Er;Cr:YSGG laser alone or combined with different remineralization agents on orthodontic bracket's enamel bond strength.

**Methods** Eighty-four extracted bovine teeth were randomly divided into 6 groups of 14 teeth each; group I: Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP, Tooth Mousse), group II: Fluoride varnish(Cervitec F), group III: Er;Cr:YSGG laser, group IV: CPP-ACP application after laser irradiation, group V: Fluoride varnish application after laser irradiation and group VI: No treatment(control). Er;Cr:YSGG laser(Waterlase MD,) was used in non-contact mode with swiping motion with a 1-2 mm distance from enamel surface (0.25 W, 20 Hz, 10% air, 0% water).

After the brackets were bonded, all specimens were kept in artifical saliva for 24 h, then subjected to thermocycling (5°C-55°C, 5000 cycles). Shear bond strength(SBS) test was performed using Universal Testing Machine with a crosshead speed of 1mm/min. The amount of adhesive remaining on the tooth surface after debonding was evaluated using ARI index under a stereomicroscope(X40). Data was analyzed using Welch ANOVA, followed by Games Howell test. ARI data was analyzed by the Kruskal-Wallis test(p<0.05).

**Results** ANOVA revealed statistical significance difference between the groups(p<0.001). While the use of Er,Cr:YSGG laser with fluoride varnish resulted in a significantly lower bond strength values than control and other preventive treatments(p<0.05), no statistically significant difference was observed between control and the rest of the treatments(p>0.001). The difference among different groups was insignificant(p>0.05). There was no significant differences in ARI values between control and other groups(p=0.061).

**Conclusions** Er,Cr:YSGG laser irradiation combined with fluoride varnish as a preventive enamel treatment endanger the orthodontic brackets' bond strength.The use of laser, fluoride varnish and CPP-ACP alone or combined used of laser with CPP-ACP did not significantly affect the SBS of orthodontic brackets.

## 0413

## Bond Strength and Ultramorphological Evaluation After Simplified Immediate Dentin Sealing

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**Objectives** Traditionally, 3-step etch-and-rinse adhesive systems were proposed for performing Immediate Dentin Sealing (IDS) technique. In this study, the effect of "simplified" IDS technique achieved with more user-friendly, lightly-filled universal adhesives on microtensile bond-strength (µTBS) and dentinal endogenous enzymatic activity (MMPs) was investigated.



**Methods** The coronal dentin of 24 sound human molars was exposed. The following groups were formed according to the adhesive used for IDS (n=8): 1) Clearfil Universal Bond Quick (QB); 2) Scotchbond Universal Plus (SB); 3) no IDS (CTR). A provisional restoration (Caviton) was placed. After 1 week of artificial saliva storage, CAD/CAM hybrid ceramic onlays (Katana Avencia Block) were luted using a universal resin cement (Panavia SA Cement Universal) in self-adhesive mode. The specimens were cut into 1-mm<sup>2</sup> thick slices and subjected to  $\mu$ TBS test and scanning electron microscope (SEM) analysis after 24 h (T<sub>0</sub>) or artificial aging (10.000 thermocycles 5-55°C; T<sub>1</sub>). *In situ* zymography was conducted on 3 additional molars per group at T<sub>0</sub> and T<sub>1</sub>. Data were statistically analyzed ( $\alpha$ =0.05).

**Results** At T<sub>0</sub>, QB showed a significantly higher  $\mu$ TBS than CTR and SB (p<0.05). Artificial aging negatively affected bond strength in QB and CTR, while bonding values increased in SB (p<0.05). Both experimental groups demonstrated higher bond strength compared with CTR after aging (p<0.05). Most failures were classified as mixed in nature. At T<sub>0</sub>, the IDS with the tested adhesives significantly increased the level of MMPs (QB>SB>CTR; p<0.05). At T<sub>1</sub>, only QB generated a higher gelatinolytic activity compared with CTR (p<0.05).

**Conclusions** The hereby proposed "simplified" IDS achieved with universal adhesive systems can have a positive impact on immediate- and aged µTBS, although it may lead to activation of MMPs within coronal dentin.

# 0090

## Long-Term Bond-Strength of an Experimental Dual-Curing Adhesive

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**Objectives** The development of dental adhesives employs shear-bond-strength (SBS) tests to predict aspects of clinical performance. However, the initial bond-strength alone offers little information on the long-term stability of the adhesive interface.

This study evaluates the effects of 24h, 2 months storage and thermocycling on SBS between an experimental dual-curing universal-adhesive and a well-established bulk-fill composite.

**Methods** SBS to bovine incisors was tested as in ISO/TS-29022:2013 (N=5), employing an experimental dual-curing universal-adhesive, 37% phosphoric-acid-gel (Total Etch), light-curing bulk-fill composite (Tetric PowerFill) and a curing-light (Bluephase PowerCure) (all Ivoclar Vivadent).

The adhesive was applied to the tooth for 20s under agitation in self-etch and etch&rinse mode and cured for 3s (Bluephase PowerCure, 2700-3300 W/cm<sup>2</sup>). The composite was applied in an 4mm increment and cured for 3s (Bluephase PowerCure, 2700-3300 W/cm<sup>2</sup>). The specimens were aged (water, 24h, or 2 months, 37°C) or by thermocycling (5°C/55°C, 30s dwell time, 10'000 cycles). The shear-bond-strength was determined using a ZWICK-ROELL Z010 Universal-Testing-Machine (500N load-cell, 1.0 mm/min). **Results** Table 1 shows significantly lower SBS to enamel than to dentin for both etching protocols. Within a substrate, the difference between self-etch mode and etch&rinse is not significant. Regardless of substrate, SBS was unaffected by aging. All samples prepared on dentin fractured cohesively. **Conclusions** An experimental dual-curing universal-adhesive and the bulk-fill composite Tetric PowerFill showed SBS stable to 2 months of water-storage and thermocycling. Based on this, it can be concluded that the adhesive offers high long-term stability when used for direct restorations.



## Table 1. Shear bond strength (SBS +/- SD MPa)

Substrate	Etching mode	SBS initial (MPa)	SBS 2 months (MPa)	TC 10k cycles (MPa)
Dentin	SE	38.1 +/- 2.9 (A,a)	45.5 +/- 4.5 (A,a)	40.9 +/- 3.7 (A,a)
Enamel	SE	30.6 +/- 2.4 (B,b)	29.6 +/- 1.9 (B,b)	27.8 +/- 1.9 (B,b)
Dentin	E&R	39.3 +/- 3.7 (A,a)	41.6 +/- 2.3 (A,a)	40.7 +/- 2.7 (A,a)
Enamel	E&R	28.5 +/- 1.6 (B,b)	29.4 +/- 3.3 (B,b)	28.0 +/- 2.9 (B,b)

Capital letters denominate statistical equivalence per row, small letter per column (independent t-Test, p<0.05)

0414

## Surface Analysis of Additively Manufactured Dental Zirconia Ceramic

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**Objectives** Differences in three-dimensional printing (3DP) technologies for dental zirconia ceramics are also reflected in final surface quality that significantly influences adhesion of bacteria in oral cavity, as well as adhesion of dental composite cements and translucency of zirconia ceramics. This study aimed to evaluate surface properties of dental zirconia ceramics manufactured using various 3DP technologies and traditional computer-assisted (CAD-CAM) milling.

**Methods** Disc-shaped specimens were prepared using two different 3DP technologies: material extrusion (MEX, Prusa i3 MK3S, Prusa, Czech Republic) and vat photopolymerization (VPP, CeraFab 7500, Lithoz, Austria), along with CAD-CAM milling. Specimens were treated with air-particle abrasion alumina particles (APA, 50 µm Al<sub>2</sub>O<sub>3</sub>). Surface topography was analyzed using scanning electron microscopy (SEM). Surface roughness was measured using optical profilometry. Wettability and capillarity were assessed using contact angle measurement and capillary rise method, respectively. Crystallographic composition of specimens was evaluated by X-ray diffractometry (XRD). Bond strength to composite cements was determined by shear bond strength test (SBS, n=12/group). Type of fracture was evaluated using stereomicroscopy. One-way ANOVA and t-test were used to determine differences among SBS groups (P<0.05).

**Results** SEM analysis revealed that VPP and CAD-CAM-milled specimens exhibited surfaces with fewer defects compared to those produced by MEX. Optical profilometry confirmed these observations, showing the lowest average surface roughness in VPP and CAD-CAM groups compared to MEX group. APA treatment resulted in lower contact angles for all manufacturing groups. Enhanced capillarity was observed in MEX group. XRD analysis did not reveal significant differences in crystallographic phases


among the groups. APA enhanced resin-zirconia SBS compared to no treatment, although no differences were observed among the manufacturing groups.

**Conclusions** The study demonstrates that VPP and CAD-CAM milling produce zirconia ceramics with superior surface quality compared to MEX, exhibiting fewer defects and lower roughness, which are essential for improved dental restoration performance.

## 0415

## Effect of Femtosecond-Laser Micro-Patterning of 3Y-TZP on Oral Biofilm Adhesion

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**Objectives** To evaluate biofilm adhesion to laser-microtextured zirconia-ceramic surfaces. **Methods** Full-sintered 3mol% yttria-stabilized zirconia (3Y-TZP) disks were mirror-polished with their surface subsequently processed by a femtosecond laser (Carbide, CB3-20W). Three kinds of surface textures were prepared: (1) grooves (3Y-TZP\_Gv), (2) grids (3Y-TZP\_Gr) and (3) dots (3Y-TZP\_Dt). Mirror-polished 3Y-TZP and standardized hydroxyapatite (HAp) disks served as control. Surface roughness (Sa) was measured using optical confocal microscopy (S-neox, Sensofar). Surface wettability (hydrophobicity) was assessed by measuring water contact angle (θ) using the sessile-drop method (OCA 15EC, Dataphysics). Multispecies oral communities (14 species) were grown in a Twin bioreactor (BIOSTAT B, Sartorius) and used to grow biofilms on the zirconia- and HAp-disk surfaces for 48h under micro-aerophilic conditions. Biofilm formation was quantified by viability quantitative-PCR (v-qPCR) and subsequently imaged by scanning electron microscopy (SEM). Data were analyzed using 2-way ANOVA and post-hoc Tukey test (a=0.05).

**Results** The significantly highest Sa value was observed for 3Y-TZP\_Gr (1.43µm) followed by 3Y-TZP\_Gv (0.99µm), HAp (0.84µm), and 3Y-TZP\_Dt (0.44µm), while mirror-polished zirconia showed the significantly lowest roughness (7.65nm). Laser micro-patterning of grids, dots and grooves significantly increased hydrophobicity of zirconia ( $\theta$ =117°, 112° and 104°, respectively) compared to mirror-polished 3Y-TZP ( $\theta$ =77°) and HAp ( $\theta$ =7°). In contrast to HAp and regardless of laser micro-patterning type, zirconia disks were predominately covered by commensals (Streptococcus species) and lower number of pathogens (P. gingivalis, A. actinomycetemcomitans, F. nucleatum). SEM confirmed the presence of (strepto-)cocci on 3Y-TZP with the biofilm mainly localized on the edges of the micro-patterned structures, while bacillus, coccobacillus and fusiform bacteria were more dominant on HAp disks.

**Conclusions** Femtosecond-laser micro-pattering of grids, grooves and dots on zirconia ceramics increases surface roughness and hydrophobicity without significantly affecting bacterial adhesion. Zirconia surfaces showed a decrease in deposition of anaerobic pathogenic bacteria compared with HAp.



## Evaluation of Dimensional Accuracy of Lithium Disilicate Glass-Ceramic Blocks

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**Objectives** We developed Lithium Disilicate (LDS) glass-ceramic block, Initial LiSi Block, which does not require crystallization firing after CAD/CAM fabrication. Glazing and staining can also be applied on LiSi Block as necessary. The aim of this study was to evaluate the dimensional accuracy in prosthesis of LDS CAD/CAM block before/after firing or glazing process.

**Methods** Three CAD/CAM materials listed in the table were evaluated. The molar abutment tooth model was scanned using Aadva Scan D2000 (GC), and crown STL data was designed by Dental Designer (3Shape) with a cement space of 80µm. Based on this data, each material was fabricated with CEREC MCXL (Dentsply Sirona), and processing time was measured. The fabricated crowns' dimensions were scanned using ATOS Capsule (GOM). After that, the crowns were crystallized or glazed according to manufacturers' instructions. Then, measurement of dimensions of the obtained crowns was repeated. The dimensional difference from STL data was calculated before/after heat treatment, and the rate of exceeding cement space (above 80µm) was evaluated (n=3). Results were analyzed by one-way ANOVA and Tukey's test. The dynamic deforming temperature of each material was evaluated using thermomechanical analyzer TMA8311 (Rigaku Corporation).

**Results** Results in the table show that LS had a statistically significant lower rate of differences of over 80µm from STL data before/after glazing. EM showed a higher rate after crystallization firing, which was due to the process at a temperature above the deforming point. CT showed no significant difference before/after glazing. However, the rate by CT was significantly higher than that of LS regardless by glazing. It is considered that grinding process on CT was difficult to perform since the processing time for CT was longer.

**Conclusions** Results suggest that Initial LiSi Block has low deformation before/after glazing and is considered as prosthesis material that can be fabricated with the closest dimensional accuracy to STL data.

Grinding process time (n=3), deforming temperature (n=3), and rate of differences from STL data of 80  $\mu$ m (cement space) or more for each material before/after glazing or firing (a-b:p<0.01, c-d:p<0.05).

Materials	Grinding process time [min]	Max. process temp. [°C] / deforming temp. [°C]	Measurement	Rate (≧80µm) [%]±S.D.
Initial LiSi Block (LS, GC Corp.)	15.4±0.01ª	750/792.8±4.7	Before glazing	3.8±0.7°
			After glazing	3.2±0.2°
IPS e.max CAD (EM, Ivoclar)	14.2±0.09ª	850/809.8±2.4	Before firing	7.0±3.2°
			After firing	17.6±2.9 <sup>d</sup>





CEREC Tessera (CT, Dentsply Sirona)	18.8±0.19 <sup>b</sup>	760/788.4±2.6	Before glazing	16.8±2.8 <sup>d</sup>	
			After glazing	13.4±2.1 <sup>d</sup>	

## Residual Stress on Translucent Zirconia Subjected to Sandblasting and Firing

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**Objectives** Monolithic zirconia restorations, composed of 4–6 mol% yttria-stabilized zirconia (4–6YSZ), are utilized in clinical practice. Sandblasting is employed to augment the bonding strength of resin-based cement to zirconia; however, it induces crystalline phase transformation and residual stress. Additionally, sandblasted zirconia may undergo firing during glazing, and the potential impact of firing on the properties of sandblasted zirconia is not fully understood. This study aimed to analyze the influence of sandblasting followed by additional firing on the crystalline phase and residual stress of 4–6YSZ.

**Methods** Plate specimens were prepared from three products from Kuraray Noritake (Tokyo, Japan): Katana HT (4YSZ), Katana STML (5YSZ), and Katana UTML (6YSZ). All specimens were polished and divided into three groups (n=3/group): untreated, sandblasting, and sandblasting followed by firing. Sandblasting was performed using 50 μm-alumina particles at 0.4 MPa, while firing was carried out at 1000°C for 1 hour. Crystalline structure was analyzed using X-ray diffraction (XRD) analysis followed by Rietveld refinement. Residual stress was assessed using cosα method.

**Results** Crystalline structures of polished specimens were composed of tetragonal (*t*) phase and another tetragonal (*t*') phase with low tetragonality. Sandblasting generated the rhombohedral (*r*) phase in all materials (41–53 wt%) and monoclinic (*m*) phase only in 4YSZ (6 wt%). Firing after sandblasting recovered crystalline phase from *r*- and *m*-phases to *t*- and *t*'-phases. However, 13–18 wt% of *r*-phase persisted even after firing. Sandblasting generated compressive residual stress in all materials, especially notable in 4YSZ. Although firing lowered residual stress, compressive residual stress still remained. The recovered *t*'-phase exhibited higher lattice constants than the original *t*'-phase, potentially contributing to the persisting residual stress.

**Conclusions** Compressive residual stress was detected in sandblasted zirconia even after firing. Generally, compressive residual stress augments the flexural strength of materials. Therefore, sandblasting of monolithic zirconia restorations may be acceptable, even when they undergo glazing after sandblasting.



# Effectiveness of Bioceramics on Mechanical and Morphological Properties of Dentin

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**Objectives** Calcium silicate materials are known for their bioactivity. The realization of calcium ions and their pH alkaline play an important role in the antibacterial activity and remineralization process. The aim of this in vitro study was to investigate the effect of calcium silicate based endodontic sealers on the dentinal morphology and the mechanical properties of dentinal structure after 4 months of aging process in PBS at 37°C

**Methods** Scanning electron microscope was used to investigate the morphological changes in dentinal tubules. Microhardness was used to evaluate the mechanical changes in dentinal surfaces. One way analysis of variance was used.

**Results** The dentinal tubules demonstrated mineral depositions onto their walls. This mineral deposition had a needle-like structure which could close these tubules and eliminate the microorganisms. No significant differences were found between the microhardness of dentinal structure for teeth obturated with calcium silicate compared to teeth without obturation (control). Calcium silicate materials have a bioactive effect including the mineralization process and mineral depositions into dentinal tubules without a significant mechanical change in dentinal surfaces.

**Conclusions** Further studies should investigate the long-term effects of calcium silicate materials on dentin and various mechanical tests should be used to analyze the mechanical behaviors of the dentin structure which is in contact with these bioactive materials.

0420

## Titanium and PolyEtherEthetKetone, an Alternative to Framework Cobalt-Chrome Dentures?

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**Objectives** The use of Cobalt-chrome (CoCr) alloy in removable partial dentures (RPDs) has raised concerns due to its carcinogenic and mutagenic properties. Titanium (Ti) and polyetheretherketone (PEEK) have emerged as potential alternatives, yet their mechanical and biological performances remain insufficiently explored.

This systematic review aims to compare the mechanical and biological performances of Ti and PEEK in RPDs against the reference material, CoCr.

Methods Following PRISMA guidelines, three databases were searched until March 2024. Only studies evaluating mechanical and/or biological properties of Ti, PEEK, and CoCr were included. Quality assessment was conducted using Rayyan software and bias risks were evaluated with the Methodological Index for Non-Randomized Studies (MINORS). Mechanical and biological aspects were analyzed. Results Out of 138 identified articles, 18 met inclusion criteria, with most exhibiting low to moderate bias risks. Retention forces and fatigue were lower for Ti and PEEK compared to CoCr, with Ti also showing



reduced hardness. PEEK demonstrated less deformation. Biocompatibility was adequate for both materials. Utilization of digital technologies and machining enhanced mechanical properties and biocompatibility.

**Conclusions** Titanium and PEEK present promising alternatives to CoCr for RPD frameworks, showing favorable mechanical and biological performances. However, further well-designed studies are necessary to ascertain their clinical applicability and long-term limitations, facilitating informed clinical decision-making.

0422

## Evaluating New Parameters to Assess Solubility of Pulp Preservation Materials

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**Objectives** *In vitro* testing protocols for dental materials should simulate the clinical situation as possible to obtain results closer to actual material performance in oral cavity. Currently there are lack of standards to evaluate materials used for vital pulp therapy. The aim of this study was to investigate new standards to test solubility of pulp preservation materials.

**Methods** The solubility of three materials used for vital pulp therapy: Biodentine, TheraCal and Activa were evaluated for 28 days using ISO 4049:2019. The test deign was modified by changing the surface area/volume ratio, using Dulbecco's modified eagle medium (DMEM) as an immersed solution alternative to water and periodic solution change. Microstructure changes of tested materials were assessed before and after completion of solubility test using scanning electron microscopy (SEM) and X-ray diffraction (XRD) analysis. Data were analyzed using a two-way ANOVA followed by Tukey post-hoc tests at a significant level of ( $p \le 0.05$ ).

**Results** The use of lower surface area/volume ratio has significantly reduced solubility value of Biodentine compared to using ISO 4049 method in 28 days ( $p \le 0.05$ ). TheraCal LC showed negative solubility values after desiccation when tested using ISO 4049:2019 and all modified parameters for 28 days. Activa exhibited negative solubility values when tested using 4049:2019 test deign. XRD graph of Biodentine exhibited high peak of calcium hydroxide in lower surface area/volume ratio group and SEM image showed Calcium hydroxide crystals formation on the surface. TheraCal and Activa showed no microstructure changes when using different testing parameters.

**Conclusions** The solubility values obtained were dependent on the material structure and method used. It is thus important to use specific test design for each material and use methods that replicate the clinical environment for relevant assessment.

## 0423

## Porous and Injectable Bone Adhesives for Stable Implants in Defects

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**Objectives** Calcium Phosphate/Amino Acid-based (CaP/J) bioadhesives are promising biomaterials due to their excellent biocompatibility, high osteoconductivity, and injectability. However, many of them exhibit a slow resorption rate. We hypothesized that adding carbonate salts (Car) could create pores inside, facilitating easier remodeling and reabsorption by the organism.

**Methods** The base material bioadhesive was composed by mixing α-TCP (CaP) and the amino acid phosphoserine (J) in a 3:1 ratio with ultrapure lab water (control group (CG)). For pore creation,3wt%Na2CO3 was incorporated at an L/P ratio of 300µl:1g as the test group (TG). Morphology was characterized by micro-CT scans (MCTs) and Scanning Electron Microscopy (SEM). Chemical compounds were investigated using Fourier Transform Infrared Spectroscopy with Attenuated Total Reflection (FTIR-ATR). Mechanical properties were evaluated through removal torque test (RTT), compression modulus test (CMT), and hardness tests (HT).

**Results** MCTs of the CG revealed packed sheets of large crystals (Fig. 1A-C), while the TG exhibited uniformly distributed crystal plates (Fig.1D-F). SEM images displayed characteristic morphological differences (Fig. 2 A-B). In FTIR spectra, the asymmetric stretching vibration of CO<sub>2</sub> typically produces a distinct absorption peak around 2349 cm<sup>-1</sup>, suggesting CO<sub>2</sub> release or containment in the TG (Fig.3). The RTT showed a higher mean value for the CG (71.58 ± 5.56) compared to the TG (41.37 ± 4.54) (Fig.4). The CMT indicated a significantly higher mean value for the CG (1248.01 ± 278.21) compared to the TG (195.42 ± 29.55) (Fig.5). The HT demonstrated a reduction in hardness for the TG compared to the CG, indicating increased brittleness (Fig.6).

**Conclusions** We conclude that the addition of carbonate salts indeed generates pores in situ during the biomaterial mixing process. Further work must be performed to improve the mechanical properties of this novel porous bulk material.

## 0424

## Need for Antibiotics Following Surgical Removal of Wisdom Teeth

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**Objectives** There isn't a mutual consensus about the prescription of antibiotics after surgical removal of wisdom teeth. Patients often use antibiotics on their own, while the majority of oral surgeons prescribe them

even when they are not necessary. Aim of this study was to evaluate patients' and oral surgeons' opinion on

antibiotic therapy after surgical removal of wisdom teeth.

**Methods** Prospective, clinical study conducted in the Department of Oral Surgery, Faculty of Dentistry (University of Belgrade) enrolled 130 operated examinees. Patients completed the survey before surgery while surgeons did it regarding the clinical parameters. Subjects were divided into two groups and the

results were statistically analyzed with descriptive statistics and Chi-square test.

**Results** Postoperative antibiotic therapy was prescribed to 103 patients (79.2%). Patients expected antibiotic



therapy due to the prevention of infection (47%) and faster recovery (27%). Every fourth examinee did not expect antibiotic therapy, which wasn't related to sex, age and level of education (p=0.302; p=0.517; p=0.097).

Surgeons decided to prescribe antibiotics after the surgeries that lasted longer than 25 minutes (p=0.005) and

the ones that required bone removal (p=0.001).

**Conclusions** Most of the patients expect antibiotic therapy after surgical removal of wisdom teeth. Surgeons

usually prescribe antibiotics according to clinical evaluation and own experiences. Encouraging fact was that

patients rarely decide to take antibiotics on their own.

## 0425

## Carotid Artery Calcifications on Panoramic Radiographs Among Dental Patients

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**Objectives** The study aimed to identify carotid artery calcifications (CACs) on panoramic radiographs among dental patients visiting VUL ZK and analyse the relationship between CACs and demographic variables: age and sex.

**Methods** The research involved a convenient sample of 3000 panoramic radiographs obtained from participants aged 45 years and older, visiting Vilnius University Hospital Zalgiris Clinic in the period from 2014 to 2020. Demographic data, namely, sex and age were collected for analysis. The investigator's ability to accurately identify carotid artery calcifications (CACs) was assessed through the evaluation of intra-observer agreement (IOA), which was considered as satisfactory. Statistical analyses were conducted using the IBM SPSS 26.0 statistical package using Mann-Whitney and Chi-square tests. **Results** The required anatomical area was visible on 2287 panoramic radiographs (76.2%): 1326 (58.0%) women and 961 (42.0%) men. Mean age of the population was 59.13 years (SD = 9.973): 58.42 years (SD = 9.815) for men and 59.63 years (SD = 10.064) for women). CACs were found in 197 (8.6%) patients, of which 115 (5.0%) were unilaterally and 82 (3.6%) bilaterally. More CACs were found in men 103 (4.5%) than in women 94 (4.1%), p = 0.002. The prevalence of both unilateral and bilateral CACs increased with age, p < 0.001. The type of lesion was not statistically dependent on gender.

**Conclusions** CACs were detected in 8.6% of patients aged 45 years and older. The presence of CACs on panoramic radiographs increased with patients' age, and they were more prevalent in men. Our results show that dentists may play a crucial role in identifying patients at risk of cardiovascular diseases.



# Distribution of calcifications within the study group's carotid arteries

CACs	Unilateral		Bilateral			
	N	%	Mean age	N	%	Mean age
Women	55	2,4	69,78	39	1,7	68,31
Men	60	2,6	66,53	43	1,9	68,35

#### 0426

## External Validation of an AI-Based Caries Detection Model on Photographs

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**Objectives** Artificial intelligence (AI)-based models have been increasingly used to automatically analyse photographs of teeth. The aim of this ex vivo diagnostic study was to externally validate a freely accessible AI-based model for caries detection, classification, localization and segmentation using an independent image dataset. It was hypothesized that there would be no differences in diagnostic performance between these data and previously published internal validation data.

**Methods** For the independent dataset, a total of 718 dental images representing different stages of caries (N=535) and noncarious teeth (N=183) were retrieved from the internet. The photographs were first evaluated by dentists, and they served as a reference standard. Next, an AI-based model was used to analyse the photographs. Diagnostic performance was statistically determined using cross-tabulations to calculate the accuracy (ACC), sensitivity (SE), specificity (SP) and area under the curve (AUC).

**Results** An overall ACC of 92.0% was achieved for caries detection, with an ACC of 85.5-95.6%, SE 42.9-93.3%, SP 82.1-99.4% and an AUC 0.702-0.909 for the different caries classes. Furthermore, the correctness of caries localization and segmentation was assessed. Herein, 97.0% of the cases were accurately localized. Fully and partially correct segmentation was achieved in 52.9% and 44.0% of the cases, respectively.

**Conclusions** Despite the promising diagnostic performance of the AI-based model for caries detection and classification, compared to previously published internal validation data, the performance scores decreased. Future studies would be needed to investigate the validity, reliability and practicability of AI-based models using dental photographs from different image sources and/or patient groups.



# AI-Based Detection of Molar Incisor Hypomineralisation – an External Validation

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**Objectives** The clinical resemblance of molar incisor hypomineralisation (MIH) to other dental hard tissue defects remains a challenge in diagnostic evaluation. Independent diagnostic methods based on artificial intelligence (AI) could therefore support and verify the visual examination. The aim of this ex vivo diagnostic study was to externally validate an open-access AI-based model for the detection and classification of MIH and related classes (demarcated opacities, enamel breakdowns and atypical restorations) on dental images.

**Methods** A dataset with web images showing teeth with (N=277) and without MIH (N=178) was evaluated by dentists and served as a reference standard. The dataset was analysed using the AI-based model (http://demo.dental-ai.de) with automated detection and classification of MIH (test method), allowing multiple findings per image. The diagnostic performance of the AI-based model was evaluated in comparison to the workgroup consensus, whereby the influence of the respective image size was also considered. The accuracy (ACC), sensitivity (SE), specificity (SP) and area under the curve (AUC) were statistically determined. The correctness of the localisation and segmentation of the MIH lesions was also subjectively assessed.

**Results** An overall ACC of 94.3% was achieved for detection of MIH. Cross-classification of the AI-based class prediction and the reference standard resulted in an ACC between 91.4% and 97.8%, with SE and SP values of 81.7% to 92.8% and 91.9% to 98.7%, respectively. The AUC was between 0.894 and 0.945. Considering the image size (12–5,100kB), the diagnostic parameters showed only minor deviations. Moreover, the AI-based model correctly predicted MIH localisation in 97.3% of cases. The segmentation was fully correct in 63.4% of all cases and partially correct in 33.9%.

**Conclusions** This study documented an encouraging diagnostic performance of the AI-based model by using an external image sample. Future studies are recommended to investigate the diagnostic validity and practicability in different settings.

#### 0429

## CBCT Radiomorphometric Indices as Auxiliary Tool for Detection of Osteoporosis

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<sup>1</sup>Department of Prosthodontics, Riga Stradins University, Riga, Latvia, <sup>2</sup>Department of Conservative Dentistry and Oral Health, Riga Stradins University, Riga, Latvia, <sup>3</sup>Department of Orthodontics, Riga Stradins University, Riga, Latvia, <sup>4</sup>Institute of Electronics and Computing Science, Riga, Latvia **Objectives** The purpose of the study was to determine whether the computed tomography mandibular indices, detected in cone beam computed tomography (CBCT) can be used for predicting the risk of osteoporosis.

**Methods** In the present study were included 201 postmenopausal females aged 52-91 years (average age 68.6±8 years), who undertook CBCT examinations due to dental implant planning.



Bone mineral density measurements (BMD) of lumbar spine and both femoral necks by dual energy X-ray absorptiometry (DXA) were performed. The worst T-score reading from both were considered and patients were divided into 3 groups: normal BMD, osteopenia, and osteoporosis. CBCT images were analysed with OnDemand3D Dental software. In cross-sectional CBCT images, the computed tomography mental index (CTMI) (inferior cortical bone width of the mandible) and computed tomography mandibular indices (superior (CTI-S) and inferior (CTI-I)) were determined in the mental foramen region.

To detect the differences between groups One-way ANOVA was used. Performance of indices to predicting osteoporosis was assessed by computing the area under the curve (AUC). Sensitivity (Se), specificity (Sp), PPV, NPV was calculated with dichotomous 2 × 2 tables.

Results Based on the DXA results, 65 females had normal BMD, while 99 exhibited osteopenia, and 37 were diagnosed with osteoporosis. Females with osteoporosis had a reduced CTMI (cortical bone thickness) compared to women with normal BMD group, respectively- osteoporosis (2,72±0.74 mm), osteopenia (3.34±1.1 mm), normal BMD (3.54±0.92 mm); p = 0.0001. The other two indices did not show a statistically significant difference between the different BMD groups. The CTMI showed promising diagnostic performance: AUC=0.61, Se=79%, SP=54%, PPV=31.3%, NPV=90.6% to predict osteoporosis.
Conclusions Postmenopausal females with osteoporosis had reduced cortical bone thickness (CTMI). CTMI is a promising tool for identifying postmenopausal females at increased risk of osteoporosis.
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## 0430

## Morphological Assessment of Upper First Premolars Using Cone-Beam Computed Tomography

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**Objectives** Upper first premolars usually have two roots and two canals, however due to their numerous variations, detail cone-beam computed tomography (CBCT) analysis is required for successful root canal treatment (RCT). The aim of this study was to evaluate the furcation level, furcation groove presence, wall thickness and canal shape using CBCT.

**Methods** The sample size consisted of 30 extracted maxillary first premolars with two separate roots. After flattening the occlusal planes to the level of the central fissure, trepanation and gaining patency (K#08), each canal was irrigated with 20ml of 0.5% NaOCl. The teeth were scanned on Cavo CBCT 3D. Subsequently, the furcation depth, furcation groove, wall thickness and canal shape were analyzed in OnDemand3D CD Viewer program. The results were statistically analyzed in IBM SPSS Statistics 25.0. program.

**Results** The mean furcation distance from the cement-enamel junction was 2.48±0.71mm. Twenty six out of thirty premolars had a furcation groove on the buccal root and in most cases it was extended to the transition from the middle to the apex third. The average thickness of the middle third of the buccal root palatal wall was 0.93±0.40mm, and even in 62.5% of cases it was less than 1mm. The buccal root in most of the samples (63.63%) was S-shaped, while the palatal root showed a more even distribution of shapes, with a slightly higher prevalence of C-shaped canals.

**Conclusions** The common presence of the furcation groove and irregularities in wall thickness indicate the importance of being familiar with problem zones during RCT.



## Association Between Autonomic Nervous System Activity and Temporomandibular Disorders

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**Objectives** Studies have shown that elevated stress levels are associated with temporomandibular disorder (TMD) -related pain, which suggests that alterations in autonomic nervous system (ANS) activity may contribute to this pain condition. The aim of the study was to evaluate the sex-specific associations between ANS activity and TMD pain-related diagnoses (myalgia and arthralgia) in a population-based study.

**Methods** Study was part of Northern Finland Birth Cohort 1966. Of the cohort members, 1964 (62.3% of those invited to oral health examination) were clinically examined as part of 46-year follow-up. TMD diagnoses were based on the modified protocol of DC/TMD (Diagnostic Criteria for TMD). ANS activity was assessed clinically by means of heart rate variability (HRV) and baroreflex sensitivity (BRS). In the logistic regression analyses stratified by sex assigned at birth, potential confounders, i.e. education and body mass index, were considered.

**Results** Among females with TMD myalgia standing BRS was 15% lower compared to the reference group (OR 0.872, 95%Cl 0.777–0.979, p 0.021) and among females with TMD arthralgia standing BRS was 12% lower compared to the reference group (OR 0.890, 95%Cl 0.800–0.991, p 0.034).

**Conclusions** The results of present study suggest that ANS activity has a role in TMD pain at least at some extent in females. Especially, lowered BRS seems to have an association with both TMD myalgia and arthralgia. Low number of males with TMD diagnoses could explain why there was no statistically significant differences between ANS activity and TMD diagnoses among males after adjustments. These findings refer to the association of stress response with TMD.

## 0432

## Validating Precision of Three Tooth-Wear Measurement Approaches Using Intra-Oral Scans

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**Objectives** Aims of this study were to evaluate the precision of three different 3D Wear Analysis Approaches (3DWAAs) using intra-oral scans (IOSs) and to investigate the inter-operator precision in applying these approaches.

Methods To evaluate precision, IOSs of patients treated within the scope of a prospective observational study on the progression of tooth and dental materials' wear from baseline (intake/after restorative treatment) and after three years were superimposed. Two independent observers evaluated height-loss over time using three approaches: 1) 3D-measurement software (GeomagicQualify2013, 3D-Systems), 2) algorithm-based automated segmentation method combined with 3D-measurement software, and 3) commercial system (TriosPatientMonitoring, 3shape). Measurement areas were defined as tooth surfaces, specifically chosen for different tooth types and locations, and the respective highest value per area was noted [mm]. The inter-approach precision and inter-operator precision were calculated using paired t-tests (p<0.05) reporting correlation, structural error, and duplicate measurement error (DME). Outliers with a disagreement > 0.2 were excluded for numerical analysis and descriptively analysed. Results In six patients 163 teeth equaling 364 measurements were evaluated and visualized in scatterplots. Outliers were mainly caused by large height-differences due to fracture, inaccuracies in necessary 2D-measurements, and errors in the commercial system. Comparing the approaches, both the automated segmentation method (reliability=0.983, DME=0.026, diff./95%-CI=-0.012[-0.015...-0.010]mm; p<0.001) and the commercial software (reliability=0.986, DME=0.022, diff./95%CI=-0.004[-0.006...-0.001]mm; p=0.003) resulted in larger height-loss values than using only the 3D-measurement software. The largest difference between observers was found using solely the 3D-measurement software, although the differences were still low concerning clinically relevant height-losses (reliability=0.986, DME=0.024, diff./95%Cl=-0.015[-0.018...-0.011]mm; p<0.001).

**Conclusions** When outliers due to software/measurement errors are handled as such, all 3DWAAs presented clinically comparable precision (differences < 18µm) in measurements independent of the operator and can therefore be equally recommended for height-loss measurements using IOSs.

## 0073

## Annotated Clinical Image Database Supporting AI Algorithms for OSCC Diagnosis

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**Objectives** Up to 86% of patients with oral squamous cell carcinoma (OSCC) receive diagnosis at an advanced stage, resulting in poor survival rates. Introducing artificial intelligence and deep learning systems in the diagnosis of OSCC is the evolution of recent research. However, to date, databases of oral cavity lesion images are limited and not well-defined or secure due to the lack of histological confirmations. One of the most frequent clinical forms of OSCC is ulcer. This study aims to illustrate the development of a platform for the collection, annotation, and labelling of clinical images, leading to the creation of the first dataset on oral ulcerative lesions.

**Methods** We designed a protocol for collection and standardization of clinical images of ulcerative oral lesions collected at the Oral Medicine Unit at University Policlinico"Paolo Giaccone" of Palermo after informed consent of patients. This endeavor was supported by a web-based platform hosted on a



dedicated server, designed in partnership with the Department of Computer Engineering of the University of Pisa.To maintain the fidelity of the clinical features in the images, we applied following inclusion criteria for image collection:high image resolution and histological confirmation of lesions with uncertain diagnoses prior to annotation.

**Results** To date, a database has been created and it is composed of 600 images (184 neoplastic, 214 aphthous, and 199 traumatic ulcers). These have been annotated and labeled by three oral medicine and include high-quality images of ulcerative oral lesions, classified in aphthous, traumatic, and malignant neoplastic ones. Other 200 images will be annotated and labeled in the next two months **Conclusions** We present a novel, annotated database of clinical images of ulcerative oral lesions. The release of this dataset with 1000 images will be planned on public servers. This could be certainly a powerful resource to significantly boost the development of AI algorithms for the early detection of OSCC, improving patient outcomes through early intervention.

## 0435

## Saliva Inflammation Markers and Association With Periodontal Outcomes

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**Objectives** Large screening panels of saliva inflammation proteins make it possible to explore biomarkers of periodontal disease severity, ultimately to be used to monitor periodontitis. We aimed to explore saliva inflammation markers associated with periodontitis severity, bleeding on probing (BoP) and pocket depths (PD) in a cohort of older adults.

**Methods** A total of 228 saliva samples from 70-years-old adults in Western Norway, were analyzed for 92 inflammatory protein markers (Olink Proteomics, Bevital, Bergen, Norway). Saliva samples were collected concurrently with a thorough clinical examination including clinical attachment loss (CAL), BoP and PD. Participants were grouped by periodontitis severity: no periodontitis (n=19), non-severe (n=142) and severe (n=67) in accordance with Eke et al (2015).

**Results** In the present study, C-X-C Motif Chemokine Ligand 5 (CXCL5) decreased with decreasing proportion of sites with BoP (rho=0.15, p=0.03) and the lowest concentrations of CXCL5 were found in participants with severe periodontitis compared to those with no periodontitis (p=0.02). Also, tumor necrosis factor-related apoptosis-inducing ligand (TRAIL) decreased with severe and non-severe periodontitis compared to healthy (p=0.02). Furthermore, Delta and Notch-like epidermal growth factor-related receptor (DNER) decreased with increasing proportion of sites with BoP (rho=-0.19, p=0.003) and with increasing mean periodontal PD (rho=-0.21, p=0.002). Hepatocyte growth factor (HGF) increased with proportion of sites with BoP (rho=0.23, p<0.0001) and mean periodontal PD (rho=1.58, p=0.017). Furthermore, adenosine deaminase (ADA) and salivary urokinase (uPA) were found to increase with BoP (rho=0.24, p<0.0001 and rho=0.19, p=0.004, respectively) and with periodontal PD (rho=0.14, p=0.03) and 0.05 (rho=0.12), respectively).

**Conclusions** We found that salivary HGF and CXCL5 to be associated with periodontitis. In addition, the recently described inflammatory biomarkers TRAIL, DNER, ADA and uPA were also associated with periodontal parameters in this cohort of older adults.



## Non-Invasive Screening Tools for Periodontal Disease

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**Objectives** Periodontal disease (PD) is the most common chronic inflammatory disease representing a major healthcare burden. Thus, gaining further insights regarding the molecular mechanisms and cellular pathways that are dysregulated in PD development and progression is mandatory. TAM receptor tyrosine kinases (RTKs) - TYRO3, AXL and MERTK - together with their ligands (GAS6 and PROS1) have been implicated in chronic inflammatory diseases, however the impact of this pathway on human PD is still unclear. The goal of this study was to quantify TAM receptors and the ligand GAS6 in saliva samples from 38 participants at different PD stages (stages I/II: n=12 and stages III/IV: n=15), including gingivitis (n=4) and healthy controls (n=7), to evaluate their potential as biomarkers for PD.

**Methods** Participants enrolled in this study were diagnosed according to the staging and grading classification scheme established by the World Workshop in 2018 and unstimulated whole saliva was collected after informed consent was obtained. Proteins in saliva supernatant were quantified through multiplex immunoassay technology (Luminex xMap).

**Results** Results showed increased levels for all proteins across disease progression, reaching the highest concentrations at stages III/IV. This profile was more evident for AXL (299.2 $\pm$ 232.9 pg/mL) and MERTK (163.5 $\pm$ 92.3 pg/mL) in stages III/IV being significantly higher than the control group (p < 0.05). In addition, salivary concentrations of AXL, MERTK, and GAS6 differed significantly between the two periodontitis groups (stages III/IV and stages I/II; p< 0.05).

**Conclusions** These findings indicate that proteins associated with dysregulated cellular pathways in PD are potential candidate biomarkers for individual PD prognosis and monitoring. The results of this study demonstrate for, the first time, the quantification of TAM pathway proteins in saliva and suggest that these biomarkers should be explored further for PD diagnosis, prognosis, and treatment monitoring.

0437

# Inflammatory Profile at Different Stages of Periodontal Disease

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**Objectives** Periodontal disease (PD) is a biofilm-induced disease that damages the soft and hard tissues around teeth, and without treatment may lead to tooth loss. Periodontal inflammation in advanced disease stages is associated with uncontrolled cytokine and chemokine release, which suggests that quantification of such biomarkers across disease stages might be useful for disease diagnosis, prognosis and therapeutic decision making. The aim of this research was to quantify salivary inflammatory biomarkers in participants at different PD stages, to support disease prognosis and monitoring. **Methods** In this cross-sectional cohort study, patients from the periodontology clinic were invited to participate and gave their informed consent. Based on the PD diagnosis according to the staging and grading classification scheme established by the World Workshop in 2018, four groups of participants were identified: periodontally health (n= 7), gingivitis (n= 4), stage I/II (n= 12) and stage III/IV (n= 16). Unstimulated saliva samples from these participants were collected before the oral examination and cytokines were quantified from saliva supernatant through multiplex immunoassay technology (Luminex xMap).

**Results** The results showed high levels of all salivary inflammatory cytokines in stages III/IV when compared to the levels of the other groups. This increased profile was more evident for the cytokine IL-10 (10.6±11.6 pg/mL) being significantly higher than stage I/II group [0.22± 0.48 pg/mL (p < 0.01)]. Moreover, this profile was also observed for IL-1 $\beta$  (959.7±1405 pg/mL), a marker already reported for PD, and for INF- $\gamma$  (13.6±43.3 pg/mL). Although the salivary IL-6 and TNF- $\alpha$  concentrations were increase in stages III/IV, the observed differences between the remaining groups were not very pronounced.

**Conclusions** These findings provide a panel of inflammatory markers as potential indicators of disease severity, namely IL-10, IL-1 $\beta$  and INF- $\gamma$ , supporting prognosis, monitoring, and clinical management of PD cases.

#### 0438

## Biocompatibility of Resin-Matrix Ceramics (RMCs) on Human Gingival Fibroblasts.

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**Objectives** This project aims to investigate the influence of Resin-Matrix Ceramics (RMCs) restorative materials (like GC Cerasmart 270 and Katana Avencia), on primary human gingival fibroblasts (ATCC PCS-201-018) (HGF) to evaluate biocompatibility of dental materials as an in vitro experimental model. **Methods** Disk-shaped samples with 15 mm diameter and 1 mm thickness were tested as received from manufacturers on HGF. HGFs reside in the subepithelial connective tissue in which play a crucial role in maintenance of tissue integrity, wound healing and regeneration process. To evaluate biocompatibility of RMC materials, the influence on proliferation of HGF was tested at 1,3 and 7 days with Alamar Blue assay, at the same time point the inflammation was analysed with ELISA (specifically detecting the inflammatory factor IL-1β) and to assess the effect of RMCs on wound healing, scratch migration assay at 24 h, 28 h and 72 h was performed. Data were analysed using one-way repeated measure ANOVA and Tukey's test. **Results** Our data demonstrated that there was no significant difference in proliferation between HGFs in



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contact with disks and untreated control group (the cells were cultured on polystyrene plates in the absence of eluates) at each observed time point. Particularly, after 1 day, a growth inhibition of 2,2% was showed in GC Cerasmart 270 and 1,6% in Katana Avencia. At day 3, the percentage increased to 11,5% in GC Cerasmart 270 and 8,9% in Katana Avencia, while at day 7, the growth inhibition was 3,8% in GC Cerasmart 270 and 3,1% in Katana Avencia. Furthermore, there was no significant variance in the expression of IL-1β in treated cells compared to control group at each assessed time point, although a trend towards increase was noted at day 3 in both tested samples. Ultimately, the results from the scratch assay indicated that both materials did not exert any influence on the wound healing capacity. **Conclusions** Biocompatibility is crucial for any dental material that may interact with vital tissues. This study aims to investigate biological effects of RMC restorative materials on HGF to evaluate, through in vitro experimental model, proliferation, inflammation and wound healing. Importantly, the results of our study give a considerable contribute to the implementation of restorative surgery.

## 0439

## Exploring Dentists' Antibiotic Treatment Prescription Practices in Romandy, Switzerland

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**Objectives** Antimicrobial resistance (AMR) stands as a critical global health challenge due to the misuse and overuse of antibiotics. Dentists along with medical practitioners significantly contribute to this issue through their prescribing habits. This study aimed to explore the self-reported antibiotic prescription practices among dentists in the French-speaking region of Switzerland.

**Methods** An electronic questionnaire was sent to 331 dentists. Questions related to antibiotic prescription in various situations and procedures, solely focused on the healthy population, without any immunocompromised individuals or patients at risk for infective endocarditis. Responses were analyzed on a three-point Likert scale.

**Results** The response rate was 28%. The results highlighted that antibiotics were commonly prescribed for conditions such as abscesses with systemic symptoms (89%), cellulitis (81.5%), acute sinusitis (62%), and necrotizing periodontitis (52%). Notably, surgical procedures like sinus floor elevation (59.8%) and implant placement (60.9%) were frequently accompanied by antibiotic prescriptions. Amoxicillin emerged as the preferred antibiotic, with clindamycin being the alternative for patients allergic to penicillin (87%). A significant majority of participants (76.1%) expressed the need for more specific guidelines on the use of antibiotics use dentistry.

**Conclusions** The findings underscore the importance of implementing stricter protocols for antibiotic prescriptions in dental practice to effectively address the challenge of AMR.



## Antimicrobial Effectiveness of Chlorine Dioxide and Sodium Hypochlorite in Retreatment

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**Objectives** Our aim was to compare the antimicrobial efficacy of hyper-pure chlorine dioxide (hClO<sub>2</sub>) in endodontic retreatment cases compared to gold-standard sodium hypochlorite (NaOCl). **Methods** Forty patients aged 18-60 having root canal treated teeth presenting chronic apical periodontitis were chosen. A two-stage disinfection involving the tooth surface was followed by disinfection of the pulp chamber above the covered gutta-percha. Root canal obturation was then removed mechanically and intracanal sample (R1) was taken by paper point method. Patients were randomly divided into two groups. During retreatment the test group was disinfected with hClO<sub>2</sub> and the control group with NaOCl. After disinfection of the root canal and one-week temporary closure, a second intracanal sample (R2) was obtained. The samples were cultured and analyzed by PCR strip test.

**Results** The most common genus found in infected root canals were Streptococcus, Staphylococcus, Fusobacterium, Tannerella and Enterococcus with prevalence of 39%, 31,7%, 41,5%, 25,9% and 19,5%, respectively. After irrigation with NaOCl Streptococcus (52,4%), Fusobacterium (21,7%), Klebsiella (19%) and Enterococcus (19%) were detected and with hClO<sub>2</sub>Streptococcus (47,1%), Enterococcus (35,3%), Tannerella (33,3%) and Prevotella (17,6%) were found. Candida albicans was found after irrigation in both groups with prevalence of 9,5% (NaOCl) and 5,9% (hClO<sub>2</sub>).

**Conclusions** Neither disinfectants were completely effective. In both cases several genera persisted in the root canals. After irrigation with  $hClO_2$  a more diverse flora was found, then with NaOCl. For a more effective disinfection a combination of the two is suggested. Incomplete disinfection by both irrigants suggests the need for a new disinfection solution or a more effective method.

## 0441

## Partial Pulpotomy for Treatment of Traumatic Irreversible Pulpits

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**Objectives** In cases of complicated crown fractures, depending on the condition of the pulp, direct capping, partial pulpotomy, pulpotomy, and pulpectomy options can be employed for the treatment of traumatized teeth. It has been shown in the literature that teeth with irreversible pulpitis can be treated successfully with partial pulpotomy or pulpotomy, in addition to canal therapy, allowing the teeth to remain functional in the oral cavity.

**Methods** A 16-year-old male patient presented to our clinic with complaints of fractured anterior teeth and severe nocturnal pain following a motorcycle accident. Intraoral examination revealed the presence of a complicated crown fracture on tooth #21, exhibiting symptoms of irreversible pulpitis. Under rubber dam isolation, the infected pulp was gradually removed using a sterile diamond round bur, hemorrhage



was controlled with a sterile cotton pellet, and a bioceramic-based putty material (WellRoot PT, Vericom, Chuncheon, South Korea) was placed over the presumed healthy pulp. Upon this, a light-cured calcium silicate-based material (TheraCal LC, BISCO, Chicago, USA) was placed, followed by restoration with composite resin (Tokuyama Palfique Estelite, Tokuyama, Tokyo, Japan). Clinical and radiographic examinations conducted during a one-year follow-up revealed no pathological conditions, and positive responses were obtained from vitality tests.

**Results** Clinical and radiographic examinations conducted during a one-year follow-up revealed no pathological conditions, and positive responses were obtained from vitality tests.

**Conclusions** As stated in the literature, in teeth exhibiting symptoms of irreversible pulpitis, alternative treatment options such as partial pulpotomy and pulpotomy can be considered apart from root canal therapy.

## 0442

# Cytokine Induction by Reactivated Epstein-Barr Virus in Periapical Granuloma

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**Objectives** Epstein-Barr virus (EBV) infects more than 90% of people worldwide; however, EBV stays latency after infection. EBV could be reactivated by short chain fatty acids such as butyric acids, and the expression of BZLF-1 mRNA and ZEBRA proteins are induced. We previously demonstrated that B cells infiltrated in periapical lesions are infected by EBV; however, it was still unclear how reactivated EBV is involved in the pathogenesis of periapical periodontitis, and the functional role of EBV in periapical lesions must be elucidated. Objectives of this study were to determine whether reactivated EBV could induce bone-resorption associated inflammatory cytokines such as IL-1 $\beta$ , IL-6 and RANKL in periapical granuloma.

**Methods** Periapical lesions (n=60) were obtained from chronic periapical periodontitis patients during endodontic surgery. Periapical granuloma (n=50) based on histological evaluation was used in this study. Triple-color immunofluorescence staining was performed using paraffin sections to investigate the localization of ZEBRA- and cytokine-expressing cells. After extracting RNA from frozen specimens, mRNA expression of BZLF-1 and cytokines was examined using real-time PCR. Healthy gingival tissues (n=10) obtained at the time of extraction of horizontally impacted wisdom tooth were also investigated as a negative control. The results were statistically analyzed using Mann-Whitney *U*-test and Pearson`s product moment correlation coefficient. Difference was considered at p < 0.05.

**Results** Immunofluorescence staining demonstrated that the percentages of co-expressing cells of ZEBRA and IL-1β, IL-6 or RANKL in periapical granuloma were 23.7, 34.2 or 24.9, respectively. The number of the positive cells in periapical granuloma was significantly higher than in healthy gingival tissues. Detection levels between BZLF-1 mRNA and IL-1β, IL-6 or RANKL in periapical granuloma were correlated and were significantly higher than in healthy tissues.

**Conclusions** The data suggested the possibility that reactivated EBV could induce IL-1β, IL-6, and RANKL expression in periapical granuloma.



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0443

# Comparing Periodontal Health in Traditional and Heated Tobacco Product Users

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**Objectives** Due to worldwide restrictions, the use of traditional cigarettes is declining. Alternative tobacco products such as heated tobacco products (e.g. IQOS) are gaining in popularity, especially in younger generations. Many people believe that these are less harmful alternatives to traditional cigarettes, but there are conflicting results in the literature about their health effects. No study has assessed their effect on periodontal health. The aim of our study was to compare the clinical, radiographic, and immunological periodontal parameters of traditional cigarette smokers (CS), heated tobacco product users (HTP) and non-smokers (NS).

**Methods** Demographic data of healthy patients aged between 20-35 years was collected using a questionnaire including age, gender, education, oral hygiene habits, duration, and daily frequency of smoking. Clinical parameters (full mouth plaque index (PI), bleeding on probing (BOP), probing pocket depth (PPD), clinical attachment loss (CAL) was recorded during a clinical examination. Marginal bone loss was evaluated in digital periapical radiographs. Gingival crevicular fluid (GCF) volume was assessed with Periotron 8000.

**Results** Thirty-nine patients (13 CS, 12 HTP, 14 NS) were included in this study. There was no sign of CAL or radiological bone loss in either of the groups. PPD, PI, BOP, number of sites with PPD≥4 mm, number of sites with PPD≥3 mm and BOP+ were  $1.82\pm0.22$ ;  $28.91\pm14.69$ ;  $26.36\pm12.41$ ;  $2.00\pm2.21$ ;  $14,64\pm9.76$  in HTP;  $1.84\pm0.19$ ;  $27.92\pm13.42$ ;  $20.85\pm7.97$ ;  $2.23\pm3.14$ ;  $15.85\pm9.85$  in CS and  $1.46\pm0.14$ ;  $18.5\pm12.03$ ;  $19.43\pm10.63$ ;  $0.21\pm0.38$ ;  $2.21\pm2.43$  in NS. GCF volume was  $0.46\pm0.43$  in HTP;  $0.32\pm0.33$  in CS and  $0.22\pm0.18$  in NS.

**Conclusions** HTP presented similar periodontal parameters to CS, while NS had the most favourable parameters. In order to assess the effect of HTPs on periodontal health, larger sample size studies are necessary in future research.

## 0444

## Induced Periodontitis in Rats With Three Ligature Types.

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**Objectives** The placement of ligatures in the cervical area of rat molars, is considered as a predictable model to induce periodontitis. The present explorative study aimed to compare the efficacy of metal wires, without or with sandblasting, versus silk ligatures in inducing periodontal bone loss in rats. **Methods** Wistar rats aged between 14 and 21 weeks were used. The animals were randomly divided into three groups receiving three different types of ligatures (metal wire MW; sandblasted wire SMW; silk ligature SL) around their first right mandibular molar, while the contralateral tooth was left without the ligature and served as control. Three-dimensional images were obtained by microcomputed tomography (micro-CT) and bone loss was evaluated at 24 and 35 days after the placement of the ligature. **Results** In the SL group, only two rats retained the ligatures until the end of the 24-day period; all other animals lost the ligatures at some time point. In the SMW, the ligatures were retained only for the 24-day period. In MW group, no ligatures were lost. Irrespective the group or experimental period, the difference in crestal bone level between ligated and control teeth was in most cases < 0.20 mm, i.e., in 19 out of 25 pairs of teeth. In few cases, the bone crest was more apically located at the control teeth compared to the ligated ones (4 cases each, at both the 24- and 35-day experimental period).

**Conclusions** Bone loss was minimal during the experimental period, with no significant differences between test and control teeth, nor among the 3 types of ligatures. Metal wires, not even roughened, do not seem a better alternative to silk ligatures for inducing bone loss in the experimental periodontitis model in the rat.

## 0445

# Long-Term Fasting Effects on Inflammatory Markers and Saliva Microbiota Composition

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**Objectives** The benefits of long-term fasting are now widely documented: effects on oxidative stress, cognitive and metabolic health, cardiovascular diseases, hypertension, and gut microbiota composition. The aim of the present study is to determine the effects of fasting on oral microbiota composition and local inflammatory markers in health.

**Methods** A cohort of 36 healthy subjects undergoing a 10±3-days fasting was included. First, a routine full-mouth periodontal examination was assessed at six sites per tooth. Unstimulated saliva samples were processed and analyzed by Microbiome Targeted Sequencing before, during and after the fasting period. Follow-up samples were sent by the patients by post after 1 month (n=32) and 3 months (n=28). The levels of Interleukin (IL)-1 $\beta$ , IL-6, IL-8, IL-10, interferon- $\gamma$  (IFN- $\gamma$ ) and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) were measured in the Gingival Crevicular Fluid (GCF) with a multiplex fluorescent bead-based immunoassay.

**Results** 21 subjects presented with healthy periodontium, 1 with gingivitis and 14 subjects with periodontitis. Saliva microbiota profiling showed a shift in microbial composition including reduction in the levels of *Neisseria*, *Gemella* and *Porphyromonas spp.*, concomitant to an increase in the levels



of Megasphaera, Dialister, Prevotella, Veillonella, Bifidobacteria, Leptotrichia, Selenomonas, Alloprevotella, and Atopobium. Furthermore, a decrease in the levels of IL-8

was observed, suggesting that long-term fasting may exert an anti-inflammatory effect in the oral cavity, thus attenuating the local inflammatory response associated with periodontal disease. **Conclusions** The intersection of fasting and oral health holds promises for both preventive and

therapeutic strategies in dentistry.

0447

# Can We Store L-PRF Membranes Successfully in a Simple Way?

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**Objectives** Leukocyte- and platelet-rich fibrin (L-PRF) offers significant benefits in periodontal therapy as well as in the healing of non-responding chronic wounds (e.g. diabetic foot). Until now, it was stated that L-PRF membranes had to be used within 3 hours after preparation. This *in vitro* study aimed to verify the qualitative changes of L-PRF membranes over time.

**Methods** L-PRF membranes from 10 volunteers were stored in L-PRF exudate (obtained after compression of L-PRF clots into membranes) at 4°C (refrigerator) for 1, 2, and 4 weeks. The following parameters were compared to baseline values (fresh membranes): bacterial contamination, morphological changes, tensile strength, release of growth factors (VEGF, PDGF-AB, and TGF-β1), and leukocyte viability (flow cytometry and confocal microscopy with live/dead staining).

**Results** Aerobic as well as anaerobic culturing confirmed the absence of microbiological contamination up to week 4. Over the 4-week time interval: L-PRF membranes shrank 5.1% in area, but their Young's modulus as well as their stress/strain at maximum load remained the same. Compared to fresh membranes, the release of VEGF (3613 pg at baseline) was significantly reduced (54.2%, 75.4% and 74.4% after 1, 2, and 4 weeks of storage, respectively), while the reductions for PDGF-AB (49781 pg) and TGF- $\beta$ 1 (107233 pg) were only statistically significant after 4 weeks of storage. The proportion of live leukocytes decreased from 85.9% at baseline, to 30.1% after 1, 13.8% after 2, and 10.5% after 4 weeks, respectively.

**Conclusions** This storage of L-PRF membranes over a 4-week period didn't result in additional bacterial contamination risks or changes in their morphology/mechanical properties. The release of growth factors decreased over time (especially VEGF), but didn't stop completely, and most leucocytes died within the first week.



# Hyaluronic Acid Affects the Virulence of Porphyromonas Gingivalis in-Vitro

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**Objectives** *Porphyromonas gingivalis* is a key bacterium involved in pathogenesis of periodontitis. Its virulence is associated with its potential to invade epithelial cells and with its cysteine-proteases (gingipains). Hyaluronic acid (HA) is a glycosaminoglycan of various molecular weights (MW) that is widely distributed in epithelial tissues. Previous studies have demonstrated the beneficial effects of adjunctive applied HA in periodontal treatment. The objective of this study is to investigate the impact of HA with different MW (high-molecular-weight HA (1000 kDa, HHA), low-molecular-weight HA (400 kDa, LHA), and HA oligomers (6 kDa, OHA)) on the invasion ability of *P. gingivalis* into gingival epithelial cells and on the gingipain activity.

**Methods** Telomerase-immortalized gingival keratinocytes (TIGKs) were infected with *P. gingivalis* ATCC 33277, with or without the addition of 4 mg/ml HA. The adhered and invaded of *P. gingivalis* were quantified by cultivation after cell lysis and visualized under microscope. The gingipain activity of *P. gingivalis* cells and surrounding media after culturing the bacterium with HA was measured via BApNA assay.

**Results** The results showed that LHA and HHA reduced the amount of *P. gingivalis* attached to the TIGKs cell surface. The reduction rate was 64% for LHA (-0.47 log10 colony forming units (CFU; p=0.004, and 91% for HHA (-1.06 log10 CFU (p<0.001). In terms of internalized *P. gingivalis*, HHA showed a 58% reduction rate (-0.34 log10 CFU, p=0.038). Microscope images confirmed the CFU results. HHA reduced the gingipain activity retained on the bacteria while increasing the in the medium, whereas OHA and LHA did not influence the gingipain activity (p<0.05).

# Conclusions

In conclusion, the findings indicated a potential favorable role of higher MW HA in protecting gingival epithelium against invasion by *P. gingivalis*. The effect of an increased release of gingipains by HHA into the environment needs to be verified in further studies.

## 0449

## Arthrospira Platensis's (Spirulina) Antimicrobial Effect on Treponema Denticola

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**Objectives** Periodontitis, a prevalent chronic inflammatory disease affecting the supporting structures of the teeth, imposes significant burdens on global oral health. Conventional therapies often fall short in addressing the multifaceted nature of periodontal pathogenesis. Recently, there has been burgeoning interest in exploring alternative and adjunctive treatments derived from natural sources. *Arthrospira platensis* (Spirulina), a cyanobacterium renowned for its rich nutritional profile and diverse bioactive compounds, has emerged as a promising candidate in periodontal therapy. We focused on evaluating the



antimicrobial effect of Spirulina against *Treponema dentincola*, a pathogenic oral anaerobic and a member of the red complex of oral bacteria.

**Methods** *Treponema denticola* ATCC 35405 was cultured in OTEB media at 37°C in an anaerobic chamber. Periodontal ligament (PDL) cells were cultured in MEM-α media at 37°C. *Treponema denticola* was treated with Spirulina up to 300µg/ml.for 24h and their Optical Dentisy (OD) was measured at 600nm. PDL cells were treated with the same concentrations of Spirulina for 24h and their proliferation was assessed by the CyQuant Assay.

**Results** Data demonstrated a non-toxic effects of Spirulina in PDL cells proliferation up to a concentration of 300µg/ml, while a dose-dependent significant decrease was found for *Treponema denticola* OD from 100 - 300µg/ml of Spirulina.

**Conclusions** Spirulina significantly reduces Treponema denticola without impacting periodontal ligament cells. Therefore, these findings along with Spirulina'a multifaceted pharmacological properties and favourable s profile suggest that Spirulina may be a promising adjunctive therapy in the management of periodontitis. With continued investigation and strategic integration, Spirulina holds the potential to complement existing periodontal treatments and enhance outcomes for patients worldwide.

## 0450

## Activity of a Bacterial Glutaminyl Cyclase Inhibitor on Multi-Species-Biofilms

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# Objectives

Modifying bacterial virulence might be an interesting alternative to antibiotics. The purpose of the study was to find the effects of an inhibitor targeting bacterial glutaminyl cyclase (selectively present in Porphyromonas gingivalis (P.g.), Tannerella forsythia (T.f.) and Prevotella intermedia (P.i.) on different multispecies biofilms.

# Methods

Different multi-species biofilms (4- (containing T.f.), 5- (containing T.f., P.g.) and 12-species biofilms (containing T.f., P.g. P.i.) were cultured in the presence of  $31.25 - 500 \mu$ M of a [4,5-c]pyridine-based inhibitor. After 4 h and 24 h bacterial counts were determined, after 24 h in addition biofilm mass, metabolic activity and if P.g. was included, gingipain activity. The data was compared applying a one-way analysis of variance (ANOVA) with a post-hoc comparison using Bonferroni correction. **Results** In all biofilms, the bacterial counts and composition was not affected by the inhibitor. In the 12species biofilm, "mass" was reduced, when applying 250  $\mu$ M (to  $82.7\pm7\%$ , p<0.001) and 500  $\mu$ M of the inhibitor (to  $75.2\pm6.5\%$ , p<0.001). Also the total biofilm metabolic activity decreased after inhibitor concentrations of 125  $\mu$ M and higher (125  $\mu$ M to  $93.3\pm3.7\%$ , p=0.033; 250  $\mu$ M to  $90.3\pm4.8\%$ , p<0.001; 500  $\mu$ M to  $87.2\pm5.8\%$ , p<0.001). The arginine-specific amidolytic activities of the bacteria decreased concentration-dependent of the inhibitor in the 5- and 12-species biofilms, in the 12-species biofilm the results were statistically significant vs. control for 62.5  $\mu$ M (85.2 $\pm7.0\%$ , p=0.009), 125  $\mu$ M (77.1 $\pm5.9\%$ , p<0.001), 250  $\mu$ M (70.7 $\pm6.2\%$ , p>0.001) and 500  $\mu$ M (60.4 $\pm10.2\%$ , p<0.001). Accordingly, *P. gingivalis* colonies lost pigmentation with increasing concentrations of the inhibitors **Conclusions** The studied [4,5-c]pyridine-based inhibitor is able to modify virulence of a multispecies



biofilm. Further in-vitro research should focus on the immunomodulation of the biofilm in the presence of the inhibitor. The inhibitor might have the potential to be a promising approach in periodontal prevention and therapy.

0451

# Blocking of Virulence of P. Gingivalis as Novel Pathoblocker Approach

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**Objectives** Periodontitis is one of the most common diseases worldwide caused by a dysbiosis of the oral microbiome, where *P. gingivalis* orchestrates this ongoing inflammation as a so called key-stone pathogen. In collaboration with our partners, we recently identified an essential protein for the maturation of virulence factors, which is not only present in *P. gingivalis*, but also in *P. intermedia* and *T. forsythia*. This so-called glutaminyl cyclase therefore represents an attractive target for the development of pathoblocker compounds to reduce virulence without killing the bacterium. One compound was selected and further deeply investigated.

**Methods** The reduction of the virulence by blocking bacQC was tested on different level of complexity. The release of gingipains after treatment with the compound was measured, the effect on hemagglutination as well as the effect in an invasion assay was tested. Furthermore, a possible resistance development was tested. Also, cytotoxicity and several other important parameters, needed for regulatory reasons were tested.

**Results** The selected compound showed dose dependently a strong inhibition on the release of the virulence factors, without affecting the growth of the bacterium itself. Also, the hemagglutination was inhibited after treatment with the compound, as well as the ability of the bacterium to invade into keratinocytes. Also, no induction of resistance against this compound was observed after 50 passages of different *P. gingivalis* strains under the existence of low levels of the compound was seen.

**Conclusions** The results confirm the new pathoblocker approach for the isolated pathogen *P. gingivalis*. Further experiments will focus on different species in biofilm experiments as well as in proof-of-concepts studies and the safety testing of the compound will be finished, soon. The first prototypes as toothpastes and/or adhesive toothgel are under development, and first products working with the new concept of biofilm re-shifting modulators will be ready in the end of 2024.



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# **SYMPOSIUM LECTURES** abstracts

#### 0116

Comprehensive Guide to Tooth Autotransplantation in Children: From a to Z Including the Role of Sustained Oral Hygiene

## Mostafa Ezeldeen

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Tooth autotransplantation (TAT) is a valuable biological solution for tooth replacement in children and adolescents affected by traumatic dental injuries (TDIs), agenesis, developmental anomalies, or specific orthodontic issues. With a relatively high prevalence of 15.2%, TDIs predominantly impact children. Conventional treatment options, such as implant placement, are constrained by ongoing dentoalveolar development, while orthodontic tooth alignment proves challenging without skeletal anchorage. TAT facilitates periodontal healing, preserves the alveolar ridge, and maintains function and growth potential. To improve TAT outcome predictability, our research group at the KU/UZ Leuven has developed a low-dose cone-beam computed tomographic (CBCT)-guided surgical planning and transfer technique, encompassing donor tooth selection and tooth replica fabrication (3D printing). This lecture will provide an overview of the CBCT-guided TAT process, emphasizing the digital workflow and treatment outcomes.

## 0117

# Integrating Orthodontic Considerations With Oral Hygiene in Tooth Autotransplantation

## Maria Cadenas de Llano Pérula

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This lecture reviews the orthodontic considerations that need to be taken into account in cases of tooth autotransplantation due to missing incisors in the upper front, stressing the importance of oral hygiene on case selection and on the final outcome. The possible strategies for maintaining correct oral hygiene during orthodontic treatment of these patients are also presented, based on the available scientific evidence.

## 0118

# Tooth Autotransplantation of Third Molars: Achieving Success With Optimal Oral Care

## Katarzyna Gurzawska-Comis

## University of Liverpool, Liverpool, United Kingdom

Tooth autotransplantation (TAT) offers a viable biological approach to tooth replacement in children and adolescents after traumatic dental injuries (TDIs), agenesis, developmental anomalies or specific orthodontic problems and in some cases failure of teeth restoration. In these cases, TAT can be utilised with predictable outcome. This lecture will focus on TAT of third molar teeth with close and open apex in



cases implant placement, are limited by the ongoing dentoalveolar development or orthodontic tooth alignment is challenging unless skeletal anchorage is applied. TAT allows for periodontal healing and enables preservation of the alveolar ridge maintaining the possibility of function and growth. To enhance outcome predictability of the TAT procedure, a low-dose cone-beam computed tomographic (CBCT)-guided surgical planning and transfer technique has been developed, involving donor tooth selection and tooth replica fabrication. This lecture will focus on the digital work-flow and surgical techniques serving TAT.

## 0121

# The Added Value of a Collagenated Thermosensitive Bone Substitute as a Scaffold for Bone Regeneration

## Imad About

Aix Marseille Université, Centre National de la Recherche Scientifique, Institut des Sciences du Mouvement, Marseille, France

Collagenated bone substitutes have been shown to significantly improve bone regeneration by enhancing vascularization and stem cell recruitment.

Recently, a thermosensitive collagenated bone substitute has been released (GTO<sup>®</sup>). As indicated by the manufacturer, it is composed of collagen-containing granules and a hydrogel made of a thermosensitive polymer which also contains collagen I and III. Once applied into the bone defect, it jellifies at body temperature, avoids the granules collapse and maintains the space for bone regeneration without volume loss.

In this presentation, the interaction of GTO with bone marrow mesenchymal stem cells, periodontal ligament cells, and endothelial cells will be presented. In particular, the angiogenic and osteogenic potentials of the thermosensitive bone substitute will be highlighted and compared to those of anorganic (Bio-Oss®) and to those of another collagenated bone filling material (Gen-Os®). A quantitative measurement of collagen release will be presented and the added value of collagen in the bone substitutes will be detailed.

## 0119

# Preclinical and Clinical Evaluation of Collagen-Based Biomaterials for Guided Bone Regeneration

# Manuel Toledano-Osorio

# University Complutense of Madrid, Granada, GRANADA, Spain

Bone augmentation procedures are frequently performed in order to reestablish bone alveolar bone arquitecture when we find bone defects caused by infection, trauma or tumor. In this regard, the election technique to solve most of the defects is the use of a barrier membrane and a bone replacement graft. In the market, we have available a wide variety of membranes; however, collagen-based membranes are the most commonly used. Two techniques are employed to obtain collagen membranes: i) the first involves the extraction, purification, and polymerization of native collagen to form a functional biomaterial, and ii)



the other technique involves decellularizing native tissues such as bovine or porcine small intestinal submucosa, pericardium, and dermis; these are the so-called extracellular matrix membranes (ECM). Additionally, they can also be subjected to the process of cross-linking in order to increase their degradation time resulting in slower degradation when the degree of cross-linking is increased. All these modifications and characteristics may influence the properties of the membrane, resulting in variations on the mechanical properties; degradation times; resistance to hydrolytic, enzyme or bacterial degradation; or biomineralization pattern, among others. On the other hand, biphasic collagenated bone substitutes are also gaining relevance in this area. They have shown to improve, among others, the neovascularization and cell recruitment. The use of a thermosensitive gel to ease their handling and their clinical use have also been implemented. However, the clinical performance of this bone replacement graft is still being performed.

## 0120

## Poly(Lactic Acid/Caprolactone) Bilayer Membrane for Periodontal Regeneration

## Patrick Schmidlin

Clinic of Conservative and Preventive Dentistry, University of Zurich, Zurich, Switzerland

This presentation will discuss clinical applications and cases of (extensive) periodontal defects treated with the use of a bone lamina and collagen-based filler materials. Participants will gain insights into the clinical approaches, treatment protocols, and outcomes observed in these cases. The focus will be on the application of these materials in promoting periodontal regeneration. The presentation will conclude with a discussion on the effectiveness and potential advantages of using lamina and collagen-based fillers in periodontal therapy.

## 0142

# Preclinical Evaluation of a new Synthetic Carbonate Apatite Bone Substitute on Periodontal Regeneration in Intrabony Defects

## Anton Sculean

# Periodontology, University of Bern, Bern, Switzerland

Introduction and background: The use of various synthetic bone substitutes as monotherapy for periodontal regeneration mainly results in a reparative healing pattern. Since xenografts or allografts are not always accepted by patients for various reasons, a synthetic alternative would be desirable. Early preclinical and clinical data have provided promising results with the use of a novel synthetic carbonate apatite bone substitute (CO3Ap-BS) for periodontal and bone regeneration. Aim: To evaluate clinically and histologically the potential of this novel synthetic carbonate apatite bone substitute (CO3Ap-BS) in periodontal regeneration.

<u>Materials and Methods</u>: Acute-type 3-wall intrabony defects were surgically created in four female beagle dogs. The defects were randomly allocated and filled with CO3Ap-BS (test), deproteinized bovine bone mineral (DBBM), or left empty (control). After 8 weeks, the retrieved specimens were scanned by micro-CT, and the percentages of new bone, bone substitute, and soft tissues were evaluated. Thereafter, the tissues were histologically and histometrically analyzed.

Results: The healing was uneventful in all animals and defects without any signs of adverse events.



Formation of the periodontal ligament and cementum occurred to varying extents in all groups, without statistically significant differences between them. Residues of both bone substitutes were still present and showed integration into new bone. Histometry and micro-CT revealed that the total mineralized area or volume was higher with the use of CO3Ap-BS compared to the control ( $66.06 \pm 9.34\%$  vs.  $36.11 \pm 6.40\%$ ; p = 0.014 and  $69.74 \pm 2.95\%$  vs.  $42.68 \pm 8.68\%$ ; p = 0.014). The percentage of bone substitute surface covered by new bone was higher for CO3Ap-BS ( $47.22 \pm 3.96\%$ ) than for DBBM ( $16.69 \pm 5.66\%$ , p = 0.114).

CO3Ap-BS and DBBM demonstrated similar effects on periodontal regeneration. However, away from the root surface, more new bone, total mineralized area/volume, and higher osteoconductivity were observed in the CO3Ap-BS group compared to DBBM.

<u>Conclusion</u>: The present findings lend biological support to the use of CO3Ap-BS in periodontal and bone regeneration.

## 0143

## Poly(Lactic Acid/Caprolactone) Bilayer Membrane for Periodontal Regeneration

## Patrick Schmidlin

Clinic of Conservative and Preventive Dentistry,, University of Zurich, Zurich, Switzerland

This lecture presents findings from a study evaluating the periodontal tissue regenerative capacities of a Poly(lactic acid/caprolactone) (PLCL) bilayer membrane in one-wall infrabony defects in dogs. Despite PLCL's proven efficiency in bone regeneration, its efficacy for periodontal regeneration therapy has not been previously assessed. Participants will gain insights into the study's methodology, which involved creating standardized bone defects in beagle dogs and comparing various test groups, including carbonate apatite and xenografts, against a control group. The analysis included radiological, histologic, and histomorphometric evaluations conducted eight weeks post-surgery. The findings and their clinical implications will be discussed.

## 0144

# Clinical Performance of Carbonate Apatite and Poly (Lactic Acid/Caprolactone) Bilayer Membrane

## Shunsuke Fukuba

Graduate School of Medical and Dental Science, Tokyo Medical and Dental University, Tokyo, Japan

Periodontal regeneration has been widely studied to restore the functional attachment apparatus, and various biomaterials have been clinically utilized. Biomaterials such as deproteinized bovine bone mineral and collagen barrier membranes are commonly used and have demonstrated efficacy in periodontal regeneration. However, there are still concerns regarding the quality and safety, particularly pontential infections from their animal origin. In Japan, synthetic carbonate apatite bone graft substitutes, which closely mimic the composition of the inorganic component of human bone, have been widely used and have shown promising clinical outcomes in bone regeneration. Tokyo Medical and Dental University was participated in a multicentred clinical trial for carbonate apatite bone graft substitutes and has extensive experience in their clinical use. Additionally, resorbable Poly(lactic acid/caprolactone) (PLCL) membranes with a bilayer structure have been utilized for guided bone regeneration in patients with substantial defects in the alveolar bone and jawbone. To evaluate the performance of the PLCL bilayer membrane



with carbonate apatite bone graft substitutes in periodontal regeneration, we conducted a prospective observational study.

The study was a single-arm, blinded, prospective observational study of PLCL bilayer membrane in periodontitis patients with either probing pocket depth (PPD) of 6 mm or more, vertical bone defect of 3 mm or more on dental x-rays, or mandibular class II furcation involvement. The bone defect was covered by the PLCL bilayer membrane after filling with carbonate apatite bone graft substitutes. In this presentation, the efficacy of carbonate apatite bone graft substitute and PLCL bilayer membrane based on the clinical case will be discussed.

## 0139

# Oral Health Care in Older Adults - a Cornerstone Towards Resilience

## Regina Roller-Wirnsberger

## Department of Internal Medicine, Medical University of Graz, Graz, Austria

Older adults undergo physiological changes of their bio-psycho-social capacity. Beyond these physiological adaptions, prevalence of chronic diseases increases with age<sup>1</sup>. With increasing numbers of chronic diseases, older people tend to accumulate functional deficits, summarized under the taxonomy of "frailty". These transitions of capacity put older subjects at an increased risk for adverse outcomes once exposed to stress, such as acute illnesses or trauma, as an example<sup>2</sup>. In this context, modern clinical care for older people is multifaceted with a strong focus on maintenance of functional capacities, also called "individual resilience"<sup>3</sup>. This approach also includes very active involvement of dentists. The current "crosstalk" will outline the concept of resilience in health of older adults, its pathophysiology and comprehensive clinical approach. Evidence from scientific literature addressing the role of oral health in maintaining resilience will be summarized and the role of inter-professional collaborative practice (ICP)<sup>3</sup>, and how to implement this framework will be addressed. The presentation style will include interactive elements to increase active participation of attendees.

<sup>1</sup>Travers J et al; Age&Ageing 2022; https://doi.org/10.1093/ageing/afac218.019 <sup>2</sup>Fried LP et al; Nature Aging 2021; https://doi.org/10.1038/s43587-020-00017-z <sup>3</sup>Roller-Wirnsberger R et al; ACER 2020; https://doi.org/10.1007/s40520-019-01455-5

## 0140

# Harmonizing the Standard for Care for Dependent Elders in Europe

## Frauke Müller

# University of Geneva, Geneva 4, Switzerland

Life expectancy in western countries continues to increase, leading to a larger number of old and very old persons in the population. Advanced age often goes along with multimorbidity, frailty and an increased dependency for the activities of daily living. Polypharmacy often creates symptoms of a dry mouth as side effect, which increases the risk for caries and impairs mastication, speech and denture wearing. Thanks to advances in dentistry and prevention, todays dependent elders retain their natural dentition until later in life. This presents a particular challenge in their oral health care, as a more complex hygiene and prevention regimen is required, compared to an edentate mouth. An e-Delphi project of the European



College of Gerodontology involving dentists, geriatricians and dental hygienists has tried to develop a novel standard of oral health care in dependent elders, recommend oral hygiene methods and tools and define the need for further education. The consensus recommended an oral examination at the onset of dependency as well as regular check-up visits and oral hygiene sessions at 6-month intervals. Older people should brush their teeth twice/day and regularly clean interproximal spaces and oral mucosa. Dentures should be rinsed after meals and cleaned twice/day. The use of denture cleansing tablets was considered necessary. Dentures should be removed before sleeping and stored dry. Fluoride toothpaste should be used in elders with a concentration that is adapted to their caries risk. Electrical toothbrushes are considered a valuable asset, which is particularly appreciated by care givers. Regarding the knowledge and training in oral health care, experts from all the fields agreed that knowledge and training for diagnosis and management of oral health care for dependent older people should be provided during the undergraduate-, and structured postgraduate curricula, as well as in continuing education programmes.

# Frauke Müller\*, Nattida Charadram

Division of Gerodontology and removable Prosthodontics, University clinics of dental medicine, University of Geneva, Switzerland

#### 0141

## The Oral Health Action Plan

#### Anastassia Kossioni

## National and Kapodistrian University of Athens, Athens, Greece

The overall burden of oral disease in older individuals is high and particularly in those who are frail and care dependent. The main barriers to good oral health in older age include person-related issues, lack of professional support and lack of appropriate oral health policies. Despite the high prevalence of oral disease with increasing age, dental consultations decrease after the age of 65 years, while medical care attendance increases. The European College of Gerodontology and the European Geriatric Medicine Society have developed joint recommendations and practical guidelines on oral health promotion in frail older people. Appropriate policies should be implemented integrating oral care into primary healthcare and universal health coverage programmes. Legislative and policy developments and protocols should target oral health promotion in long-term care, including daily oral hygiene provision, regular oral screenings, and access to emergency and routine dental care. An innovative workforce model including dental professionals and other healthcare providers (ie. physicians, nurses, pharmacists, and other professionals working with older people), should be trained and motivated to address the oral health needs of those with limited self-care capacity and limited access to dental offices. Gerodontology training programmes should be developed at all levels of health professionals' education, based on competences agreed between the respected scientific societies and gerodontology societies. Innovative learning methods should be applied including digital technology and interprofessional education. Research should be promoted and funded on effective oral health intervention programmes in the community and long-term care, as well as on new products, equipment, and technology that facilitate older patient's daily functioning and oral care delivery.



# Towards Digital Twins in Dentistry: the Role of AI in Shape Analysis and Patient-Specific Modelling

## Raphael Richert

Lyon Dental Hospital, Villefranche sur Saone, France

The integration of robotics and artificial intelligence (AI) is setting the stage for a transformative era in dentistry, characterized by the emergence of precision medicine. Central to this transformation are digital twins, developed through sophisticated imaging and modelling technologies. These virtual models of patients' dental anatomy not only facilitate simulations of treatment scenarios but also enable dentists to engage more effectively with patients about their treatment options, illustrating a direct pathway from research to practical application.

The precision delivered by digital twins is vital for individualized dental care, highlighting the broader movement towards tailored medical interventions. Traditionally, machine learning has laid the groundwork in this field, with methods such as Principal Component Analysis initially used to study dental morphology. Today's deep learning algorithms extend these foundations by extracting patterns from extensive imaging data, automating dental structure segmentation, and reconstructing precise 3D models. These capabilities allow for deeper shape analysis, which refines treatment planning and improves predictive diagnostics, such as foreseeing the biomechanical behavior of dental reconstructions or accurately diagnosing pulpitis. However, despite high performances of these AI algorithms found from bench, the demand for their explainability increases; ensuring that practitioners and patients alike can trust and understand AI-driven decisions at the chairside. Additionally, integrating such cutting-edge technologies brings also forth ethical challenges, necessitating standardized verification processes to guarantee patient safety.

This symposium explores how digital twins and AI-driven shape analysis are being seamlessly integrated into dental practices, transforming routine chairside interactions. As AI increasingly influences robotic systems in dental clinics, it not only promises to revolutionize dental practices but also poses significant ethical, regulatory, and professional challenges concerning the evolving role of dental surgeons.

## 0173

# Artificial Intelligence for Dental Implants and Tooth Auto Transplantation: From Research to Clinical Applications

## Pierre Lahoud

## KU Leuven, Leuven, Belgium

The integration of artificial intelligence (AI) into dental practice is revolutionizing many fields, including implantology and tooth autotransplantation. This keynote explores AI's transformative clinical potential in modern dentistry.

We'll trace AI's evolution into clinical applications, highlighting advancements in machine learning, medical imaging, and data analytics that enhance diagnostics, treatment planning and surgical precision. Recent case studies and applications will demonstrate AI's efficacy in improving accuracy, reducing risks, and enhancing patient outcomes.



Future directions will be discussed, emphasizing AI's potential for personalized treatments and innovations in the dental field.

This keynote aims to inspire dental professionals to embrace AI technologies, advancing digital dentistry and improving patient care. The integration of artificial intelligence (AI) into dental practice is revolutionizing many fields, including implantology and tooth autotransplantation. This keynote explores AI's transformative clinical potential in modern dentistry.

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This keynote aims to inspire dental professionals to embrace AI technologies, advancing digital dentistry and improving patient care.

## 0174

# Artificial Intelligence in Dentistry: Requirements and Challenges in Bridging the Gap Between Research Innovation and Market Application

## Teodora Karteva

# Autodontics LLC/LTD, USA and Bulgaria, Leuven, Belgium

The research scene is thriving, and the industry is buzzing. But are they dancing to the same tune, or is their rhythm off-key? Are our efforts synchronized to amplify the impact, or are we missing a beat between them? It's high time we pulled back the curtain on the challenges we all face—the Industry Entry Maze, the Validation Void, and the Sketch-to-Scale Veil. Each presents unique challenges that can impede the integration of innovative solutions into practical applications.

In this session, we'll navigate the current landscape of dental AI, spanning both research and industry. We aim to pinpoint how researchers can steer through these obstacles, how the industry can open its doors wider for external evaluations, and what steps are needed to smooth the path from lab innovations to dental practices.

Join me for a balanced view of the complexities at play in the dental AI arena, as we dissect the interactions that could redefine the future of dental care.

## 0169

## Accuracy of Digital Impressions and Bite Registrations in Full-Arch Cases

## Justinas Pletkus

Department of Prosthodontics, Institute of Odontology, Faculty of Medicine, Vilnius University, Vilnius, Lithuania



The advent of digital technology in dentistry has significantly revolutionized the field. The digital full-arch implant workflow represents a groundbreaking approach in prosthetic dentistry, leveraging advanced digital technologies to enhance the precision, efficiency, and overall success of full-arch implant restorations. This presentation aims to analyze the accuracy of digital impressions and bite registrations for full-arch implant cases, which is critical to the success of these treatments.

This presentation will synthesize findings from the latest research assessing the accuracy of digital impressions, including research done by the Vilnius University research group in the field of digital full arch implant scans and bite registration. Emphasis will be placed on evaluating key accuracy parameters, namely trueness and precision, and how digital techniques satisfy these metrics in full-arch cases and comparison with peer research. Both accurate master scans and bite registration are essential for establishing correct occlusal relationships, which is paramount in full-arch restorations to prevent complications such as malocclusion and prosthetic failure.

The research done by Vilnius University research group regarding full arch implant scanning protocols focuses on major parts of the workflow, including ways to enhance the accuracy of full arch implant scanning, comparing different scanning systems. Moreover, data will be presented regarding different bite-scanning strategies and the accuracy of various scanning systems in the context of bite-scanning.

## 0170

## Error Propagation of the Digital Workflow, Influence of 3D Printing

## Liudas Auskalnis

# Department of Prosthodontics, Institute of Odontology, Faculty of Medicine, Vilnius University,, Vilnius, Lithuania

Digital technologies in implant prosthodontics present significant advantages over traditional analog methods, including immediate visualization, enhanced patient comfort, and streamlined data storage and sharing. These advancements have the potential to facilitate a transition to a fully digital workflow, potentially eliminating the need for physical casts. Nevertheless, at present, a hybrid workflow remains necessary for numerous clinical scenarios. Physical casts continue to be utilized for adjusting occlusal and proximal contacts, manual veneering, and cementation of abutments in implant-supported fixed dental prostheses (FDPs).

Within the hybrid workflow, dental casts are typically fabricated using 3D printing based on intraoral scanning (IOS) data. However, inaccuracies in impression-taking and manufacturing processes can result in discrepancies between the implant and the prosthesis, leading to the formation of micro-gaps and strain. These discrepancies may induce severe biological complications, such as peri-implantitis, mucositis, and bone loss, in addition to mechanical failures, including screw loosening and fractures of prosthetic components. Addressing these inaccuracies intraorally, particularly in cases involving multiple restorations, is not only time-consuming but also negatively affects clinical efficiency and patient satisfaction.

While individual error sources in intraoral scanning and 3D printing have been extensively studied, there is a lack of comprehensive research on the cumulative effect of these errors throughout the entire workflow. Consequently, this presentation will focus on the propagation of errors associated with intraoral scanning and 3D printing of dental casts within the hybrid workflow.



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## 0171

## **Objective Evaluation of the Misfit in Implant-Supported Restorations**

## Ingrida Mischitz

Department of Dental Medicine and Oral Health,, Medical University of Graz, Graz, Austria

Passive fit of implant-supported restorations is a desired condition in implant prosthodontics. However, due to error propagation in numerous steps of the framework fabrication, the absolute passive fit is clinically not achievable. Current attempts to answer the question of the clinically acceptable misfit threshold were unsuccessful. As clinicians strive for the best restoration fit, detection of a misfit is a matter of high importance. For the standard clinical fit assessment alternate finger pressure technique, tactile and visual assessment, dental radiography, one-screw test and screw-resistance tests are being used. However, clinical assessment is dependent on the subjective clinician's judgement and is in need of the high-quality tools, capable to standardize the misfit evaluation. Clinical research is limited due to the ethical reasons and the lack of objective clinical methods. *In vitro* assessments employ dimensional and modelling methods, analysing microgap formation at the implant-abutment junction and biomechanical behaviour of the components of the implant-prosthesis complex. Furthermore, methods for the misfit detection are being developed, implementing tools like digital torque wrench or the use of image processing software in dental radiography. In this lecture current research and aspects of the objective misfit evaluation will be presented and discussed.

Ingrida Mischitz, DDS, Vygandas Rutkūnas, DDS, PhD, Daniel Kuleš, DDS, Sandra Huber, DMD, MS

## 0311

# CAD/CAM Denture Workflows - the Clinician Perspective

## Ronny Watzke

Dental Clinic of Ivoclar, Liechtenstein, Liechtenstein

This lecture gives the clinician's perspective regarding workflow options for providing patients with CAD/CAM dentures.

In recent years, new treatment methods for edentulous patients with removable dentures have emerged, incorporating digital technologies aimed at both the dentist and dental technician.

The digital denture system from lvoclar offers various procedures for designing and fabricating CAD/CAM removable dentures. The workflow starts with anatomical impressions and an initial bite registration (Centric Tray). To determine the occlusal plane, an innovative extraoral registration device (UTS CAD) is used. Impressions and preliminary bite registrations are then digitized, and custom bite plates with a gothic arch tracing device (Gnathometer CAD) are digitally designed and manufactured. The individualized trays facilitate functional closed-mouth impressions of the upper and lower jaws. The occlusal plane is verified using the extraoral registration device and the relationship between the jaws is established via the gothic arch tracing device. Anterior esthetics are addressed via shade choice and tooth form. All the relevant data including the impressions, jaw-relation and esthetic determination are digitized via scanning. Digital dentures can be designed and fabricated using additive or subtractive techniques. For a





streamlined workflow resulting in a monolithic denture, an innovative two-coloured PMMA disc (Ivotion) can be utilized. Ultimately the digital dentures are fitted to the patient.

The open digital denture system allows for individual modifications to accommodate the diverse needs of patients and clinicians. Intraoral scanning devices can e.g. be integrated into the workflow to create reference or duplicate dentures or if the clinician requires a try-in denture to confirm design prior to final production - these can also be made.

## 0312

## Laboratory and Pre-Clinical Tests of Denture Materials – Basics and Actual Results

## Martin Rosentritt

Department of Prosthetic Dentistry, University Hospital Regensburg, Regensburg, Germany

Apart from conventional techniques, the use of modern CAD/CAM dental technologies allows the subtractive and additive production of dental prostheses. Both denture base and denture teeth can be manufactured in combination or individually with subsequent assembly. In contrast to traditional analogous processes, digitized denture fabrication demands distinct technologies and materials. However, new materials and processes still have to prove their suitability.

Although in vivo studies are the method of choice for assessing the effectiveness of dental prostheses or the usability of new materials, they feature the disadvantages of high investment costs and expenditure. In contrast, mechanical laboratory tests (e.g. bending test, hardness test) can be employed to compare different materials and contribute to the understanding of the general performance of a novel material. As these tests provide limited information about the expected clinical performance of a material, meaningful in vitro tests may be employed, which allow the premature estimation of the principal clinical performance of dental materials under simulated in vivo conditions. These dynamic methods may represent stresses occurring in the oral cavity such as chewing forces or thermal stress. For these tests on a prosthesis, a correlation between the in vitro performance and vitro data of clinically successful systems already on the market seems to be essential. Complex interactions can only be investigated in simulation tests (e.g. chewing simulation) – even the latter do also have limitations due to the high degree of individuality of the restorations. Against this background, the current lecture provides an overview of mechanical test methods of dental prostheses and provides current research results on their properties.

## 0313

## Latest Clinical Research on Digital Removable Dentures

## Frauke Müller

## University of Geneva, Geneva 4, Switzerland

Digital technologies have taken restorative dentistry by storm. Although digitally fabricated removable dentures are still in the clinical trial phase, recent technology is able to scan even large areas of edentulous mucosa with clinically good precision. However, there is still a need for development in the design of the functional margin and the post-dam to achieve retention that is in no way inferior to conventionally fabricated dentures. Both additive and subtractive techniques can be considered for the



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fabrication of complete dentures. A first clinical study with 15 edentulous patients, who wore a printed and a milled complete denture each for 6 weeks in a cross-over study design, showed the equivalence of both procedures, both from a clinical and a patient perspective. Still, printed prostheses needed more clinical adjustments. From the denture wearer's perspective, printed dentures are still scored aesthetically inferior to other manufacturing methods. More recent techniques allow the milling of monolithic full dentures from two-coloured shell-geometry pucks (Ivotion ®, Ivoclar). Here the milling software places the virtual denture design in a way that the transition from white to pink acrylic is located correctly. A clinical pilot study showed a perfect transition from white to pink acrylic in 12 dentures, while 8 dentures showed mostly very minor deviations in the non-visible area. Eight other edentulous patients wearing Ivotion® dentures were monitored for occlusal wear. Negative divergences of about 0.05 mm were observed after one year of use, confirming this treatment modality as viable for the edentulous patient. CAD/CAM removable denture techniques are very promising, especially in the context of elderly and geriatric patients, where time, cost and reproducibility of existing denture features are important.

Frauke Müller\*, Najla Chebib, Sabrina Maniewicz, Alessio Casucci, Johan Haerri, Manuel Naharro

## 0308

## Soft Tissue Healing and Soft Tissue Barrier Around Oral Implants

## Dieter Bosshard

## University of Bern, Bern, Switzerland

The surface properties are a key factor in the osseointegration of dental implants. Modern implants are integrated into newly formed bone within a few weeks. Despite major advances in biomaterial research, peri-implant mucositis and peri-implantitis are a reality and unfortunately not rare diseases. The success and survival of dental implants therefore do not depend solely on osseointegration. The peri-implant mucosa, which lies between the bone and the oral cavity, represents an important biological barrier. It is assumed that an intact soft tissue barrier around implants ensures healthy conditions and thus the longterm survival of a dental implant. While the soft tissue seal around teeth develops during tooth eruption, the peri-implant mucosal barrier forms after the formation of a wound in the oral cavity. Healing of the soft tissue around dental implants follows a similar pattern to other soft tissue wounds, beginning with coagulation and followed by inflammation, granulation tissue formation, and the formation of soft connective tissue and epithelium. After 6-8 weeks of healing, a mature barrier (junctional) epithelium forms, which may indicate the establishment of a fully functional mucosal seal around dental implants. This mucosal seal consists of two main components: the attachment to the implant and the defense mechanisms within the barrier (junctional) epithelium. Both are considered essential for the maintenance of health, but little is known about how the epithelial cells adhere to the implant and how the surface properties of the implant influence this adhesion. While much is known about epithelial attachment and the barrier function of the junctional epithelium in the gingiva around teeth, almost nothing is known about this attachment to dental implants. One reason for this lack of information is the difficulty in obtaining the actual interface in histologic sections and the limitations of analytical histological techniques when the implant remains in place.


#### 0309

#### Oral Implants and Oral Health in the Course of Time

#### Gil Alcoforado

Clínica Alcoforado, Lisbon, Portugal

Since the establishment of the concept of osseointegration, the use of endosseous implants has not stopped growing. The first evidence of dental implants is ascribed to the Mayan civilization around 600 AD. During those times, many attempts to replace missing teeth were tried, using the most diverse materials, and utilizing very different techniques to make them stay into place. After the discovery of Osseointegration in the seventies, P-I Brånemark developed a two-stage threaded root-form implant made of commercial pure titanium. Brånemark and his team showed that these fixtures could hold a fixed restoration in totally edentulous patients. After a slow start, dental implants began to be used in patients more and more frequently. Indications were developed at the same rate as the implants were perfected in terms of their shapes, designs, surface treatments as well as connections. As time passed, mechanical as well as biological problems began to appear. The mechanical faults led to more implant design developments. Biological problems took longer to be understood and to have avenues for treatment of these new pathologies. Inflammation of soft and hard tissues adjacent to implants were diagnosed and treatment protocols were developed. The annual global dental implant market grew tremendously and is estimated at around 12-18 million implants sold, while in Europe alone, the annual market is estimated to be around 5.5-6 million implants. Following the American Dental Association 's statistics, 5 million implants are placed every year just in the USA. Knowing that peri-implant mucositis and peri-implantitis are highly prevalent and their management is challenging, unpredictable and associated with significant morbidity, these results will lead to a rate of 2.64 - 4 million peri-implantitis cases globally. The presentation will discuss the evolution of implants and implant treatments as well as look at the present perspectives and challenges in the field of implant rehabilitation.

#### 0310

# Zero Peri-Implantitis – a Clinical Concept Aiming to Minimize Biological Complications to the Maximum Extent

#### Roland Glauser

#### Cosmodent Dental Clinic, Zürich, Switzerland

This presentation will reveal new insights and define an up-to-date understanding of the current dental implant prosthetic componentry, corresponding designs and related soft tissue barrier around. A closer look is taken at established implant-abutment-prosthetic junctions. In particular, connections located intra-tissular and related componentry surface characteristics are continuously stressing peri-implant tissue physiology and jeopardizing soft tissue health. Thus, an early onset of peri-implantitis is facilitated. In return, a stringent zero gap philosophy by using a 2-piece tissue-level implant design allows for a rapid and undisturbed formation of the peri-implant soft tissue barrier. Moreover, a mucophilic surface at the level of the peri-implant soft tissue barrier enables instant cell adhesion, fast and unhindered cell migration, and a physiological turnover. In consequence, an unrivaled peri-implant soft-tissue barrier is established around this particular 2-piece tissue-level zirconia implant which secures



long-lasting soft tissue health. Clinical short- and long-term data confirm that this specific material and design combination prevents peri-implantitis best.

#### 0367

#### Is It Important to Know the Genetic Basis of Oral Health?

#### Algirdas Utkus

Vilnius University, Vilnius, Lithuania

Knowing the genetic basis can explain a wide range of oral diseases, including congenital anomalies, tooth decay, periodontitis, malocclusion, orofacial pain, cancer, and dental implant failure. Most of these conditions tend to be multifactorial or complex, involving more than one gene and environmental influences. Certain conditions are also inherited monogenically and may be part of teratogenic syndromes. A good understanding of this system is becoming increasingly important with the emergence of consumer genomics, including direct-to-consumer genetic testing.

Dental professionals now need to understand why one person is predisposed to a particular oral health condition while their first-degree relatives do not have the condition or have a less severe form of it. Knowledge of how genes work in a susceptible host is essential if patients are to receive accurate advice about their risks.

Knowledge of the genetic basis helps to provide effective personalised oral health care by optimising preventive strategies. It will allow the clinician to explain to what extent a patient's condition is a pure "failure", whether that failure can be reversed by behavioural choices and to what extent our behaviour is influenced by genes.

0368

#### **Monogenic Cleft Palate**

Baiba Lace

#### University of Latvia, Latvia, Latvia

Rapid developments in genetic testing have enabled the identification of more monogenic disorders that were previously considered to be of multifactorial inheritance. Recently, almost all clinical nosologies have identified a strong genetic background in 5 to 15% of cases. Patients with isolated cleft palate, recruited from the Riga Cleft Lip and Palate Centre, Institute of Stomatology, Riga, were analyzed using whole genome sequencing. Pathogenic or likely pathogenic variants were discovered in genes associated with cleft palate (TBX22, COL2A1, FBN1, PCGF2, and KMT2D) in five patients; thus, rare disease variants were identified in 17% of patients with non-syndromic isolated cleft palate. Our results are relevant to routine genetic counseling practices and genetic testing recommendations. Based on our data, we propose that all newborns with orofacial clefts should be offered genetic testing, at least for a panel of known cleft lip and/or palate genes. Only if the results are negative and there is no suggestive family history or additional clinical symptoms (which would support additional exome or genome-wide investigation), should multifactorial empiric recurrence risk prediction tools be applied for families.



#### 0369

Estonian Biobank as a Resource for Population Level Genetic Studies and Introduction of Personalized Medicine

Neeme Tõnisson

University of Tartu, Tartu, Estonia

#### 0364

# The Science of Fractography and Its Application in Fracture Mechanics of Brittle Materials

#### Ulrich Lohbauer

#### University of Erlangen, Erlangen, Germany

Fractographic techniques applied on brittle dental materials will be introduced and presented as a powerful analytical tool help to understand the fracture process in either experimental specimens or clinically failed restorations. Fracture mechanics related to crack propagation will be outlined and the often underestimated influence of scatter on strength will be discussed.

The suggested proposal, preferably for a symposium format, would cover 1) the science of fractography and its application in fracture mechanics of brittle materials; 2) Applied fractography to clinical fractures and gained knowledge in failure analysis.

The final goal being to educate the dental materials researcher, showing the evolution and powerful research tool that is given by the science of fractography which should be more often implemented in clinical and laboratory dental component testing and failure analysis.

0365

# Zirconia Connector Failures: Lessons to Learn

#### Susanne Scherrer

# University of Geneva, Geneva, Switzerland

Early failures due to fracture of fixed dental prosthesis made of "monolithic" zirconia have to be critically analyzed. The recovered broken parts can inform the practitioner and the laboratories about the cause of failure and alert them to the critical design parameters and surface treatment to address to ensure future success. This presentation will follow through an investigation of a series of actual clinical cases examining the retrieved fractured portions of "monolithic" zirconia FPD using the scientific tool of fractographic failure analysis. These cases will highlight issues related to zirconia material science, lab processing, design, surface treatment and the important lessons that can be learned from such premature fractures.



#### 0366

#### Interpretation and Usefulness of Analyzing Retrieved Ceramic Restoration Failures

#### <u>Marit Oilo</u>

University of Bergen, Bergen, Norway

The presentation will show how findings of clinically failed zirconia restorations can be interpreted through clinically relevant in vitro trials. These can then be used for increased understanding of how to use, design and treat our restorations to augment clinical success and survival.

#### 0480

#### Introduction to 3D Printing in Dentistry: Fundamentals, Technologies, and Materials

#### Mustafa Borga Donmez

Department of Prosthodontics, Istinye University, Istanbul, Turkey

The field of dentistry is witnessing a paradigm shift with the integration of 3D printing. The future of 3D printing in dentistry is poised to be revolutionary, with advancements in technology and materials driving innovation across various aspects of dental care. A key aspect to integrate 3D printing technologies into daily clinical practice is to understand the basics of this fabrication method. Therefore, the first session of this 3D printing symposium will introduce the participants into 3D printing by focusing on the fundamentals of 3D printing, the differences among different 3D printing technologies, and the type of materials that can be used. After this introductory session, possible restorative and prosthetic applications with 3D printing will be discussed in the second session. This session will also summarize the findings of current studies on how 3D printing has been integrated into restorative and prosthetic dentistry. The symposium will end with the third session, which will be about the use of 3D-printed composite resins indicated for permanent restorations. This session will focus on an in-depth comparison between subtractive and additive CAD/CAM materials for single-tooth restorations, from a biomechanical perspective to a clinical and financial point of view. This symposium is designed to provide the best available evidence on 3D printing technology, its development, and its integration in different clinical applications with in vivo and in vitro evidence. It is expected that future directions will lead to devising best practices for restorative and prosthetic dentistry.

#### 0481

#### Applications of 3D Printing in Restorative and Prosthetic Dentistry

#### Gülce Çakmak

School of Dental Medicine, Department of Reconstructive Dentistry and Gerodontology, University of Bern,, Bern, Switzerland



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#### 0482

# When to 3D Print and Why? the Example of 3D-Printed Composite Resins and Worn Dentitions

#### René Daher

University Clinics of Dental Medicine, Division of Cariology and Endodontology, University of Geneva, Geneva, Switzerland

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#### 0477

#### **Etiology and Detection**

#### Katrin Bekes

Department of Paediatric Dentistry, Medical University of Vienna,, Vienna, Austria

Molar incisor hypomineralization (MIH) is a frequently encountered dental condition worldwide. It is defined as hypomineralization of systemic origin of one to four permanent first molars frequently associated with affected incisors. Affected teeth are more prone to caries and post-eruptive enamel breakdown and should be diagnosed and managed as early as possible. Furthermore, tooth hypersensitivity is a common symptom in these patients. The etiology of MIH remains unclear. Over time, several etiological hypotheses have emerged, including pre-, peri- and postnatal factors. In general, the etiology appears to be multifactorial. Children with health problems in the first years of life and those whose mothers had illnesses during pregnancy may be more susceptible to MIH. Regarding diagnostics and classification of MIH affected teeth, the EAPD criteria can be used. Furthermore, the Wuerzburg concept offers a classification index – the MIH Treatment Need Index (MIH-TNI) – and a treatment concept based on it.

This lecture aims to highlight different aspects related to MIH, from its etiology to diagnosis and classification possibilities.

#### 0478

#### **Pre-Treatment & Bleaching Protocols**

#### Susanne Effenberger

#### Clinical Research, DMG, Hamburg, Germany

Discoloration of anterior teeth has a considerable psychosocial impact on patients. Studies have demonstrated treatment to improve children's overall health and oral health-related quality of life. Recommendations for therapeutic interventions include non- and microinvasive treatments as well as more invasive approaches such as composite restorations. Due to the variability of opacities and discoloration, a combination of treatment techniques may be necessary. External bleaching is a proven non-invasive option that can be used to successfully camouflage white opacities by increasing the overall whiteness of the teeth, thus reducing the color difference between affected and healthy enamel areas.

#### 0479

#### **Clinical Protocols for Resin Infiltration**

#### Omar Marouane

#### Oralys Dental Clinic, Tunis, Tunisia

Molar incisor hypomineralization (MIH) is a common developmental defect of enamel characterized by the presence of hypomineralized enamel in one to four first permanent molars, often accompanied by similarly affected permanent incisors. Resin infiltration has emerged as a promising treatment option for MIH due to its ability to create a three-dimensional physical diffusion barrier of resin, thereby preventing



acid penetration, limiting further demineralization, and improving the mechanical properties of the lesion. The treatment outcomes of resin infiltration for MIH are unpredictable due to several influencing factors, such as variable porosity, mineral density, varying hypermineralized layer thickness, and an increased organic component. Since the resin infiltration protocol was initially developed for managing carious lesions, it must be adapted specifically for treating MIH lesions. This presentation explores how to improve the clinical protocol for infiltrating MIH lesions, including the removal of the hypermineralized layer and optimization of the drying and infiltration steps. We will focus on adapting and optimizing the hypermineralized layer removal process in MIH lesions and discuss methods to estimate, adjust, and optimize the application time during the infiltration step. This optimization will be aided by the use of transillumination, which enhances the visualization of hypomineralized areas, guides precise removal of the hypermineralized layer, and optimizes the application time during the infiltration process



# Workshops & Seminar

0500a

#### Life After PhD: Academia or Industry?

Arzu Tezvergil-Mutluay<sup>1</sup>, Janine Schweppe<sup>2</sup>

<sup>1</sup>The Institute of Dentistry, University of Turku, Turku, Finland, <sup>2</sup>Global Scientific and Clinical Affairs, Kulzer GmbH, Hanau, Germany

mbarking on a career after completing your PhD in dentistry can be both exciting and challenging. This talk aims to explore the various academic options available in dentistry for individuals with a PhD background. From research-focused positions to teaching roles or administrative and leadership positions, the field of dentistry offers diverse opportunities for those with advanced degrees.

In this talk we will discuss the unique opportunities and considerations for each path, helping the participants to understand which option aligns best with their interests, skills, and career goals. Delving into academia, we'll explore the prospects of pursuing research, teaching, and clinical practice within universities and research institutions. We'll also examine the challenges of securing tenure-track positions and the rewards of contributing to the academic community.

Alternatively, the dental industry offers manifold opportunities for your career path. Never still standing development of new dental technologies and products requires dental professionals bringing along their expertise to meet dentists` clinical needs. Career opportunities in dental industry can range from research to product application to scientific affairs management. But what is a scientific affairs manager doing, how can I enter dental industry. ...? We will bring light into the life after PhD in dental industry. Throughout the session, we'll provide insights into how to make informed decisions about your career trajectory, including networking strategies, seeking mentorship, and evaluating job opportunities. Whether you're passionate about advancing dental research or eager to apply your expertise in a corporate environment, this session will equip you with valuable insights to navigate your post-PhD journey effectively.

0500b

#### Life After PhD: Academia or Industry?

Janine Schweppe

#### R&D, Kulzer, Hanua, Germany

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#### 0307

# Why, What, How and What if- the Method to Present Your Research

#### Ludovica Parisi

University of Bern, Bern, BE, Switzerland

Academic career is more and more often raising the bar for public speaking and presentation skills. In this regard, we expect audiences to be educated, familiar and engaged in our subject matter. However, we often lack the capacity to take the lead and to deliver persuasive and entertaining talks.

The goal of this workshop is to identify new ways to improve students' ability to engage, influence and lead in a professional environment on both a clinical and a scientific level.

Relevant topics in the field of oral health research will be addressed using the 4MAT learning model, a framework that allows to simplify presentation skills by addressing four important questions: i) why is the message conveyed important and valuable for the audience? ii) what key information need to be provided to the audience? iii) how can the audience's attention be captured? And iv) what happened if the audience is involved? What if not?

#### 0476

# How to Design High Quality Clinical Research

#### Catherine Volgenant

# ACTA, Amsterdam, Netherlands

Clinical research is crucial for advancing evidence-based practice in oral health. Designing high-quality clinical research requires thorough knowledge of study design, methodology, ethics, and data collection. The aim of this workshop is to provide participants an introduction in the knowledge and skills necessary to design high-quality clinical research in oral health. During the workshop we will discuss the essential elements of research design, e.g., formulating research questions to data analysis and presenting data.



#### 0499a

#### Future Smiles: Digital Innovations Paediatric Dentistry, and Orthodontics

Maria Cadenas de Llano Pérula, Mostafa Ezeldeen

KU Leuven, Leuven, Belgium

The landscape of dental field has been dramatically reshaped over the past half-century, notably influenced by digital advancements that have revolutionized various dental procedures. Particularly, the emergence of three-dimensional imaging and printing has marked a pivotal shift, enhancing clinical accuracy and patient-specific treatment plans.

During this seminar/workshop we will have the following learning objectives:

- Basics of image processing for digital dentistry including hands on for available AI tools
- Applications of digital tools in Paediatric Dentistry
- Applications of digital tools in Orthodontics
- 3D printing for Paediatric Oral Care and Orthodontics

#### 0499b

#### Future Smiles: Digital Innovations Paediatric Dentistry and Orthodontics

Maria Cadenas de Llano Pérula, Mostafa Ezeldeen

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