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SYMPOSIUM LECTURES abstracts

0026 Roles of Oral Microbiome in Cardiometabolic Diseases: Background and Aims <u>P. Pussinen</u> University of Eastern, Eastern, Finland

Chronic oral infections / inflammations deriving from imbalanced oral microbiome are associated with increased risk of cardiometabolic diseases, but the mechanisms behind the connection are unclear. The oral cavity is the starting point of the gastrointestinal tract and thus, oral pathobionts have a direct access to rest of the body. They may change the composition of gut microbiome, and induce systemic inflammation, endotoxemia, and autoimmune reactions. Although gut microbiome's essential role in general health is recognized, oral microbiome has remained unexplored. Oral infections are among modifiable risk factors and require further attention from both dentists and medical doctors to prevent cardiometabolic diseases more efficiently. In the framework of SuuRIN consortium, we will investigate causal links between oral microbiome and cardiometabolic diseases over the lifespan. Pathomechanisms behind cardiometabolic diseases involve oral microbiome, which is measurable with state-of-art multi-omics technology to address its composition are poorly defined. These are likely to include diet and other lifestyle factors as well as age and genetic variation. In SuuRIN, we will integrate extensive oral omics data with existing data on medical, dental, host intrinsic and behavioural factors across age groups and use artificial intelligence and machine learning to dissect the contribution of oral microbiome to systemic inflammation and beyond.

0027

Oral Health, Systemic Health and Nutrition

<u>S. Männistö</u> Finnish Institute for Health and Welfare, Helsinki, Finland

Chronic oral infections / inflammations deriving from imbalanced oral microbiome are associated with increased risk of cardiometabolic diseases, but the mechanisms behind the connection are unclear. The oral cavity is the starting point of the gastrointestinal tract and thus, oral pathobionts have a direct access to rest of the body. They may change the composition of gut microbiome, and induce systemic inflammation, endotoxemia, and autoimmune reactions. Although gut microbiome's essential role in general health is recognized, oral microbiome has remained unexplored. Oral infections are among modifiable risk factors and require further attention from both dentists and medical doctors to prevent cardiometabolic diseases more efficiently. In the framework of SuuRIN consortium, we will investigate causal links between oral microbiome and cardiometabolic diseases over the lifespan. Pathomechanisms behind cardiometabolic diseases involve oral microbiome, which is measurable with state-of-art multi-omics technology to address its composition and functionality and interactions with the host. Besides gender and oral infections, other determinants of oral microbiome composition are poorly defined. These are likely to include diet and other lifestyle factors as well as age and genetic variation. In SuuRIN, we will integrate extensive oral omics data with existing data on medical, dental, host intrinsic and



behavioural factors across age groups and use artificial intelligence and machine learning to dissect the contribution of oral microbiome to systemic inflammation and beyond.

0028

Determinants of Oral Microbiome Composition

<u>H. Viljakainen</u> Folkhälsan Research Institute, Helsinki, Finland

Chronic oral infections / inflammations deriving from imbalanced oral microbiome are associated with increased risk of cardiometabolic diseases, but the mechanisms behind the connection are unclear. The oral cavity is the starting point of the gastrointestinal tract and thus, oral pathobionts have a direct access to rest of the body. They may change the composition of gut microbiome, and induce systemic inflammation, endotoxemia, and autoimmune reactions. Although gut microbiome's essential role in general health is recognized, oral microbiome has remained unexplored. Oral infections are among modifiable risk factors and require further attention from both dentists and medical doctors to prevent cardiometabolic diseases more efficiently. In the framework of SuuRIN consortium, we will investigate causal links between oral microbiome and cardiometabolic diseases over the lifespan. Pathomechanisms behind cardiometabolic diseases involve oral microbiome, which is measurable with state-of-art multi-omics technology to address its composition and functionality and interactions with the host. Besides gender and oral infections, other determinants of oral microbiome composition are poorly defined. These are likely to include diet and other lifestyle factors as well as age and genetic variation. In SuuRIN, we will integrate extensive oral omics data with existing data on medical, dental, host intrinsic and behavioural factors across age groups and use artificial intelligence and machine learning to dissect the contribution of oral microbiome to systemic inflammation and beyond.

0130

Why Carbonate Apatite? Learning From the Human Bone

<u>K. Ishikawa</u>

Faculty of Dental Science, Department of Biomaterials, Kyushu University, Fukuoka, Japan

Autografts have been considered as the gold standard for bone regeneration. However, availability of autografts harvested from the patient is limited. Thus, it often needs to be mixed with commercially available bone graft substitutes to obtain enough quantity of materials. Although the actual inorganic component of human bone is carbonate apatite, and carbonate group in the apatite structure is known to play an important role in bone remodeling, sintered hydroxyapatite has been used as typical bone graft substitute since carbonate apatite will decompose during sintering at high temperatures. Our group have developed a method to fabricate chemically pure carbonate apatite granules and blocks without sintering, allowing to control the amount of carbonate ion incorporated in apatite structure. Carbonate apatite fabricated by this method showed similar resorption characteristics to human bone, which is resorbed under weak acidic condition produced by osteoclasts and stable under neutral condition of body fluid. Osteoclastic resorption of carbonate apatite presents a good condition for new bone replacement based on the bone remodeling process. In contrast, pure hydroxyapatite remains stable under both acidic and neutral conditions, making the material non-resorbable. Osteoclastic resorption of the material has a close relationship with the activation of osteoblasts through cell-cell interaction, resulting in excellent osteoconductivity. Basic properties of carbonate apatite will be discussed in the presentation.



Potential of a new Synthetic Carbonate Apatite Bone Substitute for Periodontal Regeneration

<u>A. Sculean</u>

Periodontology, University of Bern, Bern, Switzerland

Background

The use of various synthetic bone substitutes as a 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. **Objective**

To evaluate the potential of a novel synthetic carbonate apatite bone substitute (CO₃Ap-BS) on periodontal regeneration. Methods

Acute-type 3-wall intrabony defects were surgically created in 4 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 histologically and histometrically analyzed.

Results

Healing was uneventful in all cases without any adverse events. Formation of periodontal ligament and cementum occurred to varying extent in all groups without statistically significant differences between the groups. 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 CO_3Ap -BS compared to control (66.06±9.34%, 36.11±6.40%; p=0.014 or 69.74±2.95%, 42.68±8.68%; p=0.014). The percentage of bone substitute surface covered by new bone was higher for CO_3Ap -BS (47.22 ± 3.96%) than for DBBM (16.69 ± 5.66, p=0.114).

Conclusions

CO₃Ap-BS and DBBM demonstrated comparable periodontal regeneration. More new bone, total mineralized area/volume, and higher osteoconductivity were observed for the CO₃Ap-BS group compared to DBBM pointing to the potential of CO₃Ap-BS for periodontal and bone regeneration.

0132

Osteoconductive Potential and Clinical Performance of Carbonate Apatite

<u>H. Saito</u>

University of Maryland, School of Dentistry, Department of Advanced Oral Science and Therapeutics, Division of Periodontics, USA, Baltimore, Maryland, United States

The use of dental implants as a therapy for the replacement of missing dentition is becoming more popular among clinicians and bone augmentation is often needed due to the lack of sufficient bone to support the implant fixture. Although various bone graft substitutes are available on the market, an ideal material for bone augmentation is yet to be determined. Synthetic carbonate apatite has been shown to increase osteoblast differentiation compared to pure hydroxyapatite bone graft substitutes. In order to understand the osteoconductive potential of carbonate apatite bone graft substitutes, we evaluated human osteoblast cells response to synthetic carbonate apatite disk compared with allograft (cortical bone plate). We evaluated osteoblastic activity using initial cell attachment, proliferation, and differentiation. Our results showed that carbonate apatite has a similar level of initial cell attachment as allograft, and cell proliferation after 7 days was higher than allograft. In the presentation, osteoconductive potential of carbonate apatite based on the *in vitro* evaluation, and clinical cases performed using carbonate apatite bone graft substitutes will be presented and discussed the potential clinical implications.



0133 Innovative Biological Approach of Restorative Dentistry

R. Monterubbianesi

Department of Biomedical Scienec and Public Health, Università Politecnica delle Marche, Marche, Italy

In Restorative Dentistry, caries removal, cavity preparation or accidental coronal pulp injury may cause dental pulp exposure (DPE) which often leads the clinician to perform endodontic treatment going deep into "death spiral" of the tooth. Clinicians can use direct and indirect pulp cupping to maintain pulp vitality, ensuring the formation of mineralized tissue or dentin bridge between the lesion and the pulp chamber. The preservation of pulp vitality is important for tooth homeostasis, nutrition, innervation and immune defense and allows to postpone further invasive treatments.

Nowadays, innovative new biomaterials were developed for achieving this goal. The introduction of calcium silicate-based materials, commonly named bioceramics, has caused a paradigm shift in the treatment of DPE. In the past, calcium hydroxide was widely used for DPE since it is able to stimulate the formation of tertiary dentine. However, it reported some disadvantages, including pulp surface inflammation, tunnel defects in the dentin bridge and lack of adhesion. Recently, bioceramics have been suggested as alternative material for pulp capping as they showed bioactivity, water tightness, biocompatibility, and adequate mechanical properties. The objective of this lecture is to describe and summarize the properties of the new bioceramics and their biological principles, giving suggestions not only to make the most of their potential, but also to face the daily clinical practice.

0134

Simplifying the Restorative Dentistry With Bio Bulk-Fill Approach

<u>V. Tosco</u>

Restorative Dentistry and Endodontics, Department of Clinical Sciences and Stomatology, Polytechnic University of Marche, Torrette di Ancona, Italy

Restorative dentistry has traditionally focused on the use of dental materials to replace the infected tooth structure in the oral environment to restore the physical function following the tissue loss from disease processes. Resin-based composites have become the gold standard in restorative dentistry for their fundamental role in guaranteeing excellent aesthetics and function. Moreover, recent applications of nanotechnology have also been used to increase the bonding performance of several enamel-dentin adhesive systems. Current adhesive systems allow clinicians to restore tooth structure minimizing cavity preparation, by simply providing an immediate bond of different restorative materials. However, the hybrid layer, or rather the bonded interface between dentin and resin, can result unstable and fail over time, thus leading to marginal leakage and poor retention of the restoration. In this lecture novel bioactive materials such as the calcium silicate-based materials, commonly named bioceramics, will be described. Indeed, due to their biocompatibility, bioactivity, and biomineralization properties, they have been successfully applied in different clinical procedures, ensuring a reliable bond with the dentin substrate. Indeed, in addition to several clinical procedures including direct and indirect pulp capping, pulpotomy and perforation repair, the new bioceramics can be placed as a dentin replacement, filling the cavity in a single step with satisfactory cavity adaptation. In this way, the procedure is simplified, and the chair time required to complete the restoration is reduced, as they have excellent adhesive properties with resin-based composites. Finally, during the presentation the basic concepts of the use of the "biobulk-fill" approach with the new bioceramics to perform the restoration will be carried out, with the support of documentation of several clinical cases.



0159 Adhesive Bonding and Luting to Tooth Tissue <u>B. Van Meerbeek</u> BIOMAT, KU Leuven, Leuven, Belgium

This lecture aims to provide an update on modern direct bonding and adhesive luting technology. Until recently, adhesives were designed to be used in either 'etch-and-rinse' or 'self-etch' bonding mode. Today's newest generation of 'UNIVERSAL' adhesives enable dentists to choose for either an 'etch-and-rinse' or 'self-etch' bonding approach, perhaps according to personal preference or because of specific cavity/prep conditions. For instance, impermeable sclerotic dentin may better require an etch-and-rinse bonding mode, while a mild self-etch approach may be more suitable for bonding to young highly permeable dentin in young patients. Hydrolysis effects and enzymatic biodegradation as the documented main bond-degradation mechanisms will be critically appraised upon their importance and relevance. The second lecture part will deal with the latest adhesive luting technology and focus on the importance of 'touch-cure' technology with interfacially initiated polymerization and the incorporation of silane and phosphoric-acid ester functional monomers in composite-cement formulations. The pros and cons of luting using composite cements versus restorative composites will be weighed up.

0160 Adhesive Bonding to Restorative Materials <u>G. Eliades</u>

National and Kapodistrian University of Athens, Athens, Greece

The evolution of a variety prosthodontic materials has emerged the need for development of simple and reliable means of adhesive bonding to materials. Currently, resin modified glass-ionomers are used for materials cemented on retentive tooth preparations and composite luting agents (adhesive or self-adhesive) for adhesive type of preparations, with emphasis on ceramics. Self-adhesive cements have become popular due to the fast and simple application procedure. However, the complex chemistry of adhesive luting agents has raised issues related to their setting reactions (curing capacity, acidic monomer neutralization) mechanical properties (hardness, elastic modulus, creep) and bond strength with restorative materials. Most of the luting agents, require additional treatments for bonding to material surfaces (etching, grit-blasting, coupling agents) and primers with touch-cure activators to improve the self-curing conversion in dual-cured or the conversion of some light-cured materials. To minimize treatment steps, multifunctional material primers have been developed for universal use, but with high rate of component derivatization. The aim of this presentation is to critically review the performance characteristics and the current developments in the field.



Detrimental Effects of Periodontitis on General Health: Evidence, Implications and Future Perspectives <u>G. Isola</u>

Department of General Surgery and Surgical Medical Specialties, University of Catania, Messina, Me, Italy

Periodontitis, a multifactorial microbiome-driven inflammatory disease of the tooth-attachment apparatus, is epidemiologically linked with several systemic conditions, including cardio-metabolic, cognitive neurodegenerative, respiratory and autoimmune diseases. These associations may, in part, be causal, as suggested by interventional studies showing that local treatment of periodontitis reduces systemic inflammation and surrogate markers of comorbid diseases. In this regard, the potential cause-and-effect connection between periodontitis and comorbidities, is corroborated in some preclinical and clinical models of disease, which additionally provided mechanistic insights into these associations but is still not fully understood.

The role of inflammation has been widely demonstrated to be central to the early diagnosis and treatment of periodontitis, triggered by the body's response to periodontal pathogens in the biofilm. When the inflammatory response to bacterial infection becomes chronic, it may cause damage to the supporting structures of the teeth, causing the well-known process of periodontal bone loss and eventually even tooth loss. In the last few decades, the relationship between periodontitis and associated inflammation has been shown to be linked to negatively impacting and worsening several systemic health diseases bilaterally.

The objective of the present lecture is to discuss and update the recent advances in understanding the periodontitis-systemic disease connection, which may lead to innovative therapeutic options to reduce the risk of periodontitis-linked comorbidities and, in general, impact the overall efficacy of periodontal treatment.

0162

Inflammatory Response in Periodontal Treatment: ACute and Chronic Effects

<u>Y. Leira</u>

Periodontology, University of Santiago de Compostela, Santiago de Compostela, Spain

Periodontitis treatment may reduce cardiovascular risk in the long-term mainly by controlling the systemic inflammatory response, but studies have suggested a link between periodontal therapy, acute inflammatory response and endothelial dysfunction and perhaps short-lived increased risk of clinical vascular events such as myocardial infarction and ischemic stroke. In this presentation, the current evidence in this regard will be discussed.

0163

Antimicrobials in Periodontal Treatment: Ecological Effects and Risks of Resistance

<u>K. J. Scholz</u>

Department of Conservative Dentistry and Periodontology, University Hospital Regensburg, Regensburg, Bavaria, Germany

Periodontitis results from a complex interplay between dysbiotic subgingival biofilms and an exuberant immune response leading to loss of periodontal tissues. Consequently, antimicrobials such as systemically and topically applied antibiotics or antiseptics can be used in periodontal therapy adjunctively to subgingival debridement for resolving dysbiosis in the subgingival biofilm and establish health-associated microbial communities. Nevertheless, clinicians need also to be aware of potential negative effects associated with the use of antimicrobials. Although the oral cavity has been highlighted as a potential reservoir of antimicrobial resistance (AMR) genes, there is little awareness in the dental community of the potential risks associated with over-use of antibiotics and even less when it comes to antiseptics. With the latter, which are commonly used over longer periods of time, also risks associated with undesired ecological



changes of the oral microbiota need to be considered. This presentation will provide an update on adjunctive antimicrobial procedures for periodontal treatment, their clinical evidence as well as on potential risks and draw recommendations for clinical practice.

0212

Dental Multilayer Chairside Zirconia in the Focus of Fracture Mechanics

<u>U. Lohbauer</u>, R. Belli

Dental Clinic 1 – Operative Dentistry and Periodontology, Friedrich-Alexander University Erlangen-Nuremberg, Erlangen, Germany

The use of materials for subtractive manufacturing of indirect restorations is a highly emerging market in the European dental community. The market is currently dominated by lithium-silicate based glass ceramics however the high strength and toughness of translucent zirconia continues to gain in popularity. Multilayer zirconia materials, offering tailored mechanical properties in combination with adapted shades and translucency are currently under intensified scientific focus. The simultaneous development of speed sintering technologies extends the market for the economic, time-saving chairside use of such materials. This lecture investigates the physical side of this material class and reports mechanical findings from different layers in newly developed multilayer chairside zirconia blocks. Fracture strength has been a reference property for years, characterizing dental materials by focusing on the clinical load-bearing capacity. In contrast, fracture toughness is a sensitive indicator of fracture resistance and a more relevant predictor of clinical longevity under occlusal load. Both properties are covered in this talk. Furthermore, crownlike structural proof-testing is an important step forward from standardized, experimental investigations to clinically anatomic shapes. Commonly realized via simple crunch-the-crown tests, the applicability is limited to fracture load testing in comparative studies. However, we learnt from clinical fractography, that material fracture typically emanates from occlusal, Hertzian contacts or from extensive bending moments in weak regions like crown fissures or bridge connectors. Critical stress fields are also located at crown margins - a potential region and major source of CAD/CAM defects. Under radial stress, those defects lead to spontaneous bulk or chipping fractures. Here, we demonstrate a systematic approach on dome-like structures simulating the build-up and effect of radial hoop stress on crown marginal fracture. The experiments are combined with numerical simulations, elucidating the distribution of maximum principal stress.

A central aim of this lecture is to provide scientific insights into microstructural properties of the latest generation of zirconia multilayer chairside blocks and to discuss the potential and limitations in correlation with ceramic-based competitors.

0213

Facing the Challenges of Graded Zirconia for Single Visit Treatments

<u>F. Rothbrust</u> R&D, IVOCLAR, Liechtenstein, Liechtenstein

All-ceramic restorations for single visit treatment require very efficient processes. To achieve a workflow duration of below one or 1.5 hours for a crown, existing solutions often compromise on either mechanical properties or esthetics. Most single unit restorations are made with glass-ceramic materials. With respect to conventionally cemented crowns (of low wall-thickness) and full-contour bridges however, zirconia has been getting more and more popular. High-speed-sintering cycles below 25 minutes still challenge oxide ceramics with respect to mechanical properties or esthetics, especially those products with shade and material-type gradation. The new vacuum-aided sintering technology of the Programat CS6 helps to achieve better densification and therefore esthetic outcomes. However, to be able to sinter graded zirconia restorations at moderate sintering temperatures in 15 minutes, a new microstructural design of the graded ceramic material is mandatory to prevent the formation of intra-granular pores due to accelerated grain growth. The presentation illustrates the latest progress in the development of graded zirconia for fixed prosthetic multi-unit chairside restorations of high strength and describes how the challenges concerning speed are faced. The impact of the yttria-content on the microstructural characteristics of different material grades is presented and it is explained why a reduction in certain sintering aids in specific material grades is favorable for accelerated heating rates in high-speed sintering cycles. Based on current progress, it can be



concluded that - in the near future – solutions will be found for graded dental zirconia that allow the combination of speed, 1100 MPa strength, high fracture toughness and good esthetics during single visit treatments.

0214

Clinical Experience With Zirconia Restorations: From Disc to New Zirconia Block

C. Monaco

University of Modena & Reggio Emilia (Unimore), Modena, Italy

The evolution of ceramic and composite materials and overall technological progress, have brought about an important change in prosthetic and restorative dentistry, which has altered the rehabilitation approach of the last twenty years. Chairside systems have allowed a reduction in treatment-times for patients and the evolution of materials has mainly been aimed at use with such systems. The introduction of zirconia has allowed for the gradual replacement of metal ceramics both in rehabilitating vital teeth and over implants. However, due to the complexity of the sintering times and workflows, zirconia restorations have traditionally been fabricated at dental laboratories. In recent years, the improvement of sintering processes has allowed the creation of monolithic zirconia restorations using chairside systems. The aim of the lecture will be to present the long-term clinical results of zirconia restorations on teeth and implants and to introduce, with the advent of new technologies, the use of zirconia with chairside methods.

0215

Volume Augmentation in the Esthetic Area

D. Antonacci

ThinkBiologic Research Team - Department of Surgical Sciences (DISC), Division of Prosthodontics and Implant Prosthodontics, University of Genoa, Genoa, Italy

Esthetic outcome in implant dentistry is the balance between the clinic/technical teamwork and the patient intended as anatomical complexity and the patient healing pattern. First step for is always a previsualization of the bone/soft tissue anatomy together with ideal final restoration. Once digitally inserted the implant and connected to the final restoration, implant/bone tridimensional interaction may suggest the clinician how to augment the missing volume. However, in case of volumetric deficiency we can choose to go for a hard tissue augmentation or soft tissue augmentation, in more complex cases both procedures should be performed and scheduled in the treatment timeline. Nowadays, the wide availability of biomaterial allows us to customize our choices according to the clinical case with the goal of achieving optimal regeneration and less discomfort for the patient.

0216

New Insights in Maxillary Sinus Floor Elevation

<u>D. Botticelli^{1, 2}</u> ¹Specialist in General Surgery, Modena, Italy, ²Specialist in General Surgery, Ribeirão Preto, Brazil

It may seem peculiar that we can still discuss new research on maxillary sinus augmentation. However, research may provide more evidence on the techniques normally applied or on materials that have already been used for years. This research allows us to answer clinical doubts that many of us still have when performing sinus floor elevation. For example, doubts on the dimensions to be used for the access window and its position, the extent of post-surgical edema of the sinus mucosa and the possible obstruction of the ostium, the real capacity of the sinus membrane to produce bone, perforations of the sinus mucosa caused by contact with implants or non-resorbable biomaterials, and the appearance of synechiae after maxillary sinus lift. These topics will be addressed in the presentation.



0317 Clinical Diagnosis and Review of Treatment Options <u>M. Wicht</u>

University of Köln, Cologne, Germany

Developmental defects of the enamel may be attributed to a variety of disturbances during the process of odontogenisis, i.e. temporary damage to ameloblasts during the initial or final maturing phase, resulting in quantitatively (hypoplasia) or qualitatively (hypomineralised) altered enamel microstructure. The clinically imposing opacities occur either diffuse or demarcated with the latter being frequently attributed to MIH.

Differential diagnosis is primarily based on anamnestic findings and clinical appearance of the lesion and may be supported by photographs and/or transillumination, which assist to not only differentiate healthy from affected enamel but also to provide information about the lesion depth.

Most of these developmental defects are biologically harmless and would per senot require any intervention. In case a patient is striving for aesthetic correction many options from non-invasive vital tooth bleaching to microabrasion and resin infiltration, combinations of these to classic restorative therapy can be considered.

Within the scope of this lecture, actual concepts for diagnosis and masking non carious enamel opacities will be presented and illustrated by a large number of clinical cases.

0318

Qualitative Impact on Patients and Managing Patients Expectations

S. Effenberger

Charité - Universitätsmedizin Berlin, Berlin, Germany

Human beings are forming their personality under social judgement all the time, particularly in the younger generations. Aesthetically impairing lesions in anterior teeth are perceived by patients and generate dissatisfaction in affected children and adolescents as well as their parents. Affected persons might go as far as hiding their smiles. Molar-Incisor-Hypomineralization (MIH) stands out as a highly prevalent condition worldwide, characterized by disturbance of enamel mineralization that results in demarcated opacities affecting first permanent molars and incisors. The negative impact of MIH on the oral health related quality of life has been reported in the literature. Aesthetic reasons are the major concern of patients with anterior teeth affected by demarcated opacities seeking treatment. At the patient level, the following factors should be considered for appropriate treatment planning: age of the patient, medical history, ability to cooperate, psychological impact of dental appearance on patient and access to specialist dental care. Managing patients' expectations in aesthetic dentistry is a critical component of successful treatment outcomes. Patients seeking aesthetic treatment do often come with high expectations for the appearance of their teeth. Therefore, it is essential to establish realistic expectations and define mutual goals before the treatment. The key factor of this process is clear communication to provide an understanding of possibilities and limitations of available treatment options as well as to understand the preferences and expectations of the patient. Within the scope of this lecture, the current literature will be reviewed, communication strategies evaluated and illustrated by clinical cases.



0319 Al Supported Detection, Discrimination and Cost Effectiveness of Treatments <u>F. Schwendicke</u> Charité - Universitätsmedizin Berlin, Berlin, Germany

The treatment of demarcated opacities is driven by the appearance and nature of the opacity. The latter mainly determines the prognosis of different management approaches. Understanding the nature of "white spots" and differentiating different entities is challenging. The lecture will discuss how technology, namely deep learning and AI, may support dentists in making proper diagnoses.

0314

Which Is the Evidence Behind the Association Between Periodontitis and Depression?

<u>E. Figuero</u>

University Complutense of Madrid, Madrid, Spain

It is estimated that 3.8% of the population suffers from depression, reaching 5% in adults. The pathophysiology of depressive disorders is not completely understood, what results in almost one-third of patients being resistant to treatment. In the last years, new investigations are being performed to identify possible etiopathophysiological mechanisms beyond neurotransmitter alterations, especially those related to neuroinflammatory processes of extra neural origin. Much emphasis has been placed on the role of the gut microbiota; however, data for the oral microbiota are limited. The oral cavity houses the second most diverse microbial community in the body, with over 700 bacterial species that colonize the soft and hard tissues. Periodontal diseases encompass a group of infectious and inflammatory diseases that affect the periodontium. Among them, periodontiis is defined as a chronic, multi-bacterial infection that elicits low-grade systemic inflammation via the release of protinflammatory cytokines, as well as local invasion and long-distance translocation of periodontal pathogens. Recently, periodontal pathogens have been implicated in the aetiology and pathophysiology of neuropsychiatric disorders (such as depression and schizophrenia), especially as dysregulation of the immune system also plays an integral role in the aetiology and pathophysiology of these disorders. During the lecture we will discuss epidemiological data of periodontal diseases in individuals with these disorders, followed by a discussion of the microbiological and immunological links between the oral microbiota and the central nervous system



0315 What is the Evidence Linking Periodontitis to Diabetes and Cardiovascular Diseases?

P. Madianos

National & Kapodistrian University of Athens, Athens, Greece

Periodontitis (PD) is an inflammatory condition that leads to the destruction of the tooth supporting apparatus, affecting approximately 50% of the adult population, being the most prevalent chronic inflammatory non-communicable disease (NCD) of humans. According to data originating from the Global Burden of Disease (GBD) database, 1.1 billion cases of severe periodontitis were present globally in 2019. PD has been shown to have an effect exceeding the boundaries of the oral cavity, triggering a systemic inflammatory response and having a significant and independent association with other chronic NCDs, including diabetes mellitus (DM) and cardiovascular diseases (CVDs).

DM is a highly prevalent NCD, with a global prevalence estimated at 9.3% (463 million people), expected to rise to 10.2% (578 million) by 2030. Type 2 diabetes is a major cause of disability and premature mortality, mainly from vascular and renal complications. Evidence from the last 40 years has proven a bidirectional association between DM and PD, since DM negatively affects PD, while PD may complicate the severity of DM and the degree of metabolic control of DM patients. CVDs represent a large and diverse group of different pathologies, including ischemic heart disease, stroke, hypertension, cardiomyopathies and atrial fibrillation. CVDs are the leading cause of mortality worldwide, representing 32% of all global deaths. There is evidence from epidemiological studies that periodontitis patients exhibit significant sub-clinical atherosclerosis. Similarly, there is robust evidence for а positive association between periodontitis and coronary heart disease and stroke. The aim of this presentation is to summarize the evidence linking PD with DM and CVDs and to discuss clinical implications of periodontitis management in DM and CVD patients.

0316

Treatment of Periodontitis and its Effect on Systemic Inflammation: the Impact on Systemic Outcomes

<u>F. Graziani</u> University of Pisa, Pisa, Italy

Treatment of Periodontitis determines significant amelioration of systemic health and reduction of indicators of progression of systemic diseases. Literature has identified important changes, both short and medium to long-term, of bio-markers of cardio-vascular health such as inflammatory bio-markers, endothelial function, glycaemic levels and lipids function. Immediately after periodontal instrumentation a relevant perturbation of the systemic inflammation and endothelial dysfunction has been observed through a sharp and abrupt increase of inflammatory markers. Nevertheless, when periodontal inflammation subsides beneficial systemic effects are seldom noted. Systemic inflammation decreases as observed by reduction of the circulatory level inflammatory markers. Metabolic markers also show improvements as witnessed by small yet significant changes in lipid markers and, in subjects affected by diabetes, by a significant reduction on the level of glycated haemoglobin. Moreover, study on the endothelial function also indicates a beneficial effects on bio-markers of cardio-vascular health. The speaker will focus on his studies on systemic perturbations of systemic inflammation in various periodontal models (gingivitis, periodontitis, periodontitis & diabetes, Periodontitis & systemic Hypertension, Periodontitis & Obesity, Periodontitis & arthritis rheumatoidis) to provide some clinical indications of treatment.

0342 Insights Into Bone Regeneration, Bone Augmentation Techniques, and Guided Dental Implantation I. Gendviliene Vilnius University, Vilnius, Lithuania

To follow



0343 Bone Tissue Engineering: Secretomes, ECM as a Boosting Tool E. Simoliunas

Vilnius University, Vilnius, Lithuania

The most relevant problems in dentistry and maxillofacial surgery are the atrophy of alveolar bone and the formation of bone defects related to dental diseases, oncological surgeries, or trauma. Bone defects aggravate dental implant placement and impair the chewing, speech, and facial aesthetic appearance of the patient. Strategies for promoting bone regeneration include guided tissue regeneration, autogenous and allograft bone transplantation, also tissue engineering. However, all these techniques still have limitations. Autografts suffer from limited resources and donor-site morbidity due to potential infection and haematoma, also their harvesting requires an additional surgical procedure. Allografts can transfer pathogens to the patient and cause immunological rejection by the recipient's body. In comparison, tissue engineering combines bone graft materials with biological mediators to achieve predictable tissue regeneration. To facilitate artificial bone construct integration into a patient's body, scaffolds are enriched with different biologically active molecules, e.g. cell-derived extracellular matrix (ECM) or cell-produced secretome. These biodecoration techniques are a rapidly growing field of research. In this talk I will present the effectiveness of these cell-derived bioactive materials in bone tissue regeneration applications.

0344

Artificial Intelligence-Driven Planning for Oral Surgical Procedures, How Far Have We Come?

<u>P. Lahoud</u>

Department of Oral and MaxilloFacial Surgery and Imaging and Pathology (OMFS-IMPATH Research Group), KU Leuven, Leuven, Belgium

The oral surgical field has been revolutionized following multi-disciplinary collaborative research combining engineering, medicine and various fields that propelled translational dentistry into a new era. From there, in-silico modelling was born. In-silico modelling was suggested as a way of using computer modelling while incorporating mechanistic, theoretical and biological knowledge fused with data-driven modeling, aiming to forecast physiological outcomes. And while its initial pitfalls were linked to the complexity of generating accurate patient-specific models, Artificial Intelligence is now allowing us to automate several parts of a previously cumbersome and time-consuming process, making the use of in-silico modelling in precision medicine closer than ever to be used in clinical settings.

0345

Minimal Intervention Techniques in Primary Teeth - Prevention and Selective Excavation

<u>T. Kvist</u>

Department of Dental Medicine, Division of orthodontics and Paediatric dentistry, Karolinska Institutet, Stockholm, Sweden

While complete excavation and restorative treatment of dental caries remains a frequent practice all over the world, selective excavation (SE) is now the golden standard. SE may offer greater cost-effectiveness compared to stepwise excavation as the tooth is definitively restored with a permanent filling at the first and only visit. Practise Based Research Networks allows and engage clinics in research activities that contribute to evidence-based treatment methods. The center of pediatric oral health research in Sweden evaluates two different treatment methods for management of caries in primary molars; SE compared to total caries excavation.



Management of Cavitated Dentine Lesions: the Use of Silver Diammine Fluoride and the Hall Technique <u>C. Bonifacio</u>

Paediatric Dentistry, ACTA, Amsterdam, Netherlands

During this lecture we will discuss the indications of non-invasive, micro-invasive, mixed and invasive treatment approached for the management of caries in young children. The various options for managing carious lesions will be presented depending on the activity, depth of the cavity, motivation of the patient/parents and method of treatment. Focus will be on non-restorative cavity control using silver diammine fluoride, selective excavation and the Hall technique.

0347

What Do Dentists Know About the Minimal Intervention Dentistry? How Is It Accepted by Parents and Children?

<u>S. Gizani</u>

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In response to the high proportion of dental caries among a considerable percentage of children worldwide and its profound consequences including pain, infection, abscess, lost school hours and negative impact on quality of life, minimal intervention dentistry (MID) in caries management has been adopted by paediatric dentists as an alternative to the conventional approach of non-selective caries removal and pulp therapy using highspeed handpiece and aerosol. A survey among members of the European Academy of Paediatric Dentistry (EAPD) and UK revealed that Hall technique and topical application of 38% SDF were more widely used among the participants in the U.K, whereas the conventional restoration of non-selective caries removal remained the most preferred technique for the management of carious primary teeth among the participants in the E.U. Lack of teaching and confidence, difficulty obtaining materials required for MID as well as perceived lack of evidence on the efficacy of MID were identified as barriers. In addition, these techniques have been also accepted well by parents. Data on the views and practice of dentists towards MID from different countries as well as from Europe as well as parental acceptance will be discussed.

0389

Biocompatibility: From Cytocompatibility to Bioactivity Assessment

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Biocompatibility ranks as one of the most important properties of dental materials, according to the ISO 7405 and ISO 10993 recommendations. One of the criteria for biocompatibility is the absence of material toxicity to cells. In this respect, the development of predictive *in vitro* methods are needed to assess dental materials cytocompatibility and bioactivity to protect human health on one hand, and on the other hand to limit the use of animal models that raise ethical and societal issues. Regarding cytocompatibility, the cell culture setting (direct or indirect) should be selected according the targeted tissue and intended application *in vivo* (endodontic, restoration, periodontal,... etc.). In some clinical situations, dental materials are not in direct contact with representative cells, however, their dissolution products could reach surrounding tissues; this could explain the significant use of extraction techniques (eluates) when assessing cytocompatibility of these materials. The extraction method used then to obtain the tested eluates, should be suitable to allow an optimum release of components. On the other hand, in direct contact methods, the material sample is in physical contact with the cells; relevant to their clinical application, but precautions should be taken to maintain the physiological balance of cells. Bioactivity assessment on the other hand is more demanding and complex to investigate and quantify, nevertheless, when the biological behavior of a material is investigated, correlations between both cytocompatibility and bioactivity should be considered for complete risk assessment of such materials. Biocompatibility significance lies in the ability to evaluate material-host tissue interactions; in vitro analyses are achieved at the cellular level and antibacterial activity could be quantified when required. The current symposium focuses on the advancement of *in vitro* alternative methods used for a better and predictive biological assessment of dental materials.



Advancements in Dental Biomechanics: Exploring the Role of in Silico Models

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Over the past five decades, the dental practice has experienced significant advancements driven by a deeper understanding of the biomechanics of teeth and biomaterial evolutions. This enhanced understanding was made possible using various research methodologies, including randomized clinical trials, static and cyclic loading experiments, and more recently, finite element analysis. Finite element models, like those used in aeronautics, have gained popularity in dentistry, enabling applications such as predicting tooth displacement in orthodontics, studying the behavior of teeth restored with fiber-reinforced composites in endodontics, and preventing prosthodontic clasp fractures. However, despite these advancements, treatment failures still occur, firstly due to the use of a standard anatomy to create finite element models. Moreover, most of these models lack experimental validation and are often limited to comparing materials based on maximum stress values. Recently, the integration of cone beam computed tomography and artificial intelligence has enabled automation of certain aspects of the complex modeling process. In the case of maxillofacial surgery, these advances have given rise to the concept of precision medicine, which aims to assess individual anatomical and biomechanical characteristics, and to adapt treatment options accordingly. These developments hold great promise for improving our understanding of biomechanical factors, developing new materials, and enhancing clinical practice safety. However, it also presents ethical challenges due to the lack of standardized verification processes. The objective of this symposium is to evaluate the scientific evidence for In Silico models, explore their potential impact on clinical practice, and propose a methodological framework for assessing the reliability of future In Silico models.

0391

Mechanical Performance of Short Fiber-Reinforced Composites

<u>S. Garoushi</u>

Biomaterials Science, University of Turku, Turku, Finland

The longevity of conventional particulate filler resin composite (PFC) is uncertain in large restorations with high occlusal stresses due to their insufficient mechanical properties. Biomimetics represent the new concept to restore lost tooth tissue for both direct and indirect restorations. From a biomimetic point of view, the use of short fiber-reinforced resin composite (SFRC) as bulk dentin-replacing material seems a promising treatment strategy that could solve some potential problems associated with conventional PFC restoration in high stress-bearing areas. This presentation briefly presents the theoretical background and mechanical benefits of using SFRC as dentin-replacing material. Within the limitations of reported scientific evidences, the presented biomimetic restorative approach, i.e., SFRC as thick core replacing dentin, under surface layer of PFC replacing enamel offers a suitable solution to restore hard dental tissue. This strategy represents a promising and cost-efficient way to extend the indication range of direct resin composite restorations and gives the clinician alternative treatment options.



KEYNOTE LECTURE abstracts

0029

Early Healing Around a Tissue Level Zirconia Implant - a Histological Investigation in the Miniature Pig Mandible

D. Bosshardt

University of Bern, Bern, Switzerland

Background: Preclinical research has shown that surface modifications of zirconia, titanium and titanium alloys accelerate osseointegration of dental implants, substantially reducing healing times. However, biological response is not only dependent on the implant material and surface texture per se. Macro geometry, material, surface texture, and prosthetic protocols of the implant system are all contributing to the overall response to the foreign body, especially the soft tissue response.

Purpose: To examine early soft tissue integration and osseointegration of transmucosal two-piece, tissue-level, screw-shaped zirconia dental implants with a rough endosseous surface and a machined transmucosal part.

Materials & Methods: Following extraction and healing, YTZP implants (Patent[™] Standard Zirconia Implant) were inserted in the mandible of miniature pigs. Titanium (Ti) tissue-level implants (Straumann® SLActive® Standard RN Roxolid®) served as controls. Histological analyses were performed after 1, 3, 5, 7, 14, and 21 days of transmucosal healing.

Results: For soft tissue integration, no differences could be observed between YTZP and Ti. The junctional epithelium was initially growing apically along the blood clot, then on the surface of the granulation tissue, and finally made contact with the implant surface. After 14 days, epithelial contact with both implant surfaces was observed. The blood coagulum was replaced by granulation tissue and the latter by a connective tissue. Newly formed bone reached the surface of both YTZP and Ti implants at day 7. The density of new bone in close proximity to the implant surface and the percentage of bone-to-implant contact (BIC) increased steadily until day 21 with a tendency for more bone along the YTZP implants.

Conclusions: Both implant types demonstrated rapid soft tissue integration and osseointegration. YTZP implants tended to show faster peri-implant bone formation than Ti implants.

0232 **Digital Personal Branding & Academia** <u>F. Graziani</u> University of Pisa, Pisa, Italy

Prof. Graziani will cover some important aspects of communication and digital branding and in which way they may be related to research. Practical exercise for a limited group of participants will also be applied.



ORAL PRESENTATIONS abstracts

0001

Two-Body Wear Resistance of Highly Filled Universal Nanohybrid Composites

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Objectives Objective: Lifespan of resin-based composite restorations is highly influenced by the wear properties of the materials. In our study four highly filled universal nanohybrid composites (HFUNC) Enamel Biofunction (EBF) (Micerium S.p.A., Avegno, Italy), Neospectra (NS) (Dentsply Sirona, Konstanz, Germany), Clearfil Majesty (CM) (Kuraray Noritake Dental, Tokyo, Japan), Asteria (A) (Tokuyama Dental Corporation, Japan) were tested.

Methods Materials and methods: Composite specimens (n=10; diameter:10 mm; height: 1.5-2 mm) were prepared in individually printed resin-based mold according to the manufacturer's instruction. Degree of Conversion (DC) was measured by Nicolet 6700 Fourier Transformation Infrared Spectroscopy (FTIR, Thermo Electron Co. USA), Vickers hardness (VH in kgf/mm²) was tested by microhardness testing machine (Mitutoyo HV-120, Kanagawa, Japan) both on top and bottom surfaces. The ageing was performed with thermocycling machine (THE-1100, SD Mechatronik GmbH, Feldkirchen-Westerham, Germany) (10000 cycles) followed by 120,000 mastication cycles. The mean volume loss (MVL) and maximum wear depth (MWD) was detected by NewView 7100 (Zygo, U.S.A) interferometer. The data was statistically analyzed by SPSS 17 version. The significance level was α =0.05.

Results Results: The DC data were between 27.84% and 34.13%. Ageing resulted increased DC on both composite surfaces. There was a significant difference between composite groups on top surface VH before ageing (EBF:56.36±4.82, NS:49.01±2.64, CM:110.77±6.59, A:49.93±4.36), except between A/NS (p=0.572) and after ageing between EBF/A (p=0.722) and A/NS (p=0.156). MVL ranges were 2.39x10¹⁷±4.33x10¹⁶ nm³ and 1.54x10¹⁷±7.75x10¹⁶ nm³. Significant differences were detected in MVL between composites EBF/CM and NS/CM except NS/A: p=0.701, CM/A: p=0.12, EBF/A: p=0.294, EBF/NS: p=0.448. MWD were between 127.39± 19,85 nm and 71,83±37,73 µm. Comparison of MWD showed significant differences between EBF/CM, A/CM, NS/CM, EBF/NS except NS/A (p=0.713) and EBF/A (p=0.07).

Conclusions VH and wear properties are associated with the composition of HFUNC. Differences in filler type and load of HFUNC affected both MVL and MWD.



Bonding Effectiveness of Universal Adhesive not Affected by air-Abrasion/Polishing Dentin

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Objectives To evaluate the effect of air-abrasion/polishing on micro-tensile bond strength (µTBS) to dentin.

Methods Third molars had their occlusal third cut and dentin surface divided into two parts. Smear layer was prepared using a medium-grit diamond bur (107 μ m). Dentin was air-abraded/polished under distilled water irrigation at 4 bar for 15 sec (Aquacare, Velopex) using 6 Velopex powders (n=10; no air-abrasion/polishing as control): aluminum oxide 29 μ m (AO_29) and 53 μ m (AO_53), sodium bicarbonate (SB), sodium bicarbonate soft (SB_soft), bioactive glass (BG), and aluminum trihydroxide (AT). G2-Bond Universal ('G2B'; GC) was applied according to the manufacturer's instructions. Using a split-tooth model, the adhesive was applied in etch-and-rinse (E&R) bonding mode at one dentin-surface half, and in self-etch (SE) mode at the other half. A composite build-up (Clearfil AP-X; Kuraray Noritake) of 5-mm height was made in 3 layers. After one-week water storage (37°C), teeth were cut using a low-speed diamond saw in micro(μ)-specimens. Half of the μ -specimens were 'immediately' tested, with the other half first subjected to 50k thermocycles. The failure mode of all specimens was determined by light-microscopy ('adhesive interfacial failure', 'cohesive failure in dentin' or 'mixed failure'), followed by SEM fracture analysis of selected specimens. Data were analyzed using 2-way ANOVA and Tukey (α =0.05).

Results No significant difference in µTBS was recorded between the air-abrasion/polishing methods and control, this when G2B was bonded in both E&R and SE mode (Figure). In all groups, the E&R bonding mode resulted in higher µTBS than the SE mode, although being only statistically significant for AO_29 and SB when measured immediately and upon aging, and for SB_soft upon aging.

Conclusions Overall, air-abrasion/polishing with any powder did neither impair nor improve µTBS to dentin. Upon aging, G2B bonded more effectively in E&R mode than in SE mode for some specific air-abrasion/polishing methods.





Effect of IDS Using Universal Adhesives on Monolithic Zirconia's Adhesion

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Objectives This study evaluated the effect of immediate dentin sealing (IDS) treatment using different universal adhesive systems on microtensile bond strength (µTBS) of pretreated monolithic zirconia-based CAD/CAM block to dentin.

Methods Mid-coronal dentin surfaces were obtained from 32 intact human molars and randomly allocated into 8 groups according to types ofuniversal adhesives used for IDS treatment (Single Bond Universal/SBU, Clearfil Quick Bond/CUQ, Optibond Universal/OBU) and zirconia surface pretreatment methods (tribochemical silica coating with 30 µm CoJet particles/TSC and sandblasting with 50 µm Al₂O₃/SB): 1)Group TSC, 2)Group TSC+SBU, 3)Group TSC+CUQ, 4)Group TSC+OBU, 5)Group SB, 6)Group SB+SBU, 7)Group SB+CUQ, 8)Group SB+OBU. A monolithic zirconia-based CAD/CAM blocks(Lava Plus, 3M ESPE) were luted to the dentin surfaces with a self-adhesive dual-cure resin cement(Rely X U200,3M ESPE). They were subjected to 10.000 thermocycles and then sectioned. Zirconia-dentin bars(2x2x8 mm) were subjected to µTBS test with a universal test machine(Microtensile Tester, Bisco)(crosshead speed:0.5mm/min)(n=16). Failure types were analyzed under stereomicroscope. Surface roughness of pretreated monolithic zirconia were measured with contact profilometer. Surface morphology of zirconia and zirconia-dentin interfaces were analyzed under SEM(Evo LS10 Zeis). Semi-quantitative chemical microanalysis were performed with EDS. Two-way ANOVA and Bonferroni tests were used for statistical analyses(p<0.05).

Results Regarding IDS treatments, Group TSC+OBU showed statistically higher µTBS than Group TSC(p<0.05). Group TSC+OBU and Group SB+OBU showed statistically higher µTBS than Group TSC+CUQ and Group SB+CUQ, respectively(p<0.05). No significant differences in µTBS and surface roughness were detected according to surface pretreatments(p>0.05). Rougher surface morphology and higher Si content were observed after tribochemical silica coating pretreatment. A thick, intact hybrid layer with long resin tags were observed for Group TSC+OBU and Group SB+OBU. The predominant failure mode was mixed for most groups. **Conclusions** After both pretreatment methods, IDS with Optibond Universal resulted in higher bond strength than the ones with Clearfil Universal Bond Quick.



Bonding of Glass Ionomers to Resin Composite Using Universal Adhesive

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Objectives The aim of this study was to evaluate the shear bond strength of glass ionomers to resin composite with the different application modes of universal adhesive system.

Methods Two different glass ionomer cements were used: conventional glass ionomer and resin- modifed glass ionomer(N=20). Totally 40 cylinder-shaped glass ionomer specimens were fabricated (diameter:5 mm, height:2mm) using teflon molds and embedded in acrylic resins. Then, a universal adhesive system was applied with two different modes (etch&rinse and self-etch) and cylinder-shaped composite resin specimens (diameter:3 mm, height:2 mm) were bonded (n=10). All specimens were stored in distilled water for 24 h and subjected to shear bond strength test at a crosshead speed of 1 mm/min using universal testing machine. Debonded surfaces were observed with a steremicroscope under 15x magnification to determine mode of failure. Data were statistically analyzed with two-way ANOVA and Bonferroni tests(p<0,05).

Results Regarding the different application modes of universal adhesive system, no statistical differences were observed in shear bond strength for conventional glass ionomer cement. However, self-etch application of universal adhesive system showed statistically higher shear bond strength than etch&rinse application for resin-modified glass ionomer cement. Regarding the glass ionomer cements, resin-modified glass ionomer cement showed statistically higher shear bond strength than conventional glass ionomer cement with both modes of universal adhesive. Conventional glass ionomer showed predominantly adhesive failures while resin-modified glass inomer presented mixed failures.

Conclusions The self-etch mode application of universal adhesive system might be preferred for the adhesion of resin-modified glass ionomer to composite resin.



Shear Bond Strengths: Outcomes With Inexperienced vs. Experienced Operators

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Objectives The aim of this study was to investigate shear bond strengths (and failure modes) of three 'universal' self-etch and one self-etch bonding agents to bovine dentin and enamel, following adhesive application by inexperienced and experienced operators. **Methods** Experiments were performed by 6 operators who already had experience with the application of bonding agents and who did not receive any additional training and by 60 early-stage University dental students who received precise instructions on how to perform the bonding process immediately before the experiments were done. In total, bond strengths of three self-etch 'universal' agents: Scotchbond Universal[®] (**SBU**, 3M), Opti Bond[™] universal (**OBU**, Kerr) and Prime & Bond active[®] (**PBA**, Dentsply-Sirona), and one self-etch bonding agent OptiBond[™] XTR (**OBXTR**, Kerr) were evaluated. All bonding agents were applied in self-etch mode. Composite-cylinders were bonded perpendicularly to bovine dentin and enamel surfaces. Shear-strengths were measured 24 hours post-bonding. Analysis of overall data was made via mixed-model ANOVA.

Results Dentin bond strengths of **SBU**, **OBXTR** and **PBA** were comparable for both groups of operators while lower values were measured for **OBU** (p=0.019) for experienced operators (Fig 1). On enamel, bond strengths were comparable only for PBA while lower values were measured for **SBU** (p=0.041), **OBXTR** (p=0.029) and **OBU** (p=0.039) for experienced operators (Fig. 1). For all materials and dental hard tissues means of shear strengths were higher, when experiments were performed by inexperienced operators. For both groups of operators, **OBXTR** always showed the highest bond strengths, both on enamel and dentin. More cohesive fractures were detected in dentin than in enamel for all materials, regardless of whether the experiments were performed by experienced or inexperienced operators (Fig. 2).

Conclusions Inexperienced operators who received precise instructions on how to perform the bonding process achieved higher adhesion values with the same materials than experienced experimenters who did not receive special training.





Fig. 1. Shear strengths of bonding agents on enamel and dentin





Biocompatible Scaffolds With Osteoinductive Properties - in a Sheep Model

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Objectives For severe alveolar bone defects, autologous bone grafting has been considered the "gold standard"; however, the procedure has several disadvantages, including limited bone supply, resorption, donor site morbidity, infection, and bone graft rejection. In recent decades, bone tissue engineering has been shown to be a potential alternative to current bone augmentation techniques. The aim of the work was to study the microstructure of the maxillary sinus anterior wall using different biomaterials for regeneration, bacterial cellulose, and collagen, in a standardized sheep model.

Methods A standardized bone defect on the anterior sinus wall was used. 3 groups of bone defects were formed, control group, group II closed with a collagen membrane, group III closed with a bone cover.

Microtomography scanning: A Skyscan 1176 X-ray computer microtomography was used. Bone samples were scanned together with calcium hydroxyapatite phantoms, diameter corresponding to the samples thickness for being compared with the histological results. Histological study

Obtained bone tissue samples were decalcified by Trilon, subsequently paraffin embedded by Histomix. Histological sections of 5-7 µm thickness were made on a sledge microtome and stained with hematoxylin and eosin followed by general histopathological analysis.

Results On 30th experimental, bone specimens showed defect replacement by different bone tissue with different differentiation degree. Group II bone defect showed bone fragments in the resorption state and signs of osteoclastic reaction. Group III bone defect was filled by newly formed bone tissue with minor signs of bone trabeculae resorption. The defect was filled with dense compact bone tissue, and roughly fibrous connective tissue showing trabeculae of newly formed bone tissue with a pronounced osteoblastic reaction.

Conclusions Due to our sheep study model bone tissue regeneration follows a normal physiological type, starting from defect repair by granulation tissue with connective tissue bands and terminating by cell differentiation with a marked osteoblastic activity.



The Influence of new Functionalized Scaffolds on Periodontal Ligament Cells Behaviour

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Objectives There is a need to develop shapeable multiphasic scaffolds with controlled architecture and bioactive properties suitable for periodontal regeneration. In this respect, this study aimed to assess the effect of new functionalized scaffolds elaborated by Direct-Writing Electrospinning (DWE) on the biological behavior of periodontal ligament cells (PDL).

Methods Biphasic scaffolds based on polycaprolactone were elaborated using DWE technique; one of the two scaffold compartments contained hydroxyapatite nanoparticles (HAP) and the other the cementum protein 1 (CEMP1). After morphological characterizations, cell cytotoxicity, cell metabolic activity and cell colonization were evaluated using LIVE/DEAD staining, Alamar Blue assay and confocal imaging respectively. In addition, Alizarin Red staining and osteopontin (OPN) expression were studied to assess the mineralization potential of PDL cells after their contact with the experimental scaffolds.

Results No cytotoxic effect was observed for all the tested scaffolds as shown by LIVE/DEAD staining. The results demonstrated that both HAP- and CEMP1- functionalized scaffolds were colonized by PDL cells and enhanced mineralization ability compared to unfunctionalized scaffolds; as revealed by alizarin red staining and OPN protein fluorescent expression using confocal imaging. **Conclusions**

The present in vitro results demonstrated that the functionalized scaffold (HAP and CEMP-1) enhanced PDL behaviour in terms of cell colonization and mineralization ability as compared to the unfunctionalized one. In the context of native tissue preservation and regeneration, these functionalized scaffolds deserve further development for potential clinical role in repairing and regenerating periodontal defects. Moreover, combining the high accuracy of DWE and the possibility of adding multiple bioactive agents paves the way for multi-tissue regeneration.



Doxycycline-Doped Nanoparticles Exert Cementogenic/Osteogenic Effect on Human Periodontal Ligament Cells

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Objectives To evaluate if doxycycline-doped polymeric nanoparticles exert effects on proliferation and cementogenic/osteogenic differentiation of stem cells from human periodontal ligament.

Methods The polymeric nanoparticles (NPs) were produced by a polymerization/precipitation process. NPs were doped with doxycycline by NPs immersion in a 40 mg/mL aqueous solution of doxycycline hyclate (Dox-NPs). NPs were suspended in phosphate buffered solution at 1 μ g/mL concentration. Stem cells were isolated from human periodontal ligament (PDLSCs). Two experimental groups were established for evaluation (Undoped NPs and Dox-NPs). A negative control and a positive control with osteogenic medium (OM) were also tested. PDLSCs were cultured in the presence or absence of the different NPs and cell proliferation was assessed by MTT-assay after 48h. Cell differentiation was also assessed by osteogenic gene expression measured with real-time quantitative polymerase chain reaction (RT-qPCR) after 7 and 14 d of culturing. The measured genes were alkaline phosphatase (ALP) and Runt-related transcription factor 2 (RUNX2). Data analysis was performed by one-way ANOVA and Student Newman Keuls multiple comparisons (p<0.05).

Results No differences in cell proliferation were found at the different studied groups (p=0.103) (Control group average was 1, while NPs and Dox-NPs groups were 0.893 and 0.806, respectively). After 1 week of treatment, the osteogenic medium significantly upregulated ALP gene expression of PDLSCs (p=0.01) but not RUNX2 (p=0.08). After 2 weeks of treatment, gene expression of ALP and RUNX2 in PDLSCs were significantly upregulated by the osteogenic medium (ALP: p<0.001; RUNX2: p=0.005). Doxycycline NPs further enhanced (2-fold) ALP gene expression of PDLSCs treated with the osteogenic medium.

Conclusions Dox-NPs increase cementogenic/osteogenic differentiation in PDLSCs, being a potential tool to be further developed for periodontal regeneration treatments.

Grant PID2020-114694RB-I00 funded by MCIN/AEI 10.13039/501100011033. M.T.-O. is fellow FPU of Ministry of Universities [grant FPU20/00450].



Ce-Doped Silica-Based Mesoporous Nanoparticles Promote Periodontal Ligament Cells' Osteogenic Differentiation

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Objectives This study aimed to analyze the potential of silica-based Ce-doped mesoporous nanoparticles (SiCaCe-MSNs) to promote the osteogenic differentiation of human periodontal ligament cells (hPDLCs), targeting periodontal regeneration.

Methods The synthesis of SiCaCe-MSNs was performed using the Sol-Gel technique, using tetraethyl orthosilicate (TEOS) as a silicon source and Cetyltrimethylammonium bromide (CTAB) as a mesoporous agent in an alkaline environment. hPDLCs were established from human biopsies of periodontal ligament tissues from a healthy donor using the enzymatic dissociation method, and characterized with flow cytometry for the following markers, CD34, CD45, CD146 and STRO-1. Cell viability of hPDLCs cultured with SiCaCe-MSNs was evaluated with the MTT assay at different concentrations (125, 250 and 500 µg/ml). hPDLCs and SiCaCe-MSNs were further cultured in standard culture conditions with or without osteogenic differentiation medium (OM) for up to 21 days and assessed for osteogenic differentiation by means of quantitative real-time reverse-transcription polymerase chain reaction (qPCR), Alkaline phosphatase (ALP) activity, and Alizarin red staining (ARS).

Results Most of the isolated hPDLCs (83.7%) were double negative for CD34 and CD45. The double negative subpopulation of cells expressed STRO-1 at 97% and CD146 at 98,2%. SiCaCe-MSNs seem to be biocompatible after 3 and 5 days in culture, presenting better cell viability at lower concentrations (125 and 250 µg/ml). qPCR analysis demonstrated a time-dependent increase in *RUNX2* and *BMP2* expression, while higher concentration of SiCaCe-MSNs enhanced the expression of *BMP2* in hPDLCs. A time-dependent decrease in *Osteocalcin* expression was observed, as well as a slight increase in *ALP* expression and presence in cell lysates with time. ARS showed high calcium deposition, which increases with higher SiCaCe-MSNs concentration and the presence of OM. **Conclusions** The novel Ce-doped silica-based MSNs show promising properties in terms of promoting osteogenic differentiation and calcium deposition and should be considered favorable candidates for future applications in periodontal regeneration.



Prolonged Release of Calcium Through PCL/ β -TCP 3D-Scaffolds for Bone Regeneration

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Objectives Bone defects grafting materials require peculiar characteristics. Features as biodegradation, surface topography, porosity, interconnectivity and resistance play a key role in the clinical performance of the biomaterial. Poly-E-caprolactone (PCL) and β -tricalcium phosphate (β -TCP) are among the most studied materials. The objective of this study is to optimize printable PCL/ β -TCP composite biomaterials with balanced porosity and specifically designed internal architecture to resemble human cancellous bone, maintaining optimal mechanical strength and eliciting positive cellular responses. Moreover, the use of β -TCP incorporated into the PCL matrix allows a lengthened release of calcium ions, useful for bone cells stimulation.

Methods Medical grade PCL and β -TCP have been used to produce PCL/ β -TCP scaffolds for bone tissue regeneration. After the creation of filaments with different relative ratios of PCL/ β -TCP (100/0, 60/40 and 30/70), 3D scaffolds have been printed with fused deposition modeling with a ad-hoc designed internal architecture. Materials morphology was observed through micro-computed tomography, as well as their cytocompatibility responses by direct and indirect contact cytotoxicity tests, cell adhesion and morphology analysis. Additionally, 3D cells colonization pattern was assessed.

Results All the composite materials and their ad-hoc printing protocols produced optimally printed samples. Micro-computed tomography (Fig.1c) showed a well-defined internal architecture, consisting with the projected parameters - which resembles in thickness and porosity the interconnectivity of trabecular bone. The internal structure showed an average wall thickness of about 250µm which is analogous to native osteons dimensions. All the tested materials showed high biocompatibility and null toxicity, with an enhanced cellular proliferation on the composite samples. SEM images underlined a granular surface morphology and an optimal osteoblastic adhesion preferentially over the β-TCP granules peaks of the material.

Conclusions The PCL/β-TCP composite materials showed good printing properties. Cells responses were positive, showing that our PCL/β-TCP composite materials are an optimal candidate for bone regenerative applications.



Three-Dimensional Magnetic Hydrogel Composite Scaffolds for Bone Tissue Engineering

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Objectives Reconstruction of critical sized bone defects in the oral and maxillofacial region continue to be clinically challenging despite significant development of osteo-regenerative materials. Among 3D biomaterials, hydrogel composites have been explored for bone regeneration, however variable rates of degradation and lack of vascularisation limit their potential. Magnetic nanoparticles (MNPs) are known to target and regulate cell signalling pathways for controlling cell behaviour hence have been used to accelerate cell growth, organize vascular networks, and develop tissues. In this study, we report novel magnetic calcium carbonate-poly(vinyl alcohol) PVA scaffolds to enhance porosity, mechanical strength, and improve the osteogenic and angiogenic potential. Methods The scaffolds were fabricated using PVA as matrix and vaterite (calcium carbonate phase) as filler with different concentrations of MNPs and characterised using FTIR-ATR, XRD, Raman, TEM, SEM, EDS, VSM, DSC and compressive strength. A Human osteoblast like cell line and Human umbilical vein endothelial cells were used for in vitro biological tests. Results The PVA-Vaterite-MNP scaffolds exhibited magnetic fields as expected and demonstrated improved cell adhesion, proliferation and biomineralisation. The inclusion of MNPs improved the compressive strength (21.22 MPa) and structural integrity of the PVA-Vaterite scaffolds, with appropriate equilibrium water uptake (32.32-34.92%) and high glass transition temperatures (111.40-117.80°C). The PVA-MNP interaction limited chain mobility of PVA thereby lowering amorphous regions in the matrix leading to a higher crosslinking density, consequently enhancing the mechanical properties without compromising porosity. Conclusions The PVA-Vaterite scaffolds with MNP's exhibited a porous spongy structure in the hydrated state with superior compressive strength, and adequate thermal stability. The cell penetration and mineralisation ability indicate osteogenic and angiogenic potential. Furthermore, the ability to reshape the scaffolds manually to fit different anatomical bone defects renders it as a promising biomaterial in oral and maxillofacial surgery.



Impact of Scanning Distance on Trueness and Precision of Intra-Oral Scanners

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Objectives It is now impossible to ignore the influence that intraoral scanners have on dental practices. Our study aimed to examine whether there is a variety of distances where scanning offers higher trueness and precision.

Methods : A right first mandibular molar with overlay preparation on the typodont model was scanned by intra-oral scanners (IOS): BenQ BIS-1 (BenQ AB), VirtuoVivo (Dental Wings), and TRIOS 3 (3Shape). Scanning was performed six times at a distance of 5mm, 10mm, 11mm, 12mm, and 13mm with each IOS by a single operator. The reference model was obtained by a desktop scanner (Trishape E4). Scan data was exported as stereolithography files and uploaded to control software (CloudCompare V2.12.4). The software performed point pair alignment and fine registration of prepared tooth surfaces with the reference model. Following alignment, the trueness and accuracy data were obtained by calculating the deviation between the IOS data and the reference model by the software. The statistical effect of scanning distance and IOS on trueness and accuracy was investigated (*p*<0.05).

Results The scanning distance of 5,10, 11, and 12mm displayed statistically different deviation values for BenQ BIS-1 and VirtuoVivo for trueness (p<0.05). However, 10,11, and 12mm distances significantly affected the precision of BenQ BIS-1, not VirtuoVivo and Trios. For Trios3, there was no significant difference in the trueness and precision of scanning in all distances (p>0.05). While Trios 3 showed the highest trueness within all distances except 13mm, BenQ was more precise at 10, 11, and 12mm among intra-oral scanners except 5 and 13mm, which is no significant difference.

Conclusions Scanning distance can be an influential factor in the trueness and precision of intra-oral scanners, especially the ones evaluated in this study, except for Trios3.



Comparison of Caries Removal Techniques and Dental-Scanners for Quantitative Volume-Loss

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Objectives To evaluate volume loss quantitatively with ICDAS II and also to compare several caries removal techniques and four dental scanners, in terms of volume loss percentages (VLP).

Methods 120 human molars with ICDAS scores of 3, 4 and 5 were used (n=40). 3D data of each tooth were recorded using an extraoral (Ineos-x5, Dentsply Sirona) and 3 intraoral scanners (iTero-Element 5D (Align), Primescan (Dentsply Sirona), Trios-4 (Trishape) in STL data format. Caries removal techniques were stainless-steel bur (SSB), ceramic bur (CB), tungsten-carbide bur and bioactive-glass powder combination (TCBA), and tungsten-carbide bur and 29µm aluminium-oxide powder combination (TCAl₂O₃). Following caries removal, secondary STL data were recorded by the scanners. 4 initial and 4 final data for each tooth were overlapped and compared volumetrically using Meshmixer (Autodesk). 960 volumetric data were calculated for 120 teeth. Paired two-sample t test, Wilcoxon test, repeated variance analysis with Bonferroni correction, Friedman test, and Dunn test were used for statistical analyses. Deem significance was set at p<0.050.

Results Regarding ICDAS II, VLP for each assessment were considered significant (p<0.001). There was no significant difference in VLP between caries removal techniques (p=0.110). Interactions of caries removal techniques and ICDAS scores were statistically significant (p=0.018). The highest VLP was 18.5% for both SSB and CB groups regarding ICDAS 5. The lowest VLP was 4% for TCBA group regarding ICDAS 3. Significant differences were observed between Ineos-x5 and iTero (p<0.001), Ineos-x5 and Primescan (p=0.001), and Ineos-x5 and Trios-4 (p=0.005). There were no significant differences between iTero, Primescan and Trios-4 (p=0.051). **Conclusions** ICDAS scoring can give preliminary information about volume loss after caries removal procedures. In deep carious lesions, combination of burs and air-abrasion can be useful in preventing substantial tissue loss. The precision of dental scanners can be different regarding the quantitative VLP measurement.

Table 4. Comparison and agreement between intraoral scanners for ICDAS scores

	ICDAS 3		ICDAS 4		ICDAS 5		Total	
	Mean \pm sd	Median (min max.)	Mean ± sd	Median (min max.)	$Mean \pm sd$	Median (min max.)	$Mean \pm sd$	Median (min max.)
iTero VLP (%)	5.5 ± 4.5	4.0 (1.0 - 19.0)	9.6 ± 4.7	9.0 (2.0 - 20.0)	13.9 ± 8.2	13.0 (2.0 - 42.0)	9.7 ± 6.9	8.0 (1.0 - 42.0)
Primescan VLP (%)	5.6 ± 4.8	4.5 (0.0 - 23.0)	9.8 ± 4.5	10.0 (1.0 - 20.0)	15.1 ± 8.1	14.0 (4.0 - 42.0)	10.1 ± 7.1	8.0 (0.0 - 42.0)
Trios 4 VLP (%)	5.9 ± 4.3	4.5 (2.0 - 20.0)	10.7 ± 7.3	9.0 (1.0 - 43.0)	14.6 ± 7.7	13.5 (4.0 - 40.0)	10.4 ± 7.5	9.0 (1.0 - 43.0)
Test ist.	χ ² =2.293		$\chi^2 = 2.793$		χ ² =6.155		$\chi^2 = 7.481$	
р	0.318		0.247		0.051		0.051	
ICC (%95 CI) / p	0.938 (0.895 - 0.965) / p<0.001		0.815 (0.688 - 0.896) / p<0.001		0.974 (0.956 - 0.985) / p<0.001		0.95 (0.932 - 0.964) / p<0.001	
2. Friedman test statist	ic E. Renea	ted analysis of variance	tast statistic	a-h: No difference hetu	aan seannar	with the same letter If	C. Intraclas	correlation coefficient

22: Friedman test statistic. F: Repeated analysis of variance test statistic. a-b: No difference between scanners with the same letter. ICC: Intraclass correlation coefficient (95% Confidence interval)

Table 3. Comparison of volume loss percentages calculated by Incos x5 and intraoral scanners and examination of the agreement between the scanners

	ICDAS 3		ICDAS 4		ICDA	85	Total	
	$Mean \pm sd$	Median (minmax.)	Mean ± sd	Median (minmax.)	Mean ± sd	Median (minmax.)	Mean ± sd	Median (minmax.)
Ineos x5 VLP (%)	5.8 ± 4.1	5.0 (2.0 - 20.0)	10.8 ± 4.4	11.0 (3.0 – 21.0)	16.0 ± 8.0	14.0 (5.0 - 39.0)	10.9 ± 7.1	9.0 (2.0 - 39.0)
iTero VLP (%)	5.5 ± 4.5	4.0 (1.0 - 19.0)	9.6± 4.7	9.0 (2.0 - 20.0)	13.9 ± 8.2	13.0 (2.0 - 42.0)	9.7 ± 6.9	8.0 (1.0 - 42.0)
Test statistic	Z = -1.408	**************************************	t = 3.1	43	Z = -3.768		Z = -5.081	
Р	0.159		0.003		<0.001		<0.001	
ICC (%95 CI) /	0.945 (0.895 - 0.971) / p < 0.001		0.921 (0.852 - 0.958) / p<0.001		0.957 (0.919 - 0.977) / p<0.001		0.961 (0.944 - 0.973) / p<0.001	
Ineos x5 VLP (%)	5.8 ± 4.1	5.0 (2.0 - 20.0)	10.8 ± 4.4	11.0 (3.0 - 21.0)	16.0 ± 8.0	14.0 (5.0 - 39.0)	10.9±7.1	9.0 (2.0 - 39.0)
Primescan VLP (%)	5.6 ± 4.8	4.5 (0.0 - 23.0)	9.8± 4.5	10.0 (1.0 - 20.0)	15.1 ± 8.1	14.0 (4.0 - 42.0)	10.1±7.1	8.0 (0.0 - 42.0)
Test statistic	Z=-0.627		t = 2.543		Z=-2.605		Z=-3.397	
Р	0.531		0.015		0.009		0.001	
ICC (%95 CI) / p	0.939 (0.884 - 0.967) / p<0.001 0.9 (0.811 - 0.947)		811 - 0.947) / p<0.001	0.982 (0.967 - 0.991) / p<0.001		0.972 (0.9	6 - 0.981) / p<0.001	
Ineos x5 VLP (%)	5.8 ± 4.1	5.0 (2.0 - 20.0)	$\begin{array}{c} 10.8 \\ \pm 4.4 \end{array}$	11.0 (3.0 - 21.0)	16.0 ± 8.0	14.0 (5.0 - 39.0)	10.9 ± 7.1	9.0 (2.0 - 39.0)
Trios 4 VLP (%)	5.9 ± 4.3	4.5 (2.0 - 20.0)	10.7 ± 7.3	9.0 (1.0 - 43.0)	14.6 ± 7.7	13.5 (4.0 - 40.0)	10.4 ± 7.5	9.0 (1.0 - 43.0)
Test statistic	Z=-0.186	Z=-0.186 Z=-1.617		Z=-2.899		Z=-2.799		
Р	0.853		0.106		0.004		0.005	
ICC (%95 CI) / p	0.935 (0.877 - 0.966) / p<0.001 0.656 (0.349 - 0.818) /		0.349 - 0.818) / p=0.001	0.971 (0.946 - 0.985) / p<0.001		0.917 (0.88 - 0.942) / p<0.001		

t: Paired two-sample t-test. Z: Wilcoxon test. ICC: Intraclass correlation coefficient (95% Confidence interval)



Comparison of volume loss percentages according to caries removal techniques and ICDAS scores

	Q	р
Caries removal technique	2,012	0,110
ICDAS score	9,615	<0,001
Caries removal technique*ICDAS score	15,257	0,018

Q: ROBUST Test Statistic

Descriptive statistics of volume loss percentages according to caries removal techniques and ICDAS scores

Caries removal technique		Total		
	3	4	5	Total
SSB	7(2-19)ABC	14,5 (9 - 18)A	18,5(12-39)ABC	14,5(2-39)
СВ	5(3-20)BC	10,5(4-13)ABC	18,5(5- 31)AB	10,5(3-31)
TCAI2O3	4,5(2 - 7)C	8,5(3 - 13)ABC	11(5 -21)ABC	7(2-21)
ТСВА	4 (2-7)C	9,5(3-21)ABC	10,5(8-23)ABC	8 (2-23)
Total	5 (2-20)a	11(3-21)b	14 (5-39)c	9 (2-39)

Median (minimum - maximum); a-c: No difference between main effects with the same letter; A-C: No difference between interactions with the same letter



Scan Pattern on Whole Jaw 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 possible.

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 \pm 0.13mm) in the anterior region and 0.72mm (\pm 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 (\pm 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 (\pm 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.



Contacts Recorded With Articulating Paper and Digital Scanner - Prospective Study

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Objectives The collection and recording of the occlusal contacts are key steps of many dental procedures, nevertheless the lack of a standardized method for the right collection could cause clinical errors. The aim of this study was thus to compare the occlusal recording taken with articulating paper, and the one taken with an intraoral digital scanner. Moreover, because occlusal recording is ultimately a diagnostic and treatment tool, the secondary outcome was the rate of agreement among clinicians in subjectively evaluating the occlusal contacts using either articulating paper or digital impressions.

Methods Twenty-eight records were analyzed for this study. Intraoral photos of the colored signs impressed by articulating paper and intraoral digital impressions were both taken at the same time point for every patient. Thanks to a standardized occlusal template, two experienced operators registed the number of occlusal contacts for every tooth provided by both the recording techniques. Then, eleven well-trained clinicians analyzed the collected records and answered to some questions about the quality of the occlusions observed.

Results The statistical analysis showed statistically significant differences between the number of contacts reported by the photographed articulation marks and those reported by digital impressions, except for upper central incisors and first premolars. The Kappa Fleiss showed a slight and fair agreement between clinicians about the evaluated occlusions.

Conclusions The evaluation of occlusal contacts in adult patients with a complete dentition was inconsistent between digital impressions and articulating paper, except for the upper left and right central incisors and the upper left and right first premolars. Overall, a higher number of occlusal contacts was measured on digital impressions, compared to articulating paper. Finally, the agreement between clinicians in the evaluation of both recorded methods was slight for the articulating paper and fair for digital impressions.



Level of Agreement Between Clinical Plaque Detection and Intraoral Scanner.

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Objectives

This study aimed to evaluate the agreement between an intraoral scanner system (IOS) and a conventional clinical method for dental plaque detection and registration.

Methods

14 participants were recruited from the Department of Operative Dentistry, School of Dentistry, University of Athens. All subjects gave written informed consent, and the protocol was approved by an Ethical Committee. Participants eligible for inclusion were adults with good general health and a minimum of 20 permanent teeth. The examiners were dental professionals calibrated for clinical plaque registration before the study and trained in using the IOS (3Shape TRIOS5). All study participants were clinically examined with plaque assessment on each tooth's buccal and lingual surface according to the modified Quigley & Hein plaque index before and after using a disclosing agent (GC-Tri Plaque ID-Gel, GC). Then they received professional teeth cleaning, and a third recording of the index scores took place. Before and after the application of disclosing agent and after professional teeth cleaning, all study participants were scanned using the IOS. Three examiners blinded to the clinical examination also assessed plaque status on the acquired 3D models with and without disclosing agent using the same index to evaluate the inter-rater agreement. Interclass coefficient correlation, and Cohen's Kappa was calculated.

Results

Cronbach's α for the scores of the images of 3D models with disclosing agent was found to be 0.775 (0.716 for the scores without disclosing agent). The correlation was stronger for the upper front teeth and the lowest for the mandible front teeth. Cohen's Kappa for inter-rater reliability was higher when using the 3D models after the disclosing agent (ranging from 0.173 to 0.492- higher for the two more experienced examiners).

Conclusions

Level of agreement between conventional clinical registration and registration from 3D models was acceptable overall.



Intra-Oral Scanner, the Promise of an Accurate Guide Fitting

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Objectives The study aimed to evaluate the feasibility and effectiveness of using intra-oral scanner (IOS) for assessing the position of endodontic guides and predicting drilling deviation.

Methods The study involved creating a maxillary model and scanning it using CBCT and a laboratory scanner. A virtual image of a drill was superimposed on the right central incisor, and an ideal endodontic guide was created. Four types of defective endodontic guides were designed with varying thicknesses to simulate defects ranging from 200 to 1150 µm. The STL files of the 4 defective endodontic guides were uploaded to the computer-aided manufacturing software, and the endodontic guides were printed using a 3D printer. The fitting of each endodontic guide on the study model was visually checked, and the study model and endodontic guide were assessed using the Geomagic metrology software and the trueness and precision of the IOS system were measured on posterior area. **Results** Linear and angular deviations of the guide were assessed, and the trueness and precision of the IOS system were measured. The results showed that the mean linear deviation was 46.11 µm and the mean angular deviation was 5.91°. The IOS system presented a mean trueness of 1.28 µm and a mean precision of 11.52 µm. The study identified a linear deviation, suggesting that the fit of a guide will be inaccurate before any intervention on the tooth.

Conclusions Overall, the use of IOS for assessing the position of endodontic guides and predicting drilling deviation is feasible and effective, but further studies are needed to address the limitations of the current study, such as the use of posterior teeth as references for 3D model alignment and the requirement for a full arch impression with sufficient accuracy.



Soft and Hard Tissue Changes During Long Orthodontic Tooth Movement

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Objectives The structural and compositional processing of a bone and periodontal ligament (PDL) remodeling during long-term orthodontic tooth movement (OTM) are not well described, yet. Although the mechanism of bone loss and regrowth in the directly affected alveolar bone has been deeply investigated, the exact mechanism of periodontal ligament remodeling and its relation and interaction with alveolar bone during OTM remain poorly described. This work aims to provide a deep analysis of the alveolar bone and PDL remodeling after a prolonged OTM treatment on mice.

Methods Orthodontic force was applied using a Ni-Ti coil-spring connected to the first molar (M1) and incisor of maxillae in splitmouth mice model. After 5 weeks both sides of maxillae were scanned by high-resolution micro-CT. After precise estimation of the tooth movement, an extensive 3D analysis in two regions of the alveolar bone adjacent to M1 (*i.e.*, M1 socket *versus* alveolar bone between M1 and the second molar) were performed to estimate the morphological and compositional parameters. Additionally, changes of PDL were characterized on using a novel 3D model approach.

Results Bone loss and thinning, higher connectivity as well as lower bone mineral density were found in both studied regions, while the differences in the M1 socket were more pronounced. A non-uniformly extended PDL was observed after long OTM and characterized by an increased PDL thickness.

Conclusions The extended and novel methodology in this study provides a comprehensive perception about the alveolar bone and PDL remodeling process after a long-duration OTM.


Periodontal Ligament Transplantation With Gold Nanoparticles Prevents Orthodontic Root Resorption

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Objectives To investigate whether a novel biomimetic periodontal ligament transplantation can prevent orthodontically induced inflammatory root resorption (OIIRR) in a rat model of orthodontic tooth movement (OTM).

Methods Human PDLSCs were isolated from extracted teeth and characterized as mesenchymal stem cells. Simultaneously, gold nanocomplexes (AuNCs) were synthesized using gold nanoparticles complexed with Poly-L-lysine and hydrobromide rhodamine B isothiocyanate. *In vitro*, the effects of AuNCs on the viability and osteogenic differentiation capacity of PDLSCs were tested by cytotoxicity assay, ALP and ARS staining, RT-qPCR, and immunofluorescence staining, respectively. The AuNC-treated hPDLSCs were encapsulated in a type-I collagen hydrogel scaffold to mimic their native physiological niche and were then transplanted into a rat model of OTM. Thirty-five twelve-week-old male Wistar rats were included in this study and divided into 6 groups: (1) no OTM, (2) OTM, (3) Sham injection + OTM, (4) AuNCs injection + OTM, (5) PDLSCs + OTM, (6) AuNCs-induced PDLSCs + OTM. OIIRR was evaluated longitudinally, before and 31 days after OTM with micro-CT, based on a rigid voxel-based registration. Immunohistochemisty was additionally performed at 31 days.

Results *In vitro*, 0.1 mg/mL 40nm AuNCs were easily taken up by primary hPDLSCs with limited cytotoxicity and promoted osteogenic differentiation of hPDLSCs effectively, as shown by upregulation of ALP, COL1, OSTERX and RUNX2 expression. *In vivo*, micro-CT showed that OIIRR was significantly prevented in Group 6 (AuNCs-induced PDLSCs), compared to Groups 2, 3, 4 and 5 (p < 0.05). There was no significant difference in OIIRR between Groups 1 and 6 (p=0.81). Increased immunoreactivity of p62 and LC3 suggests that the underlying mechanism can be linked to the autophagy-induced osteogenesis triggered by the AuNC-hPDLSC transplantation.

Conclusions Injection of with collagen-1 embedded AuNC-treated hPDLSCs prevented OIIRR. This study presents an innovative AuNCs-based strategy for stem cell therapy in orthodontics.











Transcriptomic Profiling of Periodontal Ligament Tissue Subjected to Orthodontic Force

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Objectives The biological response of the periodontal ligament (PDL) during orthodontic tooth movement (OTM) allows the teeth to move through the bone. This research investigates the transcriptomic profile of the PDL tissue of teeth subjected to an orthodontic force (OF), aiming to explain the molecular biological basis of OTM.

Methods Patients seeking orthodontic treatment who needed orthodontic premolar extractions were invited to participate in this study. Patients were randomly assigned to two groups: control (CG) where the premolars were extracted before the application of OF and experimental (EG), where the premolars were extracted 28 days after the application of an OF of 50g, applied to the premolars by a 0.014 Ni-Ti arch wire. The total RNA was extracted from the PDL tissue and RNA-seq was subsequently performed. False discovery rates (FDR<0.05) and fold change \geq 1.5 thresholds were used to identify sets of differently expressed genes (DEGs). DEGs were further investigated to define their cellular and biological significance by Gene Ontology (GO) enrichment, Kyoto Encyclopedia of Genes and Genomes (KEGG) and network analysis.

Results 17 and 23 patients were included in the EG and CG respectively. RNA-seq identified 172 DEGs in the EG compared to the CG, with 117 upregulated and 55 downregulated. According to the GO analysis, the DEGs in the EG were significantly enriched regarding biological processes associated with extracellular matrix organization and osteoclast differentiation, molecular functions associated with protein binding and cell components associated with focal adhesion. KEGG showed that the PI3K-Akt signal and axon guidance pathways are involved in OTM.

Conclusions The gene expression profile of PDL tissue subjected to OF is significantly different from that of a CG without OTM. This is the first transcriptome study that provides whole transcriptome alteration in PDL tissue triggered by OF without using a split-mouth design.



Oral Muscle Pressure in Orthodontically Untreated and Treated Normal Occlusion.

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Objectives (1) To investigate the effect of age and diet consistency on maximum lips, tongue and cheek pressure of orthodontically treated and untreated subjects with normal dental occlusion, (2) to find out whether there is a muscle imbalance between anterior tongue and lip pressure in the same subjects at different ages and (3) to compare the 3D facial shape of treated and untreated individuals.

Methods Subjects with normal occlusion were prospectively grouped into orthodontically treated/untreated and in Children/Adolescents/Adults. Iowa Oral Performance Instrument was used to record the maximum muscle pressure. Two-way ANOVA and Tukey post-hoc test analyzed age-specific differences in muscle pressure. Two-way ANCOVA analyzed the effect of diet consistency on muscle pressure. Lips and tongue imbalance was analyzed using z-scores and 3D faces using a generalized Procrustes analysis.

Results 135 orthodontically untreated and 114 treated were included. Muscle pressure was found to increase with age in both groups, except for the tongue in treated subjects. No differences in the balance between lips and tongue muscle pressure were found, but a higher cheek pressure in untreated adults (p<0.05) was observed. 3D facial shapes showed subtle differences. Untreated subjects with soft diet consistency showed lower lip pressure (p<0.05).

Conclusions Oral muscle pressure of orthodontically treated patients without relapse does not differ from that of untreated patients with normal occlusion. This study provides normative lip, tongue, and cheek muscle pressure in subjects with normal occlusion, which can be used for diagnosis, treatment planning and stability.



0023 Root Resorption in Individuals With Self-Ligating and Conventional Bracket System <u>A. Üstdal Güney</u>, M. Güven Cukurova Universtiy, Adana, Turkey

Objectives The aim of this study was to compare the effects of self-ligating and conventional bracket system on root resorption and dentoalveolar structures in patients with skeletal Class I and moderate crowding.

Methods Total of 72 patients included in the study. The mean age of groups were 14.1 \pm 2 and 14.4 \pm 2 years respectively. No significant difference was found between the groups in terms of age and gender. To compare the effects of the two groups on root resorption and dentoalveolar structures, panoramic and lateral cephalometric radiographs of the patients taken at the beginning and final were used. While the changes in root-crown ratio were examined with the measurements made on the panoramic radiographs, dentoalveolar structures were examined with angular and linear measurements made on the lateral cephalometric film. **Results** The mean treatment duration of the self-ligating bracket group was 20.7 \pm 6.4 months, and the mean treatment duration of the conventional bracket group was 20.2 \pm 6.3 months, and there was no significant difference between the groups. When the final measurements of the groups were evaluated, IMPA showed a significant increase in the first group (p=0.012), but did not show a significant increase in the second group. The inclination of the upper incisors increased significantly in both groups. The root crownratios of the upper four incisors decreased in both groups, but there was no significant difference between the groups (p>005). **Conclusions** When the findings are evaluated, it can be said that the clinical efficiency and treatment efficiency of both bracket systems are similar.



Effect of Firing Time on the Biaxial Strength of 3D-Printed Zirconia

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Objectives This study should clarify if fast overnight firing is possible for thin-walled 3D-printed zirconia objects without a drastic reduction in material strength.

Methods Samples for biaxial strength testing (diameter 12.4 mm) were printed from a slurry containing zirconia particles (LithaCon 3Y 210). After cleaning the samples, half of the samples underwent an overnight firing (14.5h) whereas the other half was fabricated using a long firing program (51h). Each half of the specimens possessed a (nominal) sample thickness of 0.6 mm and 1.2 mm respectively. Thus, there were 4 subgroups (n=38/group) combining the two factors "specimen thickness" and "firing time".

Before biaxial strength testing according to ISO 6872, samples were only exhibited to sandblasting (Al_2O_3 , 0.1MPa). With the measured individual specimen dimensions and the maximum load during the fracture tests, biaxial strength values could be calculated for each specimen.

Mean values and standard deviations as well as the Weibull parameters (characteristic strength σ_0 , Weibull modulus m) were calculated for each test group. Kruskal-Wallis and pairwise Mann-Whitney U-tests served to detect significant differences between the test groups.

Results Biaxial strength was highest for the samples that underwent a long firing with no significant difference between 0.6 mm thick samples (σ =1057±211 MPa, σ_0 =1043MPa, m=5.8) or 1.2 mm thick samples (σ =1158±112 MPa, σ_0 =1166MPa, m=2.4). Overnight fired samples had a reduced strength for 0.6 mm thickness (σ =992±267 MPa, σ_0 =1089MPa, m=4.3) and 1.2 mm thickness (σ =805±527 MPa, σ_0 =899MPa, m=1.4) respectively. However, only the decrease in material strength for the 1.2 mm thick samples was significant (p<0.001).

Conclusions Thin 3D printed zirconia discs can be sintered overnight without impairing the material strength.



Optimized Speed-Sintering of Monolithic Zirconia Ceramics

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Objectives To evaluate the effect of different speed-sintering cooling rates on the phase composition, microstructure, optical and mechanical properties of monolithic zirconia.

Methods Speed-sintered ZirCAD LT_1200 (lvoclar) (total thermal cycle: 47 min; sintering time: 15 min; dwell temperature: 1480°C; oven-door opening and air-cooling: 1200°C) and Katana STML_800 (Kuraray Noritake) (90 min; 30 min; 1560°C; 800°C) were compared to speed-sintered ZirCAD LT_300 and Katana STML_300 with slowed cooling and oven-door opening at 300°C. Density was determined according to the Archimedes principle; chemical composition was determined using X-ray fluorescence (XRF); phase composition was characterized using X-ray diffraction (XRD); grain size was measured using scanning electron microscopy (SEM); translucency Parameter (TP) was measured with a spectrophotometer. Vickers hardness, indentation fracture toughness and biaxial strength (BS) were also assessed. Statistical analysis involved one-way ANOVA and post-hoc Tukey's HSD test (α =0.05). **Results** Regardless of slowed cooling, ZirCAD LT and Katana STML revealed similar density (\approx 6.05 g/cm³ and 6.03 g/cm³, respectively), chemical composition and grain size (\approx 0.2 µm and 1.4 µm, respectively). Both 3Y-TZP Katana ZirCAD LT_800/300 zirconia were characterized with a lower cubic-phase content (\approx 4.8wt%), which resulted in a lower Y₂O₃ amount (\approx 3mol%) in the remaining tetragonal ZrO₂ phases, as compared to the two 5Y-PSZ Katana STML_1200/300 zirconia (\approx 16.4wt% and \approx 5.7mol% Y₂O₃, respectively). TP of both ZirCAD LT and Katana STML (TP \approx 23 and 27, respectively) was not affected by slowed cooling. While the optimum hardness of 3Y-TZP and 5Y-PSZ was reached, slowed-cooling significantly improved their fracture toughness. On the other hand, slowed-cooling significantly diminished flexural strength (549.5±135.8 MPa) and mechanical reliability (m=4.4) of Katana STML_300, while it did not have any effect on ZirCAD LT zirconia.

Conclusions Fast cooling during speed-sintering can negatively influence strength and mechanical reliability of 5Y-PSZ zirconia ceramics. Further studies should focus on fine-tuning the speed-sintering protocol.



Flexural Strength of Multilayer Zirconia Depending on Sintering and Aging

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Objectives The aim was to evaluate the biaxial flexural strength of composition-gradient multilayer zirconia depending on sintering program and aging by thermocycling.

Methods In total, 96 specimens divided into 12 groups (n=8) depending on material, layer content, sintering program, and aging were produced. Sixty-four specimens from the composition-gradient KATANA^M Zirconia YML were milled from two different positions in the disc, including the layers Enamel-Body 1 (E) and Body 2-Body 3 (B), and 32 specimens from the color-gradient KATANA^M Zirconia UTML, as external control groups (C). The specimens were designed according to ISO:6872 with a diameter of 14 mm and thickness of 1.2 mm. Half of the groups were speed sintered and half conventionally sintered. The specimens were polished in pre-sintered and fully sintered stage. Half of the groups of each sintering group were thermocycled for 10,000 cycles in distilled water between two baths with temperatures of 5±2°C and 55±5°C. The biaxial flexural strength was measured with the piston-on-three-ball method and the results analyzed with three-way ANOVA, the factors layers/material, sintering program and aging and a significance level of $\alpha = 0.05$.

Results There was a statistically significant difference between all the layers/material groups; the B groups showing significantly higher flexural strength than the E groups followed by the external control C groups. Thermocycling resulted in significantly higher flexural strength compared to no aging. There were no statistically significant interactions between the three factors.

Conclusions The biaxial flexural strength of multilayer zirconia is more dependent on material composition, position in the disc, and aging than sintering program. Aging by thermocycling (10,000 cycles) increases the biaxial flexural strength. Conventional and speed sintering result in similar biaxial flexural strength.



Effect of Sintering and Cement Color on Translucency of Zirconia

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Objectives The aim of this study is to evaluate the effect of different sintering procedures and the color of the adhesive resin cement on the translucency parameter (TP) of monolithic zirconium dioxide ceramics.

Methods 36 specimens in dimensions of 10×10×1 mm were prepared from monolithic zirconium dioxide ceramic blocks. The specimens were divided into 3 groups according to the sintering procedure applied (n=12); Group I: Conventional sintering, Group II: Rapid sintering, Group III: Superfast sintering. 12 pieces of yellow and 12 pieces of transparent adhesive resin cement specimens were prepared in 0.2 mm thickness. Color measurements of the specimens were made on black and white backgrounds by a spectrophotometer. First color measurements were made on monolithic zirconium dioxide ceramic specimens. Then color mesuments were performed by matching ceramic specimens in each sintering group with yellow or transparent resin cement. Optical coupling of the resin cement and ceramic specimens was achieved by applying a refractive index solution. The Delta TP value of each specimen was calculated from the obtained data. Then statistical analyzes were performed.

Results The lowest and the highest TP values were obtained from rapid sintering/ transparent resin cement group and rapid sintering/yellow resin cement group, respectively. There was no significant difference between the groups (p>0.05). **Conclusions** According to results of this study, combinations of the the sintering procedures applied and the color of the resin cement used did not effect the translucency parameter of monolithic zirconium dioxide ceramic restorations.



Does Speed Sintering of Hight Translucency Zirconia Impact it's Color ?

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Objectives The main objective was to assess the colour difference between traditionally sintered and high-speed sintered monolayer zirconia at different thicknesses with different underlying tooth colours.

Methods 14 discs of 3Y-TZP (yttria-stabilized tetragonal zirconia polycrystal) in HT12 (hight translucency) shade (Katana, Kuraray) where milled and polished at 0.6, 0.7, 0.8, 0.9, 1, 1.5 and 2 mm thickness. The discs were sintered either with a regular program (7 hours) or with a high-speed sintering program (21 minutes). Nine discs of different shades were fabricated at 2mm thickness as replica of the underlying teeth (UT) using standardized natural die resins (Natural Die, Ivoclar-Vivadent). Each zirconia disc was placed over the UT, using an interposed neutral try-in paste (Variolink Esthetic, Ivoclar) to simulate the cement interface. CIE coordinates were measured 5 times for all combinations using a spectrophotometer (EasyShadeV,VITA).

The difference in color (ΔE_{00}) was assessed for the two types of sintering, with and without UT. A two-way ANOVA test (α =0.05) was performed to evaluate the impact of sintering and ceramic thickness, followed by multiple pairwise comparisons.

Results For both ceramics, without UT, lightness and hue decreased with thickness, while chroma increased. High-speed sintered 3Y-TZP had higher hue (p<0.05), yet lower chroma (p<0.05), for most thicknesses, compared to traditionally sintered 3Y-TZP.

 ΔE_{00} between the two types of ceramics, without UT, was acceptable (ΔE_{00} <2.7, perceptibility threshold, PT) for most thicknesses. For discs of 0.7 and 0.8 mm, the color difference was imperceptible (ΔE_{00} <1, perceptibility threshold, PT).

When combined to the underlying teeth, ΔE_{00} between traditionally sintered 3Y-TZP and high-speed sintered 3Y-TZP, was acceptable for most thicknesses, for all UT.

Conclusions Speed sintered high translucency zirconia might replace the standard sintered zirconia without a significant esthetic compromise. The clinician should carefully select the biomaterial thickness, according to the tooth color.



Effect of Wall-Thickness on Accuracy of 3D-Printed Zirconia Artificial 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 shape accuracy.

Methods Data sets for the different artificial teeth resembling a mandibular right first molar were created (Geomagic design X, 3D systems) with planar, horizontally oriented measurement points at the mesiobuccal (MB), distobuccal (DB), mesiolingual (ML), and distolingual (DL) cusp as well as parallel areas on the buccal and lingual basal surface (BB and LB). Pairs of parallel and vertically oriented surfaces were added for the buccolingual (B-L) and the mesiodistal (M-D) direction. Reference distances were 7.0 mm for MB-BB and DB-BB, 4.5 mm for ML-LB and DL-LB, 10.9 mm for B-L, and 9.8 mm for M-D. For all artificial teeth with wall thicknesses of 0.30 mm, 0.50 mm, 0.75 mm, and 1.00 mm, the outer geometry was identical. Then, 20 zirconia teeth were fabricated using a 3D printer (CeraFab 7500 Dental, Lithoz) for each group, and sintered before support removal. First, distance measurements were carried out with a micrometer screw. Second, angular deviations between the measurement points were analyzed based on 3D scans. Possible effects were investigated by use of Kruskal-Wallis test and the Steel-Dwass method.

Results Sufficient shape accuracy was given for artificial teeth with wall thicknesses of 0.5 mm or greater. Largest distance deviations were observed for 0.3 mm wall thickness, in particular DB-BB showed median deviation above 56.2 μ m, which was significantly larger than those found for the other test groups ranging from 7.4 μ m to 9.5 μ m (p<0.05). In most cases, angular deviations were also largest for teeth with 0.3 mm wall thickness (11.6°) and remained below 5.0° for the other test groups. **Conclusions** Sufficient accuracy was given for artificial teeth with at least 0.5 mm wall thickness.





Effect of Surface Pretreatments on the Bond Strength to Zirconia

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Objectives Yttria stabilized tetragonal zirconia polycrystalline is preferred for fixed prostheses due to its high durability. But there is no consensus about a standardized adhesive cementation protocol for bonding zirconia restorations that provide unequivocal and reliable results. The aim of this study was to evaluate the shear bond strength of resin cement to zirconia treated with three different surface treatments and two bonding agents.

Methods A total of one hundred and sixty zirconia specimens were fabricated from pre-sintered discs (Procera, Nobel Biocare AB) and randomly divided in four groups: Each groups was treated either with a tribochemical silica coating (TSC) (30 µm particle size), hot etching technique using KHF₂ crystal slurry for 10 min at a temperature of 280 °C or a solution of 0.5 M NaOH solution with 13.5 pH. No surface treatment groups served as control. After surface treatment an MDP-containing, or a MDP-silane-containing primer was applied to the surface and adhesive resin cement (Panavia F 2.0) was applied. Half of the specimens were stored in deionized water (37°C) for 24 h before shear bond strength (SBS) testing while the other half were thermocycled (5-55°C/5000). SBS test was performed for all specimens. Data were subjected to three-way analysis of variance. Statistical significance was preset at p<0.05. **Results** TSC pretreatment combined with MDP-silane primer group showed significantly higher SBS followed by KHF₂ etching groups (p<0.05). Thermocycling resulted in significant reduction in bond strength in all groups (p<0.05) MDP and silane-containing primer showed higher results than only MDP-containing primer for all surface treatments.

Conclusions Tribochemical silica coating of the zirconia surface combined with a MDP and silane-containing primer improved bond strength immediately and after artificial ageing.



Direct Pulp Capping Clinical Results After Er:YAG Laser Preparation

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Objectives To make an objective assessment by using laser-doppler flowmetry of the clinical outcomes after direct pulp capping treatment and preparation done with dental Er: YAG laser.

Methods The clinical study was conducted on 31 teeth. Cases were selected according to the criteria for carrying out direct vital pulp treatment. The preparation was carried out with the aid of rotary instruments-14 teeth or with an Er: YAG dental laser (LiteTouch, Syneron, Israel)-17 teeth. Biodentine (Septodont, France) was prepared and applied according to the manufacturer's recommendations. Follow up done on day 14, 30, 90, 180. Six months after the direct pulp capping, a laser-doppler flowmetry measurement of pulp blood perfusion was made of all treated teeth. Data were statistically analyzed.

Results The mean values of blood pulp perfusion measured at the teeth in the sixth month after the vital direct pulp capping treatment were 22.39 ± 2.83 PU and 21.42 ± 2.68 PU for the control group, respectively (p>0.05). For the group prepared with rotary instruments the mean values were 19.16 ± 2.63 PU and for the group with Er: YAG dental laser preparation they were 26.30 ± 2.66 PU. The choice of preparation method was not associated with the measured average laser-doppler flowmetry values in direct vital pulp capping treatment (p>0.05).

Conclusions The results obtained from the clinical research conducted by us give us the reason to claim that the application of high-tech devices such as lasers for the preparation of hard dental tissue and follow up, along with new pulp capping biomaterials are reliable for application in vital pulp capping treatment of the dental pulp and the success thereof does not yield to the classic.



Coronal vs Deep Pulpotomy for Irreversible Pulpitis- a Randomized Clinical Trial

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Objectives To assess the outcome of coronal and deep pulpotomy performed in mature permanent teeth with extremely deep carious lesions and symptomatic irreversible pulpitis

Methods The study was conducted at the tertiary care center on 60 mandibular molar teeth with extremely deep carious lesions and irreversible pulpitis. All the procedures were performed under local anesthesia and rubber dam isolation. The caries were completely removed and access to pulp chamber was made. The teeth were randomly assigned to two study groups. Group I: The entire coronal pulp was removed; Group II: the pulp was removed 2-3mm deep inside the root canal orifices. Bleeding was arrested with a 2.5% NaOCI application. The residual pulp was capped with MTA and teeth were restored with composite resin during the same visit. Teeth were followed at 6 & 12-month intervals. Outcome assessment was done at a one-year follow-up using clinical and radiographic criteria.

Results A total of 51 teeth were available for analysis at 12-month recall. The success rate in the deep pulpotomy group was 92% (23/25) and coronal pulpotomy was 92.3% (24/26). There was no statistically significant difference between the two groups. **Conclusions** The coronal pulpotomy has high success in teeth with extremely deep carious lesions where bleeding can be arrested within 10 minutes after coronal pulp amputation.



Can We Consider Vital Pulp Therapy Without Pulp Volume Loss?

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Objectives Vital pulp therapy implies pulp dressing with a biocompatible material which leads to a protective tertiary dentin secretion. Currently, this dentin is secreted at the expense of the pulp volume. However, maintaining the pulp volume is pivotal to avoid additional tissue loss in case of secondary caries. The objective of this work was to develop a collagen-based biomaterial with a controlled release of Complement bioactive C5a to induce both regenerating the missing pulp and a site-specific stem cell recruitment.

Methods C5a was encapsulated in Poly Lactic-co-Glycolic Acid microspheres using the water in oil emulsion method. The microspheres were then loaded into in the upper phase of bi-phasic collagen (1,5%) sponges. C5a release from the sponges was quantified by ELISA for 30 days. The toxicity was evaluated on pulp cells using the MTT test and on the dental pulp using the entire tooth culture model. The effect of C5a released from the biomaterial on dental pulp stem cell (DPSC) migration was investigated using Boyden Chambers. A specifically designed 3D printed device was used to investigate the sponge colonization by the pulp cells. **Results** After a burst at day 1, C5a was continuously released until 30 days. The microspheres-containing collagen sponges showed no toxicity to pulp cells and the entire tooth culture histology showed a healthy pulp in contact with the collagen sponges. C5a release form the collagen sponges migrating towards the C5a-containing phase.

Conclusions This new material allowed pulp cell colonization and guiding DPSC recruitment following a C5a release which has been previously shown to induce DPSC differentiation. These results show that the new material holds promise of a potential use both for dentine and pulp regeneration without pulp volume loss.



Characterization of Inflammatory Cell Infiltrate in Human Dental Pulp

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Objectives This study was undertaken to evaluate the characteristics and densities of CD4 T helper lymphocytes, CD45RO memory T lymphocytes, CD8 T suppressor lymphocytes, CD20 B lymphocytes and CD68 macrophages in the dental pulp in healthy and carious human teeth.

Methods In this study we have examined 80 pulps of human teeth under different clinical conditions: healthy teeth, shallow cavities, deep cavities and with a clinical diagnosis of irreversible pulpitis. Teeth were extracted for various therapeutic reasons (mostly for orthodontic reasons), and immediately cut longitudinally; pulp tissue was extirpated and fixed in 10% buffered 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: CD4, CD45RO, CD8, CD20 and CD68. Wilcoxon and Mann-Whitney tests were used for statistical analysis. **Results** T lymphocytes were observed in normal pulpal tissues with CD8 lymphocytes being predominant. Pulpal tissue in shallow cavities shows a focal accumulation of mononuclear inflammatory infiltrate, and more than 90% of the lymphocyte population were T lymphocytes with a CD4/CD8 ratio of 0.84. Higher numbers of CD45RO, CD4, CD8; and B lymphocytes were observed in the pulps from deep cavities. A ratio of 1.22 of CD4/CD8 lymphocytes was observed in the deep cavities. A B/T lymphocyte ratio of 1.81 suggested this ratio might be used as an index in the immunohistological diagnosis of irreversible pulpal pathosis. **Conclusions** Dental caries revealed distinct quantitative and qualitative differences in inflammatory cell infiltration. Results obtained in this study suggest about the regulatory functions of helper (CD4) and suppressor (CD8) T lymphocytes. The interaction of T and B

lymphocytes and their products in the pathogenesis of pulpal disease is present.



The Comparative Evaluation of an Experimental Dentin-Chip Added Pulp-Capping Material

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Objectives To compare the biocompatibility, inflammatory response and antimicrobial activity of an experimental material with different pulp-capping materials.

Methods Five pulp-capping materials (ProRoot MTA/Dentsply, Biodentine/Septodont, Dycal/Dentsply, TheraCal LC/Bisco, calcium hydroxide/Saver-Pyrax) and an experimental material (calcium hydroxide+bovine dentin chip) were examined. The effects on cell viability were investigated via WST-1 assay in L929 cells. The inflammatory response was determined by the change in monocyte chemoattractant protein 1 (MCP-1/CCL2) and macrophage inflammatory protein-1 α (MIP-1 α /CCL3) levels. The antimicrobial activity against oral-microorganisms (*Streptococcus mutans, Lactobacillus acidophilus* and *Enterococcus faecalis*) was examined by agar-diffusion.

Results The lowest cell viability was detected in ProRoot MTA and Dycal-exposed cells at 24 and 48 hours (p<0.05). The cell viability following the calcium hydroxide+bovine dentin chip was similar with Biodentine and control at 24 hours. The significant decrease was observed for cell viability of calcium hydroxide+bovine dentin chip group at 48 hours, but it was higher than ProRoot MTA and Dycal (p<0.05). The highest MCP-1 value was detected in ProRoot MTA and TheraCal LC-exposed cells at 24 and 48 hours compared to the control (p<0.05). The MIP-1 α values in experimental groups were not different from the control. The MIP-1 α level of calcium hydroxide+bovine dentin chip group at 48 hours (p<0.05). A limited inhibition zone against *Streptococcus mutans* was detected only in Dycal group.

Conclusions The experimentally developed calcium hydroxide+bovine dentin chip combination showed competing properties and additional advantages compared to the existing pulp-capping materials. The calcium hydroxide+bovine dentin chip seems to have high potential to be considered as a biocompatible pulp-capping material.



Cellular and Molecular Pulpal Response to LPS Multi-Injection Induced Inflammation

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Objectives In response to pathogens a dental pulp inflammation called pulpitis occurred, more often clinically diagnosed as reversible or irreversible. But its applicability and the limitation to identify parts of pulp not affected by the inflammation process of this clinical diagnosis is of a great interest in identifying potential biomarkers, as diagnostic tools of pulpal disease. In order to more preserve healthy dental pulp tissue in vital pulp therapy process. In this rat model of LPS multi-injection induced chronic inflammation, we tried to identify a molecular limited point that does not allow the preservation of residual dental pulp vitality.

Methods In this model, rat molar inflammation is induced by mechanically exposing the pulp and bringing it into contact one, two or 3 times with LPS from Escherichia coli or PBS as a positive control (APAFiS no.19-042)(n=6). Dental pulps were sealed with an obturation cement. 24h after injection, teeth were removed for QPCR, histological and immunohistological analysis.

Results The histological analysis allowed us to describe tissue changes during chronic inflammation. The inflammation, induced by 3 contacts of LPS, showed a higher expression of MMP9 gene expression compared to the healthy pulp, while DSPP gene expression was downregulated. By immune histochemistry, IL-6 expression was more highly diffused in the residual pulp after 3 contacts of LPS compared with only one. The presence of CD68-positive cells was also higher with 3 LPS contacts.

Conclusions This model makes it possible to describe dental pulp tissue changes during LPS repeated chronic inflammation. It also allows us to link molecular and cellular events of inflammation to the repair capacities of the pulp dentin complex. Ratio expression of MMP9/DSPP could be a good couple of biomarkers that can be used to identify the possibility to realize or not a vital pulp therapy.



A Novel Glycosaminoglycan Mimetic for Chemokine Hydrogel Functionalization

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Objectives Humans, unlike salamanders, lack the ability to regenerate infected tissues, with regenerative capacity decreasing postbirth alongside immune system development. However, tissue repair, regeneration, and immune system-guiding cells can be modulated. This study assesses the effects of the chemokine-binding and antimicrobial polymer, chlorite-oxidized oxyamylose (COAM), on chemokine delivery for dental pulp repair and regeneration.

Methods Chemokine (SDF-1/CXCL12) binding to COAM was analyzed using gel filtration chromatography. COAM's glycosaminoglycan mimetic properties were evaluated via surface plasmon resonance (SPR). Chemokine release from fibrin hydrogels was assessed using enzyme-linked immunosorbent assay (ELISA). The immunophenotype of dental pulp stromal cells (hDPSCs) encapsulated in 3D fibrin hydrogels was examined with flow cytometry analysis (FACS). CXCR4⁺ populations within hDPSCs were investigated using Western blot and FACS. The influence of encapsulation and the presence of COAM and SDF-1/CXCL12 on hDPSC proliferation was evaluated by FACS. An ex-vivo tooth model was employed to study dental pulp reactions to functionalized hydrogels.

Results Gel chromatography and SPR revealed that COAM forms a strong binding complex with SDF-1/CXCL12, exhibiting a higher affinity than heparin sulfate. The formation of this binding complex influenced SDF-1/CXCL12 release patterns from fibrin hydrogels. hDPSCs maintained their phenotype after 14 days of encapsulation, and COAM and SDF-1/CXCL12 presence did not impact encapsulated hDPSC proliferation patterns.

Conclusions COAM formed a binding complex with SDF-1/CXCL12, delaying release from fibrin hydrogels and demonstrating greater efficiency than heparin sulfate. COAM may be a promising strategy for hydrogel functionalization with chemokines for immunomodulated dental pulp regeneration.



Can Neutrophils Control the Evolution of Pulpitis?

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Objectives The challenge of improving caries management is based in part on a better understanding of the pulp-dentin complex biology. Among all the actors involved during pulpitis, neutrophils could play a decisive role since they are a pillar of antibacterial immunity but also a major factor in tissue destruction. Both chemokines CXCL1 and CXCL2 have been described as crucial in neutrophils recruitment by binding to the CXCR2 receptor. In this work, we aimed to develop a new *in vivo* model of pulpitis to better mimic different stages of pulp inflammation, and then to characterize spatial and temporal dimensions of the expression of CXCL1 and CXCL2.

Methods The model used is a new model of progressive and controlled pulpitis in rat (APAFiS no.19-042). Under operative microscope, the inflammation is induced by mechanically exposing the pulp and bringing it into contact with LPS from *Escherichia coli* or PBS as a positive control during 30min, 24h, 48h, 72h, 96h or 120h (n=4 per condition). Teeth are then removed for hematoxylin and eosin staining and immunohistological analysis of CXCL1 and CXCL2 expression.

Results The relevance of the model is validated histologically by the size of the cell degeneration area, which increases with the duration of the inflammatory stimulus, reaching complete necrosis at 120h. CXCL1 and CXCL2 show different expression profiles: CXCL2 is found from 24h in perivascular area and odontoblastic palisade while CXCL1 expression is mostly localized to the area of cell degeneration from 24h.

Conclusions This model makes it possible to describe tissue changes during inflammation and the results suggest that CXCL1 and CXCL2 could play distinct roles in neutrophils recruitment and in the balance of inflammation. Thereafter it would be interesting to relate those molecular and cellular events with repair capacities of the pulp dentin complex.



Evaluation of Active Magnesium-Containing-Toothpaste on Dental Plaque in Children

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Objectives Dental plaque is an archetypal biofilm of a complex microbial community found in the oral cavity. The aim of this randomized, double-blind and crossover study was to compare the plaque reduction efficacy of a newly developed toothpaste to a marketed active magnesium toothpaste with single-use brushing in children.

Methods Forty healthy children aged 9–12-years-old were included in the study. The participants were asked not to eat for 4 hours and not to brush for 24 hours in advance of the test. In the first stage, the preliminary plaque in the children was recorded by the first researcher using plaque dye (Tri Plaque ID Gel, GC, Japan). After plaque disclosing the researcher brushed children's teeth with ROCS active magnesium toothpaste (DRC Group, Switzerland) for 1 minute with a standard toothbrush then the plaque staining was applied again. This procedure was repeated with Flouride toothpaste (Colgate Total, Palmolive, USA) according to crossover design after a washout period of 2 weeks. Dental plaque on the upper anterior incisors was photographed intra-orally before and after brushing under standardized conditions. These photographs were scored by using Turesky-Modified Quinley-Hein-Plaque-Index (TMQHPI) by two researchers (NKD, EAS) blinded to the groups. and inter-examiner reliability was assessed with Cohen's Kappa test. Data analysis was performed using the Mann-Whitney-U and Wilcoxon-Test.

Results The inter-examiner Kappa value was 0.85 (almost perfect). This randomized, double-blind, single-brushing, crossover study demonstrated both kinds of toothpaste showed statistically significant differences in TMQHPI scores immediately after single brushing when compared to baseline(p<0.001). There was a significant difference in TMQHPI plaque reductions between the toothpastes evaluated. Active magnesium toothpaste resulted in consistently and significantly(p<0.001) lower TMQHPI scores than Fluoride toothpaste.

Conclusions Active magnesium toothpaste was found to be effective in reducing plaque when compared to Fluoride toothpaste with single-use brushing in children aged 9-12 years.



Knowledge and Attitudes About Oral Health Among North Macedonian Pregnant Women

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Objectives This cross sectional study aimed to evaluate attitudes and knowledge regarding oral health and infant oral health among pregnant women.

Methods The study involved 130 pregnant women in the Republic of North Macedonia who completed an anonymous online questionnaire (Google forms) from January to June 2022. The questionnaire contains 27 questions and was divided into three parts. The results were analyzed with descriptive statistics, chi-square test and linear regression analyses.

Results The women are most informed about oral health in pregnancy from their dentists (30.8 %), (20.8%) from their gynecologist, while 19.2% of pregnant women receive information through television or the Internet. The chi-square test found that there was a difference in attitude regarding the age at which they should stop breastfeeding between respondents who had their first pregnancy and those who already had children (Chi square value =13.216, p= 0.004, p < 0.05). Only 20.5 % of respondents are aware that breastfeeding can cause tooth decay.

Linear regression analysis showed that pregnant women's knowledge about the association between pregnancy and periodontal diseases is statistically significantly positively associated with their gynecologist's advice to visit a dentist (β =1.282, P≤0.001). In addition, pregnant women's knowledge about children's oral health is statistically significantly negatively associated with women already having children (β = -0.693, P=0.043).

Conclusions Pregnant women in the Republic of North Macedonia do not have sufficient knowledge, and they are neither aware of the importance of oral health during pregnancy nor infant oral health.



Experience of Dental Health Care in Patients With Eating Disorders

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Objectives There is no evident dental treatment protocol for patients with eating disorders. Dental treatment is therefore usually postponed until patients are medically rehabilitated. This may lead to extensive dental damage, with great suffering and costs for both the patient and the society. The objective of this study is to assess how patients with eating disorder experience their oral health and dental treatment.

Methods

DATA COLLECTION

10 informants, all females, aged 23-51 years (M=37.5) referred to Eastman Institute, a dental specialist clinic in Stockholm, were included in the study between 20220131-20230118. They were selected with the method of purposeful sampling. All were diagnosed with an eating disorder and in need of oral rehabilitation.

METHODS

A psychologist conducted individual interviews, recorded on tape, using a topic guide consisting of open ended questions related to the perception of oral health related to their eating disorder and experiences and expectations of dental treatment. The interviews were transcribed and analysed using thematic analysis according to Braun and Clarke.

Results In dental health care the respondents were met with lack of knowledge and limited experience of treating patients with eating disorders and the oral consequences of the condition. The dental damage led to inhibition in social contexts, that negatively affected the quality of life. Patients expressed anxiety for future deterioration of the oral health. A prominent theme was feelings of guilt and shame for having caused the dental damage themselves. Their expectation of the oral rehabilitation was to regain a normal healthy smile, not being reminded of the eating disorder every time they inevitably looked at their teeth.

Conclusions Interdisciplinary approaches to integrate oral health into the medical treatment of patients with eating disorders could have a positive outcome on the clinical efficacy of the treatment.



Dental erosions, due to self-starving, binge-eating and self-induced vomiting caused by an eating disorder



Sex	Age	Diagnosis	Duration of eating disorder (years)	Secondary diagnoses	Occupation
F	49	Bulimia Nervosa	25	Sober alcoholic	Doctor
F	49	Bulimia Nervosa	25	ADHD, Autism	Sickness benefit
F	22	Bulimia Nervosa	6	200	Broker
F	21	Bulimia Nervosa	4	-	Law student
F	46	Bulimia Nervosa	20	Depression	Self-employed in health food
F	32	Bulimia Nervosa	20	ADHD, bipolar disease, Autism	Student
F	23	Anorexia Nervosa	6	Rumination, Reflux	Dance student
F	50	Bulimia Nervosa	15	-	Teacher
F	24	Bulimia Nervosa	10	Bipolar disease, PTSD, Autism	Student
F	51	Bulimia Nervosa	10		Self-employed in fashion

Table 1. Patients recruited between 20220131-20230118



The Prevalence, Dental Complications and Effects of Infant Oral Mutilation

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Objectives The aim of this scoping review on infant oral mutilation (IOM) was to study the prevalence, dental complications, and immediate and long-term effects of this practice, in addition to providing a systematic overview on existing knowledge and analysis of identified knowledge gaps on IOM.

Methods Five electronic bibliographic databases (OVID/Medline, Embase.com, Clarivate Analytics/Web of Science Core Collection, SCOPUS and Global Index Medicus) were searched for relevant studies. Data was entered in a bespoke data-charting form. The risk of bias was assessed by two independent reviewers.

Results A total of 478 studies were identified from the search, out of which 42 studies were included in this review. Of the 42 studies, 19 were prevalence studies published between 1969 and 2019, who were additionally assessed for the risk of bias. We found the prevalence of IOM in Uganda was 2% - 30%, Ethiopia 12% - 86%, Sudan 10%, Kenya 61% - 87% and Tanzania 0% - 24%. Based on the prevalence studies we observed that the most common factor motivating IOM was diarrhoea. The immediate effects of IOM were found to be infection, bleeding, anaemia, pneumonia, septicaemia, osteomyelitis, meningitis, tetanus and blood-borne diseases, with some infants dying from these effects. Missing canines, enamel hypoplasia, malformations, abnormal eruption of permanent teeth, occlusal discrepancies, midline shift, chronic periapical infections, rotations, canine transposition or odontomas were the long-term effects found in relation to IOM.

Conclusions Infant oral mutilation (IOM) is a global, harmful traditional practice with serious immediate and long-term consequences. It is important to create professional and public awareness of the procedure in low and high-income countries. Furthermore, there is a need for more research on the prevalence of IOM in Africa and other areas of the world to determine the long-term consequences of the practice.



The Use of Dental Anxiety Management Techniques During One-Session Treatment

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Objectives The study aimed to examine the dentists' utilization of dental anxiety management techniques in the context of an intervention study.

Methods The one-session treatment for dentally anxious adults was conducted by two clinically experienced dentists (> five years of experience) who were not formally trained in behavioral management techniques. Diagnostic interviews conducted by the researcher before treatments included information on the severity of the patient's dental anxiety, previous dental attendance behavior, the experience of the previous dental visit, possible negative experiences of dental care, and wishes for treatment.

The data consisted of five video-recorded treatment sessions for five dentally anxious patients. Four of the voluntary participants scored 19 points or above and one scored 13 points in the Modified Dental Anxiety scale. Theory-driven qualitative content analysis was used to identify and classify techniques applied by dentists according to Milgrom's classification, consisting of specific strategies to enhance trust and control, in addition to behavioral, cognitive, practical, and pharmacological strategies.

Results Altogether, five categories of techniques were identified under two main themes: enhancing trust and control, and psychological management. Typically, the techniques fell into enhancing trust and control, and they included the categories of 'building a trustful relationship', 'informational control', and 'behavioral control'. Different techniques were frequently applied throughout the sessions according to patient-specific needs, oral health, and dental treatment situations. In addition, we identified psychological management techniques that were classified into the categories of 'behavioral strategies: relaxing the body' and 'cognitive strategies: relaxing the mind'. These techniques were regularly implemented in specific situations that aroused strong anxiety and changes in breathing or in muscular tension. The techniques were often used simultaneously.

Conclusions Techniques utilized by skillful dentists included a variety of specific techniques manifested in a versatile and tailored manner. The findings provide dentists with useful information on encountering anxious patients in their everyday work.



Oral Health Awareness of Highly Educated New Mothers in Italy

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Objectives The foundation for lifelong health behavior is established during the child's first 1000 days from conception. There are many studies describing the positive influence of behavioural parental counselling interventions improving oral health in mothers and children. This cross-sectional survey aimed to interview new mothers with high levels of schooling to assess knowledge and habits in relation to their own and their child's oral health in Italy.

Methods An on-line questionnaire was spread in perinatal courses and private gynaecologic clinics. Mothers age \geq 18 years, with offspring aged between 0 and 36 months, with a high school diploma or higher educational degree were included. A survey was conducted merging two standardized questionnaires (27 items) on oral health during pregnancy and baby's oral health, investigating socio-demographical factors, knowledge and attitudes towards their and their baby's oral health. The sample size calculated at $_{95}$ Cl was 378. Descriptive statistics were performed.

Results A total of 1202 women met the inclusion criteria, 60.48% were over 35 years old, 73,96% had a post graduate degree and 87.85% had stable job. More than one child was stated by 24.54% and the majority had babies aged 0-12 moths (63.98%). During pregnancy, 29.53% had problems with teeth and/or gums and only 39.52% went to dental offices. Overall, 45.17% was not aware of a possible correlation between oral health and pregnancy, and 64.23% did not received indication about their oral health or on the future health of the baby's mouth. Less than 25% was aware of the increased caries risk due to prolonged or nocturnal breastfeeding and only 35,36% known about cariogenic bacteria transmission through salivary contacts.

Conclusions The study confirmed that knowledge and attitudes towards mother's and baby's oral health are poor, and more efforts should be taken to improve by health professionals dental education among future mothers.



Management of Diabetes and its Oral Manifestations With Nanotechnology-Based Treatment.

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Objectives Devastating oral complications of Type 2 diabetic mellitus (T2DM) such as delayed wound healing, caries, neurosensory disorders, xerostomia, and periodontitis are preventable with optimal glycemic control. The main drawback of the FDA-approved glucagon like peptide 1 analogue Exendin 4 (Ex4) is its short half-life, thus requiring frequent administrations. Here we aimed to overcome this limitation and prolong Ex4 half-life, by developing a sustained release drug delivery system (DDS) based on liposomes. **Methods** Liposomes loaded with Ex4 (Lipo-Ex4) were prepared and characterized for the drug level of encapsulation and kinetics by Reversed-phase chromatography. For bioactivity, the glucose clearance of mice treated with free-Ex4 or Lipo-Ex4 was evaluated with intra peritoneal glucose tolerance test (IPGTT). The original model, in which treatments were administrated daily, was modified to administration every 2-3 days, to allow clearance of the free drug.

Mice body weight (BW) was monitored to examine toxicity.

To determine whether our formulation is effective, we performed the modified IPGTT in diabetic (DB/DB) mice.

Results In-vitro. Lipo-Ex4 exhibited high encapsulation (75%) and sustained release (2 weeks vs. 1d).

In-vivo, the released Ex4 was biologically active.

Lipo-Ex4 exhibited prolonged half-life and plasma presence, compared to free Ex-4, ((8h vs. 2.5h and 6h vs. 24h, respectively). The modified IPGTT showed that Lipo-Ex4 improved glucose clearance compared to free-Ex4 (23% reduction in blood glucose levels vs. 0%, respectively). All mice gained weight, but mice treated with Lipo-Ex4 gained less weight compared to free-Ex4. Ex4-LMVV improved fasting glucose in diabetic mice compared to free-Ex4 (198 vs. 388 mg/dL, respectively).

Conclusions We developed a novel sustained release DDS by encapsulating Ex-4 in liposomes, which prolonged the Ex-4 half-life and was able to treat T2DM in mice. Our approach will reduce treatment frequency, improve patients' compliance and safety. Optimal

glycemic control will also improve oral health.



Impact of Heat-not-Burn Tobacco on Periodontal Health: a Cohort Study

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Objectives : Smoking is associated with a variety of oral conditions and is considered one of the main risk factors for periodontal disease. Cigarette smoke affects periodontal health through different mechanisms, such as impairment of the immune response and the periodontal tissue's ability to heal in the phases following disease activity.

While clinicians' comprehension of smoking's role in periodontitis has consistently increased across the years, society is witnessing a rapid evolution of smoking habits: the risks associated with alternative tobacco products, like tobacco heaters, is not easy to quantify. Therefore, an observational study was conducted at the University Hospital of Messina to assess the impact of tobacco heating products on periodontal health in patients with no diagnosis of periodontitis.

Methods A cohort of 200 patients was analyzed; patients were aged between 18 and 40 years, in good general health conditions, and declared a smoking habit history. Each patient underwent a routine dental scaling and polishing two months before inclusion. Four subgroups were defined (n=40 patients each): cigarette smokers, ex-smokers, ex-smokers that switched to heated tobacco, and dual smokers. A fifth group of non-smokers acted as control.

Periodontal charting was conducted on each patient to assess the periodontal status.

Results Data analysis showed a statistically significant difference between patients with a smoking habit (cigarette smokers, exsmokers that switched to heated tobacco, dual smokers) and control group/ex-smokers for what concerns probing depth, bleeding on probing, and plaque score. Moreover, a positive correlation was found between pack-year score and periodontal indexes.

Conclusions Results from this study support the hypothesis that heat-not-burn tobacco consumption negatively affects periodontal health and should be considered a risk factor for periodontal health similar to cigarette smoking. Further investigations should be conducted in order to better comprehend its role in periodontal patients.



Local Treatment of Liposomal Resolvin-D1: Inhibition of Periodontitis

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Objectives Periodontitis is an infectious inflammatory disease of the supporting structures of the teeth. Resolvin-D1 (RvD1) is a specialized pro-resolving lipid mediator that enhances active resolution of inflammation and osteoclastogenesis inhibition. However, RvD1 short half life and reduced in vivo retention limit its therapeutic potential. In this study, we aimed to engineer a RvD1 loaded liposomal formulation (lipo-RvD1) that targets and resolves the periodontitis associated inflammation and investigate its mechanism of action (MOA).

Methods In vitro: Large multi-vesicular liposomes encapsulating RvD1 were prepared and characterized for RvD1 encapsulation efficiency (EE), release, and stability by ELISA.

Fluorescent-labeled liposomes were used to determine time-dependent biodistribution using IVIS system.

In vivo: The Ligature-induced periodontitis model was performed in C57BL/6 mice; To induce bacteria accumulation and bone loss, a silk 5-0 suture, was encircled around the 2^{nd} upper molar' CEJ. To prevent periodontitis development, local sub-gingival injection was applied with saline, free RvD1, empty liposomes, and lipo RvD1. Mice were sacrificed at day 1, 3, and 8 post-procedure. The distance between alveolar bone contour (ABC) and cementoenamel junction (CEJ) was measured by μ CT. Gingival tissues were analyzed by H&E and TRAP staining and q-rtPCR (n=5-7/ group).

Results Liposomes exhibited high RvD1 EE (>80%), demonstrated controlled release in vitro, and resided in periodontal tissue for 3d. Lipo-RvD1 restored bone better than free RvD1 at 8d. Lipo-RvD1 decreased osteoclasts and expression of catabolic markers (CTSK, MMP3) in days 3-8. Although free RvD1 decreased neutrophils and macrophages in days 1-3, lipo-RvD1 displayed a stronger inhibition effect of neutrophils and other inflammatory markers including, IL-6, IL-17 at 8d. Furthermore, lipo-RvD1 decreased Th17/Treg ratio and shifted T cells to the anti-inflammatory phase.

Conclusions Lipo-RvD1 decreased bone loss significantly compared to free RvD1 and attenuated inflammatory processes. Our novel sustained-release formulation may be useful for other aggressive or chronic degenerative conditions in implantology, osteoarthritis and osteomyelitis.



Salivary MMP-9 and SOD Levels After Non-Surgical Periodontal Treatment

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Objectives Matrix metalloproteinase 9 (MMP-9) is one of the major collagen-degrading enzymes in saliva associated with periodontitis and activated by oxidative stress. Superoxide dismutase (SOD) is an antioxidant enzyme acting against oxidative stress which increases in response to inflammation and tissue breakdown. The aim of the study was to assess the effect of non-surgical periodontal treatment (NSPT) on salivary MMP-9 and total SOD (T-SOD) levels in Stage-III Grade-B (P-III-B) and Grade-C (P-III-C) periodontitis patients.

Methods A total of 49 subjects including 17 periodontally healthy (H), 16 P-III-B and 16 P-III-C were recruited for the study. At baseline the clinical periodontal parameters including plaque index, gingival index, bleeding on probing, probing depth and clinical attachment loss were recorded and the saliva samples were collected from all subjects. At 3 months after NSPT the clinical parameters were reevaluated, and the samples were recollected from only periodontitis groups. Salivary MMP-9 and T-SOD levels were analyzed by enzyme-linked immunosorbent assay.

Results All periodontal parameters were higher in both periodontitis groups than H group at baseline (p<0.05) and improved 3 months after NSPT in both periodontitis groups (p<0.05). At baseline, salivary MMP-9 and T-SOD levels were higher in both periodontitis groups compared to H group (p<0.05) and significantly decreased after NSPT compared to baseline (p<0.05). Both salivary MMP-9 and T-SOD had diagnostic ability both for P-III-B (AUCs:0.764 and 0.774, respectively) and P-III-C (AUCs:0.772 and 0.733, respectively). Moreover, after adjusting for age, periodontitis groups were associated with both salivary MMP-9 and T-SOD levels (p< 0.05).

Conclusions This study showed that elevated levels of salivary MMP-9 and T-SOD are associated with P-III-B and P-III-C. Moreover, after NSPT their levels were decreased.



Long-Term Assessment of Hyaluronic Acid Application in Gingival Recession Treatment

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Objectives To evaluate the long-term clinical outcomes of isolated and multiple adjacent gingival recession defects following treatment utilizing the modified coronally advanced tunnel (MCAT) or the laterally closed tunnel (LCT) technique with cross-linked hyaluronic acid (HA) in addition to connective tissue graft (CTG).

Methods A total of 17 systemically healthy and non-smoker patients presenting one isolated RT1 and RT2 of a depth of \geq 3 mm, and 13 patients with at least two adjacent RT1 and RT2 (n=42) of a depth of \geq 2 mm were included to the study. Isolated recession defects were treated using the MCAT or LCT technique plus cross-linked HA in addition to CTG, while multiple recession defects were treated together with the MCAT or LCT technique alone by using HA plus CTG. The following clinical parameters were assessed at follow-up examinations (and at baseline): mean root coverage (MRC), complete root coverage (CRC), keratinized tissue width (KTW), attached tissue (AT), root coverage esthetic score (RES), as well as probing depth (PD). The primary outcome variable was MRC.

Results The treatment of isolated and multiple recession defects were evaluated with a mean follow-up time of 58.4 ± 11.8 months (range 44 to 75 months) and 55.5 ± 8.56 months (range 40 to 68 months), respectively. At the final follow-up examination, MRC was $88.8\pm18.6\%$ and $83.89\pm25.6\%$ for isolated and multiple recession defects, respectively. A statistically significant gain of mean KT of 2.82 ± 0.83 mm (p =0.018), and mean AT of 1.85 ± 1.59 mm were found for isolated defects (p=0.022). However, no significant differences were identified in any of the parameters for the mean KT, AT, and PD for multiple defects. The mean RES was 9.09 ± 1.37 and 8.72 ± 1.62 for isolated and multiple defects, respectively.

Conclusions Utilizing cross-linked HA in conjuction with CTG in tunnel approaches exhibited more favourable and predictable results for the treatment of isolated recession defects compared to multiple adjacent defects.



SEM Characteristics After Different Instrumentation Modalities

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Objectives Root surface instrumentation is an integral part of periodontitis treatment. Recent years different devices are introduced aiming the endpoint of clean and smooth root surface that favor periodontal healing. However, their potential to damage or modificate the root surfaces is still controversial.

The aim of the present study is to evaluate the morphology of root surfaces after instrumentation with 4 different modalities - hand curettes, Er:YAG laser, ultrasonic and polishing device.

Methods 10 freshly extracted incisors due to advanced periodontitis are randomly divided in 5 groups. The root surfaces of each group are instrumented with: Gracey curettes (Hu Friedy Mfg. Co., LLC) - group A; Er:YAG laser (Lite Touch, Light Instruments LTD) - group B; ultrasonic device (Piezon Master 400, E.M.S.) - group C; and ultrasonic device combined with subgingival polishing with erythritol (AIRFLOW® Prophylaxis Master, E.M.S.) - group D. Two teeth remained for control. Teeth are prepared for morphological evaluation with scanning electron microscope (JEOL, JSM-6390).

Results The SEM micrographs demonstrate deep surface scratches, remnants of biofilm and smear layer after hand instrumentation. Group B - Er:YAG laser, reveals microrough, but very clean surface with exposed collagen fibres. Root surfaces instrumented with ultrasonic device (group C) are smooth but demonstrate some biofilm remnants. In group D - subgingival polishing with erythritol and ultrasonic scaling, root surfaces are smooth and without biofilm or smear layer.

Conclusions With the limitation of the present study it could be concluded that different modalities for root surface instrumentation could be recommended in different clinical situation (and root anatomy) and at different phases of the periodontal therapy. Subgingival polishing and ultrasonic scaling with slim tips seem to provide clean and smooth surface without surface damage which

could be beneficial for long-term care of initial and moderate periodontitis.



Plaque-Inhibitory Effect of Electrolysed-Saline Mouthwash in a 4-Day Non-Brushing Model

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Objectives To evaluate the plaque-inhibitory effect of electrolysed-saline mouthwash (ESM) on de-novo plaque formation, gingival inflammation, active matrix-metalloproteinase-8 (aMMP-8) concentration and the microbial composition of subgingival plaque. **Methods** This study used a double-blind, randomized, placebo-controlled, cross-over, 3-treatment-arm, 4-day, non-brushing, experimental plaque-accumulation model to test the efficacy of ESM (free chlorine=200ppm, pH=7) in comparison to a positive (0.12% chlorhexidine digluconate; CHX) and negative control (distilled water). During each of the three 4-day study arms, subjects refrained from mechanical oral hygiene and rinsed their oral cavities twice daily with either ESM, CHX, or placebo, according to a randomization scheme. The Turesky modification of the Quigley-Hein plaque index (PII), the modified gingival index (MGI), and aMMP-8 concentrations were assayed as outcome parameters. Subgingival plaque was collected for bacterial DNA extraction to evaluate the impact of mouthwash use on microbial composition and species abundances. The outcomes were assessed at baseline and after 4-days, with a 7-day washout period between each study arm.

Results The results showed significant differences in PII for both dark- and light-colored disclosed plaque on day 4, with ESM and CHX outperforming the placebo treatment at several tooth sites. However, there were no significant differences in MGI or aMMP-8 levels between the treatments at baseline or follow-up. More importantly, ESM impeded the re-growth of periodontitis-associated pathobionts while exerting no effect on core species and commensals, whereas CHX exhibited an inferior effect towards pathobionts and impeded the re-growth of Streptococci and other anaerobic commensals.

Conclusions The plaque-inhibitory effect of ESM was significant, yet inferior to that of CHX. By altering the microbial ecology of subgingival plaque, ESM showed promising results in the prevention of dysbiosis – it balanced the quality of plaque composition by controlling key pathobionts and restoring health-associated commensals. Overall, ESM demonstrated potential as a viable alternative to CHX in the prevention of dysbiosis.



Periodontal Therapy Efficacy Impacted by Oral Bacteria in Periodontitis Patients

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Objectives The purposes of this RCT study were to compare the efficacy of two non-surgical periodontal treatment protocols (NSPT), quadrant scaling and root planning (Q-SRP) or full-mouth disinfection (FMD) in patients with periodontitis and to assess the effect of baseline periodontal bacteria on treatment regimens' protocols and clinical efficacy at a 12-month follow-up.

Methods Eighy-one patients with stage II and III periodontitis were finally selected based on specific exclusion and inclusion criteria. The included subjects were randomly distributed for Q-SRP (n=39) or FMD (n=40) NSPT protocol. During the follow-up sessions at 1, 3, 6 and 12 months, all the included periodontal patients were assessed for probing depth (PD), bleeding on probing (BOP), and clinical attachment loss (CAL). During the follow-up period, patients were motivated to perform personal oral hygiene. Real-time PCR was performed to quantify the mean count of some periodontal pathogens. Data were analyzed to evaluate the impact of periodontal bacteria concentrations on the efficacy of both Q-SRP and FMD.

Results At one-year follow-up, Q-SRP was more effective than FMD on the reduction of mean PD (Q-SRP: 4.87 ± 0.4 mm to 3.19 ± 0.6 mm; FMD, 4.91 ± 0.5 mm to 2.80 ± 0.7 mm) and the mean proportion of Tannerella forsythus, Porphyromonas gingivalis (Pg) and Actinobacillus actinocomyctemcomitans (Aa). The multivariate linear regression analysis showed that the baseline Pg (p=0.006), Aa (p=0.014) levels and the Q-SRP protocol (p= 0.028) were significant predictors of the mean PD reduction (p=0.019). Furthermore, the PD and BOP reduction was higher in the Q-SRP group when there was a low baseline Aa mean count.

Conclusions At 12-month follow-up, the Q-SRP protocol was more effective than FMD in reducing clinical and microbiological mediator changes in patients with periodontitis. Furthermore, baseline Aa and Pg levels impacted the efficacy of both NSPT protocols, with a more significant impact in the Q-SRP group.



Microbial and Sialochemical Saliva Shifts With Tumor Irradiation

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Objectives Analyze the effects of head and neck irradiation on oral salivary microbiome and sialochemical composition Determine changes in analytes and biomarkers during irradiation

Assess alterations in bacterial abundance and diversity due to irradiation

Methods The study conducted at University Hospital Regensburg included 36 eligible patients who received radiotherapy treatment between Sep 2019 and Dec 2020. Saliva samples were collected from all subjects and analyzed for biochemical and microbial composition. Saliva collection was done using Salivettes® for clinical chemistry and tubes with buffer solution for microbiological testing. Sialochemical analysis was performed using a Roche Cobas pro c503 system, and microbial analysis was conducted by 16S-rDNA semiconductor sequencing. Nucleic acids from saliva specimens were extracted and quantified using PCR on a LightCycler 480 II Instrument.

Results Sialochemical analysis of saliva samples at four time points showed significant changes in parameters such as albumin, amylase, potassium, magnesium, phosphate and sodium. No significant changes were observed in parameters such as calcium, chloride, protein, LDH, and pH. Microbial evaluation of saliva showed no significant change in alpha diversity, but bacterial abundance decreased significantly at time points 2 (during RT) and 3 (end RT) compared to baseline. Significant changes in beta diversity were observed in weighted UniFrac distance metric. Veillonella was identified as a biomarker, and several bacterial genera showed significant differences in relative abundances during the observational period.

Conclusions The present study reveals radiation-induced damage to the salivary glands in patients, resulting in compositional alterations and changes in the salivary microbiome. The findings are consistent with previous studies that have shown increases in albumin and decreases in amylase levels during radiotherapy, as well as alterations in pH, sodium, potassium, calcium, chloride, and magnesium concentrations. However, some differences were observed compared to previous studies, indicating that factors such as sample processing and methodology may affect the results. Further research is needed to better understand the impact of radiation on salivary gland function and its implications for oral health.










Saliva Collection: the Influence of Food Consumption and Toothbrushing on the Oral Microbiota

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Objectives In oral microbiota research, saliva is often the biological material of choice. To avoid bias in the results, it is necessary to take into account all factors that affect the saliva sample.

The aim of this project was to compare whether the condition of toothbrushing, food consumption, and varying time spacing between these factors can influence the bacterial profile of a saliva sample.

Methods Unstimulated saliva was collected from six healthy respondents with excellent dental hygiene (exclusion and inclusion protocol) at intervals of (a) the morning before eating and toothbrushing with toothpaste, (b) immediately after eating and toothbrushing, (c) one hour after eating and toothbrushing, (d) two hours after eating and toothbrushing, (e) three hours after eating and toothbrushing.

Bacterial DNA from 30 samples was isolated using DNeasy PowerSoil Pro Kits (QIAGEN) and bacterial profiles were analyzed by PCR-denaturing gradient gel electrophoresis (DGGE).

Results The PCR-DGGE profiles were compared. The pattern of bands was richest in collection (a) for four respondents, and in collection (b) for two respondents. The poorest bacterial profiles were observed in collection (c).

Conclusions The study suggests that the time between toothbrushing and food consumption has an impact on the resulting bacterial profiles in saliva and may influence the results of the study. The above findings need further data on a larger number of respondents.



Development of a Score to Classify Severity of Dry Mouth

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Objectives Almost 500 trials on xerostomia/dry mouth/hyposalivation are registered on ClinicalTrials.gov. Still, there are no uniform requirements for patient inclusion into studies. Even though a wide range of instruments are available to separately grade the severity of xerostomia (subjective feeling of dry mouth) <u>or</u> hyposalivation (objectively reduced salivary secretion), no tool combines xerostomia <u>and</u> hyposalivation. The aim of the present work was to develop a dry mouth severity score (DMSS) based on published questionnaires and measures, introducing cut-off values and a grading system based on patient data from the Dry Mouth Clinic, University of Oslo, Norway.

Methods We have used multiple instruments to describe dry mouth patients: questionnaires on oral health-related quality of life and xerostomia, tests of salivary secretion and candida growth, evaluation of oral dryness, pathology of mucosa and teeth, and tests of taste- and smell function. Among these instruments, we propose a DMSS based on the General Xerostomia Question (GXQ), Shortened Xerostomia Inventory (SXI), Clinical Oral Dryness Score (CODS), and secretion of unstimulated and chewing-stimulated whole saliva (UWS and SWS). Data from patients with primary Sjögren's Syndrome (n=55), non-Sjögren's Sicca (n=24), head and neck cancer (n=29), psychiatric disorders (n=23), and controls (n=64) were used to calculate the DMSS.

Results Cut-off values were set at GXQ \geq 2, SXI \geq 11, CODS \geq 6, UWS \leq 0.1mL/min, and SWS \leq 0.7mL/min (one point (p) each, range 0-5p). For DMSS, a grading from 0-3 is proposed; 0 (0p), 1 (1-2p), 2 (3p), and 3 (4-5p).

DMSS differentiated well between patients and controls as 65% of patients scored 2 or 3 and 77% of controls scored 0. DMSS correlated positively with oral health-related quality of life.

Conclusions DMSS provides a means to classify dry mouth patients according to severity for standardized inclusion into clinical trials, securing patient uniformity and relevant comparisons between studies.

Points	Patients n (%)	Controls n (%)	DMSS	Patients n (%)	Controls n (%)	
0	9 (7%)	47 (77%)	0	9 (7%)	47 (77%)	
1	10 (8%)	11 (18%)	1 27 (200/)		14 (229/)	
2	27 (21%)	3 (5%)		57 (20%)	14 (2370)	
3	29 (22%)	0	2	29 (22%)	0	
4	28 (21%)	0				
5	28 (21%)	0	3	56 (43%)	0	



Assessment of Salivary Glands in Juvenile Sjogren's Syndrome

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Objectives To assess salivary gland impairment properties in a cohort of Juvenile Sjogren's syndrome (jSjS) patients. **Methods** jSjS cases were selected from records of the Sjogren's syndrome (SjS) Center registry at the Hadassah Medical Center, Israel. Diagnosis was evaluated according to 2 set of criteria: European League Against Rheumatism (EULAR)/American College of Rheumatology (ACR) classification (Shibosky et al. 2016) and American-European Consensus Group Classification criteria (AECG) classification (Vitali et al. 2002). Medical evaluation included serology workout, referral to rheumatology, ophthalmology and other relevant specialties according to organs involvement.

Results Five patients were diagnosed with jSJS according to expert opinion at mean age of 14 years. Patients presented the following findings: xerostomia (3/5), parotid swelling (2/5), xerophthalmia (3/5), positive Schirmer's test (1/5), Arthritis (2/5), Anti–SSB (La) antibodies (3/5 patients), and Rheumatoid Factor (4/5). Only 3/5 patients met the adult EULAR/ ACR SjS criteria, and 2/5 met the AECG criteria. The most significant marker was positive Anti–SSA(Ro) antibodies (5/5 patients).

Conclusions JSjS is a rare condition, hard to diagnose and there is a need of personalized treatment approach. Systemic manifestations in the JSS patients' cohort exhibited a wide range of signs and symptoms severity, both in salivary gland impairment manifestations as well as other organ involvement. Young patients not always exhibit the same profile as older patients, and thus it is crucial to develop updated criteria for this unique group.



A Preliminary Study of ALDH1&2 Expression in Oral Lichen Planus

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Objectives Cancer stem cells (CSCs) are responsible for initiating the process of carcinogenesis. The aim of our study is to examine the presence of CSCs through immunohistochemistry in oral lichen planus (OLP), oral leukoplakia and healthy tissues. **Methods** The study sample consisted of paraffin embedded epithelium samples from the archives of the Department of Oral Medicine/Pathology, School of Dentistry, Aristotle University of Thessaloniki, Greece during the period 2009-2019. The study sample contained 24 cases of OLP (14 erosive and 10 reticular) and 30 cases of oral leukoplakia, compared with 5 normal oral epithelium samples, derived from healthy epithelium, adjacent to fibromas, from other cases. The study was approved by the Ethics Committee of the School of Dentistry, Aristotle University of Thessaloniki, Greece (protocol number 8/03.07.2019). The CSC related protein ALDH1&2 was examined with immunohistochemical methods (sc-166362, Santa Cruz Biotechnology, Dallas, Texas, USA, 1:100). The samples were evaluated through a scale of 1 to 3 depending on the percentage of positive cells. The statistical analysis was performed with the Pearson Chi-square test and the significance level was set at $p \le 0.05$.

Results The cytoplasmic staining of ALDH1&2 was observed mostly in the basal layer of the epithelium. Statistically significantly higher expression of ALDH1&2 was observed in the Leukoplakia group than in the OLP group (p = 0.035) and in the Erosive OLP group than in the Mildly and Non-Dysplastic Leukoplakia group (p < 0.001).

Conclusions The Moderately and Severely Dysplastic Leukoplakia is a well-known potentially malignant oral disorder and expressed ALDH1&2 similarly to the Erosive Lichen planus group. The characteristic expression of ALDH1&2 in oral potentially malignant lesions of OLP suggests the presence of CSCs and might imply oral tumorigenesis even in lichenoid lesions.



The Giant Cell Granulomas of the Jaws: Retrospective Pilot Study

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Objectives The purpose of this study was to investigate the patients who have central and peripheral giant cell granulomas of the jaws, analyse the treatment tecniques, and also recurrency rates.

Methods Patients who applied to Hacettepe University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery in 2013-2023, with Giant Cell Lesions as a result of pathology were included in our study. Lesions size (horizontal, vertical, sagittal), recurrency and location, patient's demographic data, cortical bone resorption and treatment tecniques were recorded.

Results 15 patients were included in this study. Gender intense were at females (12 patients, %80), the average age was 39.9 and average follow-up periods was 5 years. 9 of 15 patients were peripheral, 6 of them central giant cell granuloma. The chronic diseases were determined in 4 patients. 9 lesions (%60) were seen at mandibula, 6 of them were in anterior side, 2 of them were in posterior side. Only one lesion was observed in both posterior and anterior side of right mandibula. 6 lesions (%40) were located at maxilla, 2 of them were in anterior side, 4 of them seen in posterior side. 6 of 15 patients (%40) had bone destruction. The avarage size of lesions were 2.0x1.6x1.1cm. The most prefered treatment method was curretage (11 patients, %73.3), however, reccurrency was seen 4 of these patients (%36). 2 of 15 patients were treated with the combination of curretage and steroid injections, one of these lesions had recurrency. One patient were performed steroid injections, however, the lesion didn't heal enough so systemic denosumab were applied.

Conclusions Curretage was crucial treatment method for this lesions on the other hand reccurrency rate was %36 in this study. Larger sample size prospective and retrospective clinical studies are needed for the decision of the best treatment option.



0150 Investigation of Prevalence of HPV-Related Lesions in Oral Cavity

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Objectives WHO has recently reported that Human Papillomavirus (HPV)-related oral cancers will increase in several years. The aim of this study was to investigate the prevalence of HPV-related oral mucosal lesions at a university department.

Methods Electronic search of database of Hacettepe University, was undertaken to identify patients with oral mucosal lesion and a biopsy report between 2012 and 2022. The biopsy reports including tentative diagnosis of "granuloma", "papilloma", "fibroma", "condyloma acuminatum", "verruca vulgaris", "lipoma", "leukoplakia", "squamous papilloma", "HPV" were investigated to detect HPV-related lesions. Patients who referred to Faculty of Dentistry, Department of Oral and Maxillofacial Surgery and whose biopsy reports were presented as HPV-related lesion were included in this study. A questionnaire was applied to these patients with teledentistry and patient's gender, age, education level, the number of their children, systemic condition, family history and the occurrence of recurrent lesion were recorded.

Results Total 4544 patients were screened. Possible HPV-related lesions were diagnosed in 24 patients. Squamous papilloma (10 patients, 41.7%), verruca vulgaris (3 patients, 12.5%), condyloma acuminatum (2 patients, 8.33%), papillomatous lesion (3 patients, 12.5%) were reported. Hyperkeratosis and acanthosis was reported in 6 patients. The prevalence of HPV was found 0.4%. All of 24 patients were called, but 8 males and 8 females with a mean age 42,9 years participated to the questionnaire. Nine patients was smoking, and 4 of 16 patients had alcohol use. The chronic diseases were determined in 11 patients. It was detected that none of married patients had a possible HPV-related lesion in their partners or children. Only 1 patient with squamous papilloma had recurrency.

Conclusions The prevalence of HPV-related lesions in oral cavity was found to be low in this study, but multicenter studies with large sample size are needed to confirm the incidence of HPV in population.



Head and Neck Pain Drawings: Diagnostic Value for Temporomandibular Disorders

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Objectives The use of head and neck pain drawings has been incorporated into the diagnostic gold standard for temporomandibular disorders (TMD). However, evidence is needed on the clinical use of this additional information. The aim of this study was to evaluate the spatial extent of pain in TMD patients and how it correlates with structural and psychosocial findings.

Methods In a cross-sectional study, 121 patients (mean age = 39 years; range 18 - 82; n females = 94) were diagnosed using the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD). Intra-articular disorders were confirmed or excluded by magnetic resonance imaging (MRI). Participants were instructed to mark all painful areas on a facial sketch. A grid template was then placed over the sketches, and each region containing markings was scored as painful. Spearman correlation and multivariable quantile regression were used to examine the relationship between the calculated pain area, pain lateralization, psychosocial variables (DC/TMD axis II), and intra-articular diagnoses.

Results Pain was observed in all facial regions, but was primarily concentrated in the temporomandibular joint and masseter regions. When patients reported unilateral pain, it was associated with structural TMJ findings in the majority of cases. Individuals with bilateral pain and those with greater spatial extent had significantly higher scores on all Axis II variables (p < .05), except for functional limitation of the jaw.

Conclusions Head and neck pain drawings may help to stratify patients with TMD. Greater pain extent and pain bilateralization are associated with higher levels of emotional distress, pain chronicity, and somatization, but not with functional limitation and not with structural findings of the temporomandibular joint.



COVID-19 and Temporomandibular Disorders - Comparison of 3 Time Periods

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Objectives The objective of the present study was to compare the effect of the pandemic on painful and non-painful TMD in men and women, at three consecutive time points: before the pandemic (pre-COVID), during the lockdown periods and after the pandemic subsided (post-COVID).

Methods A total of 587 adult patients (108 in the pre-COVID group, 180 in the during lockdown group and 252 in the post-COVID group), who arrived for a routine dental treatment at the School of Dental Medicine, Tel Aviv University, between October 2018 and January 2023 were evaluated according to Axis I diagnosis of the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD). Neither of the subjects arrived for treatment with a specific complaint referring to TMD. Each patient received a DC/TMD Axis I diagnosis as follows: (i) *Painful TMD* (defined by the presence of at least one of the following - local myalgia, myofascial pain with referral, arthralgia, or headache attributed to TMD); (ii) *Non painful TMD* (defined by the presence of disc displacement with/without reduction, degenerative joint disorders and/or dislocation).

Results Two-way ANOVA analyses were performed to compare between time points and evaluate interactions between time and gender. Painful TMD group showed main effects of time (F=24.842, p<0.001) and of gender (F=14.304, p<0.001) with an interaction between the two variables (F=3.897, p<0.05). In the non-painful TMD group a main effect of gender (F=4.536, p<0.05) and a significant interaction between gender and time (F= 3.628, p<0.05) were found.

Conclusions Results show that the COVID-19 pandemic had a different effect on women than on men with regard to painful and non-painful TMD diagnoses.

Figure 2: differences in the prevalence of painTMD and nonpainTMD diagnosis between sexes in the time groups evaluated.





Predictors of Pain Outcomes in Patients With Painful Temporomandibular Disorders.

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Objectives Baseline characteristics may predict treatment response in patients with painful temporomandibular disorders (TMD), e.g., higher baseline Characteristic Pain Index (CPI) scores associated with higher CPI following treatment. This study quantitatively estimated the association of baseline characteristics with pain at follow-up.

Methods In this prospective cohort study, TMD pain patients (n=1901) sought treatment for their TMD pain in 182 dental practices enrolled in the National Dental Practice-Based Research Network (NationalDentalPBRN.org). CPI (0 -100 scale) was used to measure patient pain intensity at baseline, 1, 3, and 6 months. Proc MIXED was used to assess adjusted estimates of the independent effects of time and 15 predictors in a repeated measures analysis. Risk factors were identified by their higher CPI than the overall study means at each follow-up, and protective factors by their lower CPI means.

Results Eight of the 15 baseline predictors were both risk factors for higher CPI at 6 months and protective factors for lower CPI.(Table 1)

Conclusions Independent levels of 8 baseline characteristics serve as indicators of pain outcomes at 6 months following initial assessment by Network practitioners. They can be used to identify patients in need of specialized treatment.

Risk	Protective
1. Graded Chronic Pain Scale (GCPS) Grades 2a-4	GCPS Grade 1
2. CPI > 50	CPI ≤ 50
3. Coping with Psychological Distress measured with Patient Health Questionnaire-4 (PHQ-4): Very or Extremely difficult	Coping with Psychological Distress measured with PHQ-4: Not or Somewhat difficult
4. > 6/21 sites positive for widespread pain (WSP)	≤ 6 sites for WSP
5. > 1 prior practitioner seen for TMD pain	0-1 prior practitioners seen for TMD pain
6. Modified Oral Behaviors Checklist score ≥ 0.73 (scale: 0.00-2.00)	OBC score < 0.73
7. WSP ≥ 3 months	WSP < 3 months
8. TMD pain ≥ 3 years	TMD pain < 3 years

Predictors for risk and protective factors



Relative Risk of Clinical Characteristics Associated With Post-Treatment TMD Pain

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Objectives Baseline characteristics can be used to predict occurrence of clinically significant temporomandibular (TMD) pain post-treatment.

Methods In this prospective cohort study, TMD pain patients (n=1901) sought treatment for their TMD pain in 182 dental practices enrolled in the National Dental Practice-Based Research Network (NationalDentalPBRN.org). Relative risk (RR) was used to estimate association of Characteristic Pain Index (CPI) scores \geq 60/100 at 6-month follow-up. GEE logistic regression accounted for clustering of patients within Network practices. The median value served as the cutoff for high versus low (=reference) categories of continuous predictors. Discrete categorical predictors were assessed as 1=present versus 0=absent. The control category for ordinal predictors was their least severe category.

Results Compared to their reference groups, the RR estimates for the following categories of eight baseline characteristics were significantly associated ($P \leq 0.0024$) with CPI scores $\geq 60/100$ at 6-month follow-up:

1. Graded Chronic Pain Scale: Grades 2-4 versus Grade 1 (reference) (RR ranges = 4.87-13.57).

2. CPI > 50/100 versus \leq 50/100 (RR = 5.32).

3. Difficulty Coping with Psychological Distress (Patient Health Questionnaire - 4): 'Somewhat difficult'=1 versus None=0; 'Very difficult'=2 versus 0; 'Extremely difficult'= 3 versus 0 (RR ranges = 1.85 - 3.52).

- 4. Widespread Pain (WSP): > 6/21 sites versus \leq 6/21 sites (RR = 2.37).
- 5. WSP present \geq 3 months versus < 3 months (RR = 3.52).
- 6. >1 prior TMD pain clinicians versus 0-1 clinician (RR = 2.13).
- 7. Modified Oral Behavioral Checklist: > 0.73 versus \leq 0.73) (RR = 1.70).
- 8. TMD pain \geq 3 years versus < 3 years (RR = 1.59).

Conclusions Relative Risk estimates for higher categories of eight baseline characteristics can be associated with significantly higher chance of having persistent, moderate to severe pain intensity at 6-month follow-up. This information may assist in selection of treatment strategies.



Comparison of Post Endodontic Pain After Endomethasone N vs SP

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Objectives Post Endodontic Pain (PEP) after endodontic treatment (ET) might be reduced by adding cortisone to the composition of the Root Canal Sealer (RCS) although no grade A evidence supports this statement.

Methods A multicenter prospective randomized controlled clinical trial was performed in general practice (ClinicalTrials.gov # NCT04885686) between June 2021 and May 2022. Its main objective was to demonstrate the superiority of Endomethasone N RCS (EndoN), compared to its hydrocortisone-free equivalent Endomethasone SP RCS (EndoSP), with regard to reduction of the maximum spontaneous PEP pain during the 7 days following the ET, self-estimated on a 0-100mm Visual Analogic Scale (VAS). The secondary objectives were to assess 1) spontaneous PEP; 2) provoked (masticatory) PEP; 3) intake of analgesics; 4) quality of life and anxiety after ET; 5) safety of ET. Adult patients with indication of ET in a molar or premolar in one session were included between 2021 and 2022 in 15 centers.

Results The final sample consisted of 286 patients. The mean age of the sample was 47.7 y.o. including 49% men and 51% women. Before ET, 49.7% of the teeth were asymptomatic; provoked pain occurred in 29.4% and spontaneous pain in 21.0%. The maximum PEP intensity was mild. The study evidenced a lower maximum spontaneous PEP intensity during the 7 days following ET in the EndoN compared to the EndoSP group (13.5±17.9 vs 23.9±26.6, IC 95% [5.2-15.8], p<0.0001 Wilcoxon test). Maximal masticatory PEP was also lower in the EndoN group (12.3±19.1 vs 24±27.8, p<0.0001). At every evaluation time, the masticatory PEP in the EndoSP group was higher than in the EndoN group. In addition, no serious adverse events occurred during the study.

Conclusions This RCT demonstrated the superiority of EndoN compared to Endo SP in reducing both spontaneous and masticatory PEP during the 7 days following ET.



0156 Comparison of 3D Bone Characteristics of MRONJ Using 2D&3D Images

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Objectives Bone characteristics of patients with medication-related osteonecrosis of the jaw (MRONJ) have not been investigated using 2D image sections. Therefore, the aim was to evaluate the trabecular changes of MRONJ patients in comparison to controls using panoramic (PR) and cone-beam computed tomography (CBCT) images.

Methods Digital panoramic and sagittal sections of CBCT images of 24 MRONJ patients and 22 healthy controls were used for the comparison of bone area fraction (BA/TA), trabecular thickness (Tb.Th), trabecular separation (Tb.Sp), and trabecular number (Tb.N) calculations. *Fraction* and *Slice Geometry* plugins of the FiJi software were used for measurements on three regions of interest (ROIs): ROI-1 anterior and ROI-2 inferior to the mental foramen and ROI-3 superior to the mandibular canal. Comparisons of MRONJ patients and controls as well as different ROIs were done using the independent samples t-test (p<0.05).

Results Parameters that differentiated MRONJ patients from healthy controls were BA/TA and Tb.Sp only on PR. While BA/TA values of PR were lower (p=0.002) for MRONJ patients, Tb.Sp was higher (p=0.027) than CBCT. None of the parameters and ROIs revealed any difference between patients and controls on CBCT images (p>0.05). BA/TA values of MRONJ patients calculated on PR were lower on all ROIs (p<0.05). Tb.Sp values of PR images of MRONJ patients showed higher values on ROI-1 (p=0.017) and ROI-3 (p=0.035). No difference was found between measurements of MRONJ patients and controls as well as different ROIs regarding Tb.Th and Tb.N on PR images (p>0.05). Generally, standard deviations of all parameters were higher for MRONJ patients compared to the controls, both in PR and CBCT images.

Conclusions BA/TA and Tb.Sp can be used to differentiate trabecular bone changes of MRONJ patients in PR images. For more reliable results, ROIs 1&3 should be preferred regarding measurements of 3D bone characteristics on 2D projection images.



Cone Beam Computed Tomography for the Identification Risk of Osteoporosis.

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Objectives The aim of the study was to determine whether the mandibular cortical bone thickness, detected in cone beam computed tomography (CBCT), are affected by general bone mineral density (BMD) in postmenopausal females and to evaluate whether CBCT can be used for predicting the risk of osteoporosis.

Methods The study included 131 postmenopausal females aged 54-87 years (average age 69.1±8.1) who underwent CBCT examinations due to dental implant planning. BMD measurements of the lumbar spine and both femoral necks were performed by dual-energy X-ray absorptiometry (DXA) and worst T-score reading from both were taken into account. CBCT images were analysed with *OnDemand3D Dental* software. In cross-sectional CBCT images four areas of the mandible (lateral incisor, first premolar, mental foramina, first molar) were selected to determine vestibular, lingual, and basal cortical bone width. Difference between groups was evaluated by One-way ANOVA. Performance of CBCT 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 According to the DXA results 46 females had normal BMD, 60 had osteopenia and 25 had osteoporosis . In women with osteoporosis, cortical bone thickness was statistically significantly lower in the basal part of the mandible in all mandibular regions (lateral incisor (p=0.023), first premolar (p=0.0001), mental foramina (p=0.032) and first molar (p=0.01)). Statistically significant difference between different BMD groups was observed according to vestibular cortical bone thickness only in the incisor region (p=0.006). The basal cortical bone thickness of first premolar region showed promising diagnostic performances: AUC=0.74, Se=73.9%, SP=85%, PPV=31.9%, NPV=89.3% to predict osteoporosis.

Conclusions Postmenopausal females with reduced BMD showed reduced cortical bone thickness in the basal part of mandible. CBCT is a promising tool for identifying postmenopausal females at increased risk of osteoporosis.



Stress Analysis of Implant-Supported Crowns Made of Different Materials.

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Objectives The objective of the present finite element analysis (FEA) was to determine the distribution and transmission of stress in implant-supported crowns made of different restorative materials.

Methods

Based on the STL data of a molar crown (tooth 46), a standardized titanium implant replica (type Tissue Level Straumann, CH) and a simulated human mandible (BodyParts3D/ Anatomography, Database Center for Life Science, J), a model was created for the present FEA using reverse engineering (Fusion 360 and Meshmixer, Autodesk, USA). The mandible was divided into cancellous bone and compacta. In addition to the above structures, a cement gap of 100 µm was created for adhesive cementation (Panavia F 2.0, Kuraray, J). The calculation was performed for four different superstructures made of composite (Grandio Bloc, VOCO, D), PICN (Enamic, Vita Zahnfabrik, D), lithium disilicate (emax Press, Ivoclar Vivadent, FL) and zirconia (emax ZirCAD, Ivoclar Vivadent, FL). The load was applied via an oxide ceramic ball (d=12 mm) by means of a forced displacement of 8 µm in the occluso-apical direction. Linear-static simulation was performed using Fusion 360 CAE software (Autodesk, USA). All components were investigated with respect to von Mises equivalent stresses and the occurring displacement.

Results Stress maxima ranged between 561.9 MPa (zirconia) and 219.3 MPa (composite) in the region of the restorative materials and 79.6 MPa (zirconia) and 4.3 MPa (composite) in the osseous structures.

The reaction forces in the area of the oxide ceramic sphere ranged between 106.3 N (composite) and 259.6 N (zirconia). Materials with high elastic moduli (zirconia, lithium disilicate) exhibited higher von-Mises stresses in all components and produced higher reaction forces than the resin-based materials.

Conclusions FEA showed a stress development that was dependent on the material of the superstructure and the conditions of the FEA analysis. Under the present conditions with a forced displacement, resin crowns caused lower stress in the area of the implant and the osseous structures.



Material Characterization of Surface-Modified Toughened Zirconia for Enhanced Osseointegration Potential

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Objectives To evaluate phase composition, microstructure and hardness of yttria- and ceria-stabilized zirconia exposed to three surface-modification techniques.

Methods One commercial 3mol% yttria-stabilized zirconia (3Y-TZP, TZ-3Y-E, Tosoh) containing 0.25wt% Al₂O₃ and one lab-made 10mol% ceria-stabilized zirconia (Ce-TZP) containing 0.25wt% Al₂O₃ 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 mirror-polished. Each zirconia grade was exposed to: (1) sandblasting (Al₂O₃, 110 µm, 4.5 bar), (2) acid-etching (20% HF, 2h), (3) sandblasting + acid-etching, and (4) mirror-polishing (control). Density was determined according to the Archimedes principle; 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, while also Vickers hardness was assessed. Statistics involved one-way ANOVA and post-hoc Games-Howell test (α =0.05). Results Ce-TZP revealed higher density than 3Y-TZP (6.215 vs. 6.055g/cm³). Sandblasting with/without acid-etching increased monoclinic phase for both 3Y-TZP (≈10wt%) and Ce-TZP (≈42wt%) zirconia. Mirror-polished 3Y-TZP and Ce-TZP showed the lowest roughness (Sa: 0.0081 µm and 0.0078 µm) followed by acid-etching (0.041 µm and 0.038 µm) and sandblasting with/without acidetching 3Y-TZP (0.88/0.88 µm) and Ce-TZP (1.24/1.18 µm). SEM revealed irregular surfaces after sandblasting and small pits <1 µm between zirconia grains after acid-etching both zirconia grades. Sandblasting, acid-etching and sandblasting + acid-etching significantly increased zirconia hydrophilicity (θ: 67.8°, 54.7° and 29°) in comparison to mirror-polished 3Y-TZP (78.6°). Sandblasting with/without acid-etching both zirconia grades revealed a significantly higher hardness compared to polished and etched disks. Conclusions Sandblasting with/without acid-etching can help increasing surface roughness, hydrophilicity and hardness of 3Y-TZP and Ce-TZP but also cause high transformation toughening in Ce-TZP, which can be beneficial properties in zirconia implantology.



Electrochemical Characterization of Seven Commercial Dental Implants.

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Objectives The purpose of this study was to comparative evaluate the electrochemical properties of Ti dental implants. **Methods** Seven commercially available dental implants (Ice/ICE, IMZ TPS /IMZ, Ospol/OSP, Osseotite Full/OST, Replace Select/RPL, SLA Active/SLA and Semados SM /SMD) with different surface texture and composition were included in this study. Three specimens per implant were tested in a Ringer's solution (8.6 g NaCl, 0.33 g CaCl₂ 2H₂O, 0.3 g KCl, in 1000 ml distilled water), employing a mini corrosion cell system setup, with a saturated calomel reference electrode and a 0.008cm² cross-sectional area. Two anodic scan curves were recorded for each implant (-1.0V up to 2.0 V and backwards to zero potential) and were determined from each curve. The results were statistically analysed by one way ANOVA and Tukey-Kramer multiple comparison test (α =0.05). **Results** Significant differences (p<0.05) were found in the electrochemical properties tested, with the implants classified in the

following order (best to worst) E_{corr} : IMZ,OSP,SLA>RPS>SMD>OTF,ICE; E_{pit} : OSP>RPS>SMD>ICE,IMZ,OTF>SLA. All curves showed negative hysteresis, denoting that the passive film can be reformed in reverse scanning.

Conclusions The different surface texture and elemental composition of implant surfaces introduced to enhance osseointegration, significantly modify the corrosion resistance of the implants, which may affect their clinical performance.



Accuracy Assessment Protocol of Direct Metal Laser Sintering in Prosthodontics

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Objectives Direct metal laser sintering (DMLS) shows many advantages in the production of metal-based restorations, such as automation, production speed and minimal amount of waste. However, with multistage production process there is a need to define the source of possible errors. The aim of this study was to develop a standardized protocol which allows reliable and simple accuracy assessment of DMLS production procedure after each production batch for dental applications.

Methods A standardized control model was designed in CAD software according to selected values that mimic the dental arch geometry, while a master model was designed as a construction in which the control model fits on the "key-lock" principle. Both models were 3D printed from atomized Co-Cr alloy powder using the EOS M100 (EOS GmbH, Krailling, Germany) 3D printer, after which they were precisely measured in raw form using the ATOS Q (GOM GmbH, Braunschweig, Germany) digitizer. After removing the supporting pins and polishing, a second measurement was carried out. There were 133 designated measurement reference points, grouped from A to I. Measurement data of both models in raw and finalized form was statistically analyzed using the SPSS software.

Results Measurements of the reference points demonstrated deviations from the CAD model values. The statistically significant difference was determined in dimensional comparison of the raw and polished models (t=3.128, p=0.061). However, no statistically significant difference was determined between the CAD model and the dimensions of the polished model (t=2.492, p=0.014). **Conclusions** The results suggest that DMLS can cause dimensional discrepancies between virtual and 3D printed shapes, but they can be recognized and assessed. The developed protocol can be used to define if an error occurred in the production process.



Two-Piece Zirconia Implants With Two Various Platforms: RCCT's Preliminary Results

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Objectives This study aimed to evaluate two different types of two-piece zirconia implants with a platform at the tissue level and bone level implants 6 months following restorations as part of an ongoing randomized clinical investigation.

Methods A 10 mm long and 4 mm wide zirconia implants with a platform at the soft tissue level (Z5-TL, Z-Systems) (n = 5) or bone level (Z5-BL, Z-systems) (n = 5) were inserted in healthy adults with missing maxillary premolars according to the type 4 protocol using a surgical guide as a partially guided procedure. Using the Osstell[©] device, the stability of the implants immediately after implantation and 3-4 months later was measured. Lithium-disilicate ceramic crowns were cemented to ceramic abutments. After six months patients underwent a clinical control and X-ray examination.

Results Initial measured ISQ values were between 73 and 79 and after 3 to 4 months between 76 and 84. In one Z5-BL case, the marginal bone resorbed before loading necessitating using the abutment designed for the Z5-TL platform. In one case of Z5-BL, the abutment fixation screw fractured, and an ultrasonic device was used to successfully remove the broken fragment. In nine cases, the mucosa adjacent to the implants remained stable after six months, whereas one Z5-TL implant displayed gingival recession. After 6 months, resorption of the marginal ridge of approximately 1 mm was observed in 3/5 Z5-BL implants, whereas expected mild saucerization of the marginal ridge was observed in 3/5 Z5-TL implants. Six months after implantation, all implants (10/10) were functional and successfully integrated.

Conclusions Zirconia implants placed with type 4 protocol in the maxillary premolar region integrated successfully and could be restored with all-ceramic crowns. Mild but clinically acceptable resorption of the marginal bone was observed with both implant types, while the soft tissues were stable six months after loading.



0169 Does the Integrity of Collagen Membrane Affects its Osteoconductivity? K. A. Apaza Alccayhuaman, R. Gruber Oral biology, Medical University of Vienna, Vienna, Vienna, Austria

Objectives The aim of the present study was to compare the intact with the minced bilayer collagen membrane.

Methods an intact or minced bilayer collagen membrane was randomly placed over a 5mm calvaria defect in Sprague Dawley rats. After three weeks of healing, ex vivo micro CT, histology, and histomorphometry were performed.

Results we report here that the intact compared to the minced bilayer collagen membrane showed a higher median volume of 1.47mm³ (0.59 min; 5.30 max) versus 0.40 mm³ (0.08 min; 3.73 max), respectively (p=0.09). Consistently, the defect coverage was higuer in intact than in the minced bilayer collagen membrane with 42.8% (14.6 min; 84.9 max) versus 21.8% (5.3min; 74.2 max), respectively (p=0.13). We currently perform histological analysis ideally confirming that the minced bilayer collagen membrane maintain osteoconductive propoerties but require proximity to the defect margin.

Conclusions These data suggest that the integrity of the bilayer collagen membranes affects their osteoconductive properties in rat calvaria defects.



Immediate Implantation and Restoration in the Anterior Mandible- 8-Year Follow-up

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Objectives The objective of this retrospective study was to evaluate the short- and long-term survival and success rates of immediately placed and restored implants in combination with GBR in the anterior mandible. Additionally, the study aimed to provide valuable information on objective aesthetic parameters, such as the presence or absence of papillae and the frequency of marginal gingiva recession.

Methods This retrospective study aimed to determine the survival and aesthetic outcomes of implants immediately placed and restored in the anterior mandible. The study included 75 implants that were inserted along with guided bone regeneration in 42 patients. Over a follow-up period of 3 to 8 years (mean of 6.95 \pm 1.78 years), the study evaluated aesthetic, marginal bone loss (MBL), and biological and prosthetic complications.

Results No failures were recorded during the follow-up period, and after eight years, the survival rate was 100%, while the cumulative success rate was 87.44%. Age and gender did not have a statistically significant impact on MBL, but smokers had a greater MBL than non-smokers at both the 3-year (1.12mm vs. 0.58mm, respectively, p=0.205) and 8-year (2.98mm vs. 1.23mm, respectively, p = 0.016) time-points. At 3 years, only 13.3% of the implants had mesial papillae, 36.0% had distal papillae, and 16.0% had the cervical metallic part of the abutment exposed.

Conclusions Based on the limitations of this study, immediate placement and restoration of the mandibular incisors can be a feasible procedure, but only a few implants will achieve complete restoration of the papillae.

Figure 3: Rehabilitation of the anterior mandible with a fixed partial bridge relying					
on 2 implants.					
	b	c	d		
e	f	g	h		

The following images depict the treatment of severe bone loss in teeth #32-42(a, b). Image c shows an occlusal view after tooth extraction and implant placement in a lingual position. FDBA particles (d)packed in excess in the residual gap and above the buccal wall. (e) depicts a resorbable collagen membrane draped over the abutment and above the bone graft. (f) shows a buccal view of the final abutment after surgical site closure. (g) displays a periapical radiograph of the final restoration. Finally, (h) shows a buccal view of the final restoration.



Demographic data and implant distribution

Variable	Number	%
Gender		
Female	16	38.1
Male	26	61.9
Smoking Status		
Yes	10	23.8
No	32	76.2
Implant length (mm)		
13	18	24
16	57	76
Implant Diameter (mm)		
3.3	62	82.7
3.75	9	12
4.2	4	5.3
Implant site		
Central Incisor	14	18.6
Lateral Incisor	56	74.7
Canine	5	6.6
Rehabilitation Type		
Single Crown	9	21.4
Fixed Partial Bridge	33	78.6

Marginal bone loss according to demographic variables after 3 and 8 years follow up (3y, 8y)

Variable	N(%)	Marginal Bone Loss Mean ± SD	P-Value
Gender			
3 Years			
Female	16 (38.1%)	0.78±0.38	
Male	26 (61.9%)	0.66±0.41	0.68
8 Years			
Female	11 (39.3%)	1.49±0.65	
Male	17 (60.7%)	1.77±1.17	0.15
Age			
3 Years			
65<	17 (40.4%)	0.77±0.40	
≥65	25 (59.6%)	0.66±0.39	0.95
8 Years			
65<	13 (46.4%)	1.95±1.17	
≥65	15 (53.6%)	1.41±0.76	0.17
Smoking Status			
3 Years			
No	32 (76.2%)	0.58±0.03	
Yes	10 (23.8%)	1.12±0.39	0.20
8 Years			
No	21 (75%)	1.23±0.49	
Yes	7 (25%)	2.98±0.98	0.016*

Oral Session



Comparison of Remineralizing Efficacy of Bioactive Dental Varnishes

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Objectives The effectiveness of fluoride varnish, sodium-tri-metaphosphate treated eggshell and membrane powder varnish, and bioactive glass-fluoride varnish in preventing erosion were evaluated.

Methods Two windows were created for the etching cycle on the buccal face of 72 molars. One of the windows was used for varnishes [Fluor varnish (FV, Metroberry, Imicryl), STMP treated eggshell and membrane powder varnish (ESPV, Bio Viera, Imicryl), and bioactive glass varnish (BAGV, Polimo, Imicryl)], and the other as an untreated control. The erosion cycle was applied with acidic syrup (Atarax) 3 times a day and a beverage (Coca-Cola) 4 times a day for 5 days. Samples were analyzed with SEM (Scanning Electron Microscopy) (n=1), ATR-FTIR (Fourier Transform Infrared Spectroscopy) (n=6), and Vicker's hardness tester (n=5). Data were statistically analyzed with One-Way ANOVA and Tukey HSD test.

Results The protective effects of the varnishes were observed in the obtained SEM images. In the comparison between the groups, a difference was found between the FV and ESPV groups in terms of $v_2 CO_3^{-2}$ peak spectrum and microhardness values (p<0.05). No difference was observed between the CO_3^{-2} and PO_4^{-3} peak spectra in the varnish groups demineralized with acidic syrup, and beverage and in the control groups (p>0.05). There was no difference in the CO_3^{-2}/PO_4^{-3} ratios between the groups (p>0.05). According to microhardness analysis, the BAGV group demineralized with acidic syrup and the FV group demineralized with acidic beverages were similar to the control group (p>0.05). Other groups were different from the control group (p<0.05). **Conclusions** The ESPV and BAGV showed a similar protective effect with fluoride varnishes against erosion. It has been shown that the investigated varnishes can be used as an alternative to fluoride varnishes for protection from acid erosion.



Dental Treatments Under GA on 2331 Pediatric Patients: Observational Study

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Objectives The use of general anesthesia (GA) to provide dental treatments is not only reserved to children who are medically compromised or have disabilities, but it is also seen as a strategy for treating healthy children who are uncooperative, because of young age or extreme anxiety. This study retrospectively analyzed the characteristics of dental treatments conducted under GA in pediatric dental patients.

Methods Data from pediatric patients, who underwent dental treatments under GA at the AORN Santobono-Pausilipon Pediatric Hospital, Naples, Italy, from January 2011 to December 2022, were recorded. The following data were collected: gender distribution; average age; health status; anesthetic procedure; adverse events; dental procedure performed.

Results 2331 pediatric patients (1359 (58.3%) males and 972 (41.7%) females) were treated. Mean age was 6.3±2.6 years. 1748 (75%) patients were healthy and uncooperative and 583 (25%) patients were medically compromised and/or disabled. Among medically compromised and/or disabled children, 443 (76%) were autistic patients, 71 (12%) were epileptic patients, 20 (3.5%) were patients with Down syndrome, 26 (4.5%) were patients with psychomotor retardation, 23 (4%) were patients with other syndromes. In relation to the anesthetic procedure, 848 patients (36.4%) underwent oral endotracheal intubation, 83 patients (3.6%) underwent nasal endotracheal intubation and 1400 patients (60%) were treated with facial mask. Two adverse events occurred (1 massive intraoperative bleeding and 1 postanesthesia delayed awakening). Relatively to the dental procedure, 2086 (89.5%) patients were submitted to dental extractions (5.61±3.6 teeth were extracted for each patient); 53 (2.3%) patients to supernumerary teeth removals; 6 (0.2%) patients to odontomas removals; 23 (0.9%) patients to soft tissues neoformations excisions; 158 (6.8%) patients to cysts excisions.

Conclusions Different types of dental treatments under GA can be safely provided in a hospital setting both for healthy uncooperative and for medically compromised and/or disabled children.



Early Enamel Lesions During Fixed-Orthodontic Therapy, Systematic Review and Meta-Analysis

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Objectives The development of carious lesions around brackets and bands is the among one of the most common side effect of orthodontic treatment with fixed appliances. Early Enamel caries lesions (EECLs) with a characteristic chalky white appearance are a public health problem because as they are the first step of carious lesions that may evolve into cavitated lesions if left untreated. The prevalence of EECLs, related to orthodontic treatment, described varies widely across studies, ranging from 27% to 97%. Based on these premises, the purpose of this systematic review is to evaluate, summarize and analyze the incidence and prevalence rates of EECLs in relation to orthodontic treatment.

Methods The present systematic review was registered *a priori* in Prospero (CRD4202341295), and databases were searched for appropriate studies. The risk of bias assessment was carried using the Cochrane collaboration's RoB 2 and RoB 1 tool for RCT and NRSI studies, respectively and the Joanna Briggs Institute Critical Appraisal Checklist for Studies Reporting Prevalence Data for cross-sectional and longitudinal studies. Prometa3 Software was used for the meta-analysis.

Results Out of 286 papers 21 met the inclusion criteria and 19 of them were included in meta-analysis, the incidence rate of new carious lesions formed during orthodontic treatment was 0.47 in 540 patients, 0.15 in 1890 teeth with a mean number of EECLs equal to 2.29 in 208 patients evaluated; the prevalence rate of EECLs in patients undergoing orthodontic treatment was 0.57 in 1450 patients, 0.19 in 12346 teeth with a mean number of EECLs equal to 2.24 in 484 patients evaluated.

Conclusions Incidence and prevalence rates of EECLs in patients undergoing orthodontic treatment are quite high and meaningful. This diffuse burden of EECLs development is an alarming challenge and deserves considerable attention from both patients and professionals, which should lead to a greater focus on effective caries prevention.



Caries Risk Assessment and Management in Europe : the CARMEN Study

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Objectives Although knowledge of the pathophysiology of dental caries has increased, little information is available on caries risk management (CRM) in Europe. The aim of the CARMEN study was to describe dental clinicians' (DC) adherence to caries risk management guidelines and the impact of their strategies in four European countries.

Methods This was the first international large-scale observational, prospective, and retrospective longitudinal study conducted among DC in Bulgaria, Greece, Poland, and Portugal from 2019 to 2020. Data on DC and patient dental care were collected at inclusion, with a patient history of the last 3 years and 1 year of follow-up. Fifty-one DC were recruited:19 Bulgarian, 8 Greek, 14 Polish, and 10 Portuguese (63% women; mean age 44 years (± 12)). They had been practicing for a mean of 19 years. They included 1,009 patients (56% women; mean age 35.4 years (± 19.7)): 366 Bulgarian, 281 Greek, 276 Polish and 86 Portuguese.

Results Dentists with specific university CRM training relied more on the application of guidelines in routine practice. A significant association was found between low patient's socio-economic status on one hand, and higher caries risk, and presence of active carious lesions, on the other (P<0.001). Bulgarian DC claimed to apply less fluoridation (< 5%), performed more restorations (45%), but engaged more patients in therapeutic education than DC from other countries. Remineralization was mainly performed by the Polish DC. Assessment of oral dental health and reassessment of CRM were higher in Bulgaria and Poland than in Greece. More details are provided in Table.

Conclusions Specific university training promotes adherence to caries risk recommendations. Dental caries risk and active carious lesions were linked to patients' socioeconomic status. The diversity observed in CRM and counselling provided by DC in Europe should be explored following the COVID-19 period.



Dental clinicians caries risk management characteristics, description by country

		All N=51	Bulgaria N=19	Greece N=8	Poland N=14	Portugal N=10
Rely on recommendations for caries risk management		2	0	1	0	1
Missing value n(%)		31 (63.3)	12 (63.2)	4 (57.1)	10 (71.4)	5 (55.6)
	Missing value	2	0	1	0	1
Carry out caries risk assessment at every patient	Yes	28 (57.1)	9 (47.4)	7 (100)	5 (35.7)	7 (77.8)
	Only on the first visit	12 (24.5)	8 (42.1)	0	2 (14.3)	2 (22.2)
	Missing value	23	10	1	9	3
You carry out caries risk accorry ant p/0/)	For children	10 (35.7)	4 (44.4)	2 (28.6)	0	4 (57.1)
You carry out carles risk assessment n(%)	For elderly patients	8 (28.6)	4 (44.4)	3 (42.9)	1 (20.0)	0
	Other	10 (35.7)	1 (11.1)	2 (28.6)	4 (80.0)	3 (42.9)
	Missing value	42	17	8	7	10
Caries risk assessment do not carry out n(%)	If there is no caries	7 (77.8)	2 (100)	0	5 (71.4)	0
	Other	2 (22.2)	0	0	2 (28.6)	0
	Missing value	2	0	1	0	1
Mean frequency of accessment of the potient	Each visit	13 (26.5)	2 (10.5)	5 (71.4)	2 (14.3)	4 (44.4)
Mean frequency of assessment of the patient	Once a year	26 (53.1)	12 (63.2)	1 (14.3)	8 (57.1)	5 (55.6)
	Twice a year	10 (20.4)	5 (26.3)	1 (14.3)	4 (28.6)	0
	Missing value	2	0	1	0	1
	Oral exam	48 (98.0)	18 (94.7)	7 (100)	14 (100)	9 (100)
	Medical interview	39 (79.6)	15 (78.9)	5 (71.4)	14 (100)	5 (55.6)
	Salivary tests	4 (8.2)	0	0	1 (7.1)	3 (33.3)
	CRA tools (AAPD, HAS,)	4 (8.2)	2 (10.5)	0	0	2 (22.2)
Assessment of caries risk process n(%)	Dental software (Cariogram®,)	3 (6.1)	2 (10.5)	0	1 (7.1)	0
	Radiographic examinations	33 (67.3)	7 (36.8)	7 (100)	12 (85.7)	7 (77.8)
	Nutritional assessment	35 (71.4)	14 (73.7)	5 (71.4)	9 (64.3)	7 (77.8)
	Fluoridation	25 (51.0)	4 (21.1)	4 (57.1)	12 (85.7)	5 (55.6)
	Fluoride intake	20 (40.8)	4 (21.1)	4 (57.1)	10 (71.4)	2 (22.2)
	Others	6 (12.2)	2 (10.5)	0	2 (14.3)	2 (22.2)



Fluorescent and NIR Devices in Secondary Caries Detection. a Systematic-Review

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Objectives To systematically review the diagnostic accuracy of devices with fluorescence and near-infrared (NIR) in recurrent caries detection.

Methods A comprehensive search of electronic databases was conducted for studies from their inception until February 2023. Studies that evaluated the diagnostic accuracy of fluorescence-based devices and NIR cameras for caries detection were included. The review protocol was a priori registered in Prospero. Two reviewers independently screened the studies, extracted data, and assessed the risk of bias using the QUADAS-2 tool.

Results Of the initial 96 search results, a total of 9 studies were included in the systematic review.

Only one in vivo study was identified, showing 0.60/0.81 in terms of sensitivity and specificity when using a fluorescent device for detecting caries around amalgam restorations.

The rest of the studies were in vitro. Three of them used NIR devices to detect recurrent caries, showing 0.90-1 sensitivity and 0.71-1 specificity, while the others used fluorescence devices compared to conventional methods, such as visual examination and radiographs with 0.05-0.97 and 0.00-1 sensitivity and specificity respectively.

Conclusions The diagnostic accuracy of fluorescence and NIR devices for detecting recurrent caries varied widely across the studies. Fluorescence-based and NIR cameras are promising tools for recurrent caries detection. However, further research is needed to determine their diagnostic performance in vivo and in vitro and assess the feasibility of their clinical application.



Caries Originating From Impacted Third Molars and Relationship With DMFT

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Objectives This study aimed to evaluate the prevalence of caries on the distal surface of adjacent second molars caused by mesioangular and horizontally impacted mandibular third molars and their relationship with DMFT.

Methods The study was carried out at Selcuk University Faculty of Dentistry, Department of Oral and Maxillofacial Surgery. In the study, radiographs of patients who were scheduled for mandibular third molar surgery were examined. If the partially erupted or impacted third molars in the mesioangular and horizontal planes were in contact with the second molars, these patients were called for clinical examination. A total of 272 patients were included in the study. After clinical and radiological examination, DMFT values and distal caries of second molars were recorded. The effects of DMFT values, age and gender on the prevalence of caries in the second molars in contact with the mesioangular or horizontal wisdom teeth were evaluated by statistical analysis. One-way ANOVA and Chi-square tests were used for statistical analysis.

Results The prevalence of caries in the second molar teeth was found to be significantly higher in males. When the 20-30 and 30-40 age groups were compared, there was no statistical difference between the groups. Considering the DMFT values; the caries prevalence of the DMFT>5 group was statistically higher than the other DMFT groups (DMFT<1 and $1 \le DMFT<5$).

Conclusions Gender and DMFT values affect the prevalence of distal caries in the second molars which are adjacent to the mesioangular or horizontally impacted third molars. In individuals with high DMFT values, prophylactic extraction of third molars in mesioangular and horizontal positions should be considered.



Transition From Preclinical to Clinic: Perceived Stress of Dental Students

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Objectives For dental students, the transition to clinical practice might be stressful. However, there is limited literature on this topic. The aim of the study is to compare the perceived stress level of dental students in the same class one year before and after beginning clinical practice.

Methods The Perceived Stress Scale (PSS-10) was administered to 64 third-year dental students at Usak University Faculty of Dentistry during the academic year 2021–2022. One year later, the same students who transitioned to clinical practice were administered the same survey again. The variable of this study was the transition to clinical practice.

The statistical evaluation of the analyses was carried out using SPSS 23. The percentage distribution, t-test, Pearson correlation analysis, ANOVA test, and Tukey test were used for inter-group comparisons of the data, and the results were evaluated at a significance level of p < 0.05.

Results A total of 36 female and 28 male students aged between 20 and 30 was included into the study. There was no significant difference in total scores between genders before and after the intervention (p>0.05). A significant difference was found in the Perceived Stress Scale-10 (PSS-10) scores between pre- and post-application assessments (p=0.00). Moreover, significant differences were observed in items 1, 2, 3, 6, 9, and 10 of the PSS-10 (p<0.05). The dependent sample t-test indicated a significant difference in smoking habits within one year (p<0.05).

Conclusions Clinical practice is of importance to impact student perceptions of stress. Therefore, it is recommended that an adaptation process should be performed for the transition from preclinic to clinic.



Empathy and Professional Quality of Life Among Israeli Hygienists

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Objectives Professional quality of life has been studied intensely among physicians, nurses and dentists with only few studies relating to dental hygienists. The present study aims to examine the factors that affect empathy and professional quality of life of dental hygienists in Israel and explore their relationships with coping strategies.

Methods Invitations to participate in the study were distributed in 2022 through social media to licensed dental hygienists working in Israel. Hygienists who responded to the invitation were requested to complete the following questionnaires: 1. Jefferson Scale of Physician Empathy – Health Professionals (JSPE-HP); 2. Professional Quality of Life (ProQoL) which measures professional burnout (BO), compassion satisfaction (CS), and secondary traumatic stress (STS); 3. Coping Inventory for Stressful Situations (CISS) which measures 3 coping dimensions- task-focused coping (TC), emotional-focused coping (EC) and avoidance-focused coping (AC). **Results** 127dental hygienists fully completed the requested questionnaires. A series of linear regression analyses showed that the best predictors of subjects' empathy were task-oriented coping and burnout (R2= 0.19. F(2.104)=12.84, p<0.01); best predictors of secondary traumatic stress, compassion satisfaction, empathy, and age (R2= 0.57. F(4.97)=32.67, p<0.01); the best predictors of secondary traumatic stress were emotion-focused coping and burnout (R2= 0.36. F(2.100)=28.22, p<0.01) and the best predictors of compassion satisfaction were task-focused coping, burnout and emotion-focused coping (R2= 0.48. F (3.98) =30.32, p<0.01). **Conclusions** Hygienists' empathy, quality of life and coping strategies are interrelated and should be explored in more depth.



Impact of a Culturally Adapted Oral Health Intervention on Immigrant Parents' Perceptions

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Objectives This is a randomized cluster study aimed to assess the impact of a culturally adapted intervention on immigrant parents' oral health-related knowledge, attitudes, and indulgence regarding their children's oral health.

Methods Immigrant parents with new-born infants attending 7 geographically distributed health centres in Bergen, Norway were included in the study. Data on oral health knowledge, attitudes, and indulgence was assessed through structured questionnaires at baseline (0-6 months after birth) and follow-up (18-24 months after birth). Summary- and mean change summary scores were calculated for the outcome variables. Group differences in mean change scores were calculated by independent sample T-test. The intervention group (50.7% of participants) received 2 sessions at baseline and 6 months after. The intervention was in the form of oral health information translated to the participants' mother tongue (30-minute individual presentation, practical demonstration of tooth brushing techniques and a pamphlet with similar information). The control group received conventional oral health information. **Results** Participants were equally distributed, socioeconomically, between the intervention and control groups at baseline (n=345) and follow-up (n=212). Knowledge, attitudes, and indulgence improved between baseline and follow-up in the intervention and control groups. Regarding knowledge, the intervention group improved more than the control group in terms of mean change scores (standard deviation), 1.2 (2.9) and 0.8 (2.7), respectively. The control group improved more than the intervention group with mean change scores regarding attitude to oral hygiene [1.8 (4.9) versus 0.5 (4.4)], attitude to diet [1.3 (2.7) versus 0.5 (2.7), p<0.05] and indulgence [-1.4 (2.6) versus -0.5 (3.8)].

Conclusions The culturally adapted 2-session intervention had a limited effect on immigrant parents' oral health-related knowledge, attitudes, and indulgence. Involvement of staff members of the Child Health Care Centres in the provision of culturally adapted interventions at multiple intervals might improve the impact on immigrant parents' oral health perceptions.



Child Abuse Education Among Dental Personnel and Reporting Child Abuse

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Objectives The aim of this study was: firstly, to assess the association of the public health dental personnel's (PHDP) schooling/training on Child abuse and Neglect (CAN) in the last three work years with filing reports to the Child Welfare Services (CWS) and secondly to assess the association of expressed need of training on CAN with filing CAN reports to the CWS. **Methods** This national cross-sectional study uses data from an electronic survey census of the public health dental personnel (PHDP) from Norway (n=1791) conducted in 2019. For measures of association and regression analysis, the Pearson chi-square test and logistic regression were used, respectively. Data was reported with proportions, odds ratios (OR), and 95% confidence interval (CI). **Results** The overall prevalence of ever-filing CAN reports was 70% and 50% in the last three work years. The prevalence of having had CAN training during schooling and the last three work years was 56% and 79%, respectively. The logistic regression analysis showed significant OR (95% CI) of 2.5 (1.6-4.0) for one day CAN work training,2.5 (1.6-4.0) for 2-4 days CAN work training,5.0 (2.6-9.5) for 5 or more days CAN work training, 0.5 (0.3-0.8) for those that expressed the need for a little more training on CAN routines,0.5 (0.3-0.9) for those that expressed much more need for training on CAN routines. Education about CAN during schooling was not associated with filing CAN reports

Conclusions Child abuse and neglect training during work in the previous three years of schooling is associated with filing reports of concern in the last three years but not during schooling among PHDP of Norway. The likelihood of filing reports of CAN increased with the number of days of CAN training during work and reduced with an expressed need for training on routines of reporting CAN.



Systematic Review of Longitudinal Associations Between Oral and Mental Disorders

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Objectives We aimed to map the existing research and critically review longitudinal studies that have examined diseases of the oral cavity in individuals with mental disorder and vice versa.

Methods Complying with the JBI framework for scoping review, we systematically searched in MEDLINE, PsycINFO, EMBASE, Cochrane Library, and Scopus for relevant articles published during the last 20 years. Each review step is done by two reviewers independently before resolving by consensus as necessary. Covidence was used for screening and data extraction. Newcastle-Ottawa Scale was used for quality assessment. Sankey diagrams are used for presenting the main findings. The review protocol is registered with Open Science Framework: https://doi.org/10.17605/OSF.IO/VRPU9

Results The systematic search resulted in 10,604 unique references. Upon title and abstract screening, 283 papers were selected for full text review. Exclusion reasons were mainly lack of longitudinal data (n= 84) and sub-standard definitions or misclassifications of mental or oral diseases (n=44). Thus data were extracted from 128 studies. Most studies were conducted in Taiwan (n=29, 22%), USA (n=22, 17%), Japan (n=14, 11%), South Korea (n=10, 8%), Sweden (n=8, 6%). Preliminary findings revealed that tooth loss/number of teeth, periodontitis and Sjogren's Syndrome were the most common oral health exposures. Tooth loss was associated with dementia (n=9 studies), cognitive impairment (n=13) and depressive symptoms (n=4). Periodontitis was associated with dementia (n=7), cognitive impairment (n=6) and depression (n=4). Sjogren's Syndrome was associated with dementia and other cognitive disorders (n=5) and depressive disorders (n=3). Fewer studies investigated mental health exposures, and they reported that depression and dysthymia were associated with increased risk of temporomandibular disorders (n=5).

Conclusions The findings reveal evidence for potentially bidirectional causal associations between sets of oral and mental disorders highlighting niches for future investigations. Clinicians managing oral and mental health patients need to screen for coexisting conditions and provide treatment and support accordingly.



Socio-Economic Factors and Tooth Loss in Young Adults With Periodontitis

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Objectives To investigate the relationship between education/income and tooth loss over 10 years in young adults with periodontitis **Methods** This register-based study was conducted retrospectively on 471 patients aged <36 years who had been diagnosed and treated for periodontitis at two specialist clinics in periodontology in Stockholm Sweden between 2003 and 2009. A majority had periodontitis Stage 3 and Grade C at baseline. The variables were collected from the baseline clinical examination and from two national healthregisters; the Swedish dental health register at the National Board of Health and Welfare and the LISA register at SCB Statistics Sweden. The tooth loss between the years 2009-2019 was registered. Statistical analyses were performed with negative binomial regression. Confounding variables to the relationship between tooth loss and education/income were included in the analysis.

Results The mean number of lost teeth due to periodontal reasons during the follow-up period was 1.4 (range 0-26). The tooth loss was significantly (p=0.004) lower for individuals with a post-secondary education \geq 3 years while income had no influence on tooth loss. The confounders smoking, interruption of specialist treatment and age were significantly correlated to tooth loss. **Conclusions** Tooth loss for young adults with periodontitis, was significantly lower among the group with a post-secondary education \geq 3 years, when adjusted for confounding variables.



Variable	Description
Age (years, mean (SD))	27.7 (6.5)
Females (N (%))	266 (56.5)
Smoking habits (N (%)):	-
Non-smoker	305 (65.7)
Smoker	128 (27.6)
Former smoker	31 (6.7)
Systemic disease (N (%))	38 (8.9)
Education (N (%)):	-
Elementary school <9 years	75 (16.0)
Gymnasium 2-3 years	214 (45.7)
Post-secondary education <3 years	75 (16.0)
Post-secondary education >3 years	104 (22.2)
Annual income (swedish crowns (N (%)):	-
<240.000	146 (31.1)
>240.000 and <430.000	172 (36.6)
>430.000	152 (32.3)
Periodontal classification (N (%)):	-
Periodontitis stage I	14 (3.0)
Periodontitis stage II	59 (15.6)
Periodontitis stage III	366 (78.2)
Periodontitis stage IV	29 (6.2)
Periodontitis grade (N (%)):	-
A	2 (0.4)
B	86 (18.4)
C	380 (81.2)
Extent of periodontitis (N (%)):	-
Generalized	223 (47.6)
Localized	148 (31.6)
Molar/incisor pattern	97 (20.7)
Interruption of specialist treatment	246 (52.2)
Supportive care during follow-up period (N (%)):	-
Never	56 (11.9)
Less than every two years	182 (38.6)
Every two years	163 (34.6)
At least every year	70 (14.9)

TABLE 2 Negative binomial regression analysis: tooth loss due to periodontal reasons in relation to education and income after inclusion of confounding variables. N=471.

Variable	Incidence risk ratio	95% Confidence interval	р
Education (N (%)): Elementary school <9 years Gymnasium 2-3 years Post-secondary education <3 years Post-secondary education >3 years	- 2.06 2.02 1.99 1	1.30 - 3.28 1.37 - 2.99 1.25 - 3.16	0.002 <0.001 0.004
Annual income (swedish crowns (N (%)): <240.000	1.23	0.87 – 1.74 0.77 – 1.52	0.24 0.64


>240.000 and <430.000 >430.000	1.08 1		
Smoking	2.23	1.69 – 2.92	< 0.001
Interruption of specialist treatment	2.23	1.70 - 2.94	< 0.001
Age (one year)	1.06	1.03 – 1.08	< 0.001



Bonding Neat Hydrophobic Resins to Etched Dentin

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Objectives To evaluate the effect of different concentrations of dimethyl sulfoxide (DMSO) used as dentin pretreatments on the resindentin bonding performance of neat hydrophobic resins.

Methods Mid-coronal flat dentin surfaces from 60 sound molars were etched with H_3PO_4 for 15s, rinsed for 15s and randomly divided into 12 groups according to the hydrophobic adhesive type (R1 or R2), DMSO pre-treatment concentration (5%, 50% or no treatment) or solvent removal approach (blot-drying or air-drying). Etched dentin surfaces were blot-dried, pre-treated or not with 50 or 5% (v/v) DMSO-ethanolic solutions for 60s and further air-dried for 30s (DMSO-dry bonding) or blot-dried (DMSO-wet bonding). For each pretreatment condition, bonding was performed using neat hydrophobic bonding resins: R1: 35 wt% E-BisADM; 14.4% TEGDMA; 0.5% EDMAB; 0.13% CQ; 50% ethanol, or R2: 35% BisGMA; 14.4% TEGDMA; 0.5% EDMAB; 0.13% CQ; 50% ethanol. Bonded teeth (n=5/group) were stored in distilled water (37 °C/24 h) and sectioned into resin-dentin beams (0.9 mm²) for microtensile bond strength testing (0.5 mm/min) until fracture. Bond strength data were analysed with factorial ANOVA and Tukey's test (α =0.05). Additional specimens were examined for interfacial nanoleakage analysis and hybrid layer characterization evaluation under SEM.

Results Bonding neat hydrophobic resins to etched dentin produced unreliable bond strengths with high occurrence of pre-test failures. Differently, DMSO-treated samples produced significantly higher bond strengths than untreated samples (p<0.05). DMSO concentration affected bond strengths depending on resin type and solvent removal approach (p>0.05). All groups showed well-defined hybrid layers along the interface with prominent multiple resin tags except for untreated samples.

Conclusions Although both solvent removal approaches and DMSO concentrations ranging between 5 and 50% may be used to effectively bond neat hydrophobic resins to etched dentin, higher DMSO concentrations followed by blot-drying may produce superior dentin bonding depending on resin hydrophobicity.



Adhesive-Resin Layer Thickness Influences Bond Strength to High C-Factor Dentin.

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Objectives To investigate the influence of different adhesive-resin application modalities on the effectiveness of a 2-step universal adhesive (UA) bonded in self-etch (SE) bonding mode to high C-factor class-I cavity-bottom dentin.

Methods After application of the primer of G2-Bond Universal (G2B, GC) followed by strong 3-bar air-blowing, G2B's adhesive resin was applied into standard class-I cavities (3.5x3.5x4 mm) prepared in recently extracted human third molars following four application modalities: (1) '1L_S': one layer strongly air-blown (3 bar); (2) '1L_G': one layer gently air-blown (0.25 bar); (3) '2L_G': two layers each gently air-blown (0.25 bar); (4) '1L_V': one layer not air-blown but vibrated for 15 s. Upon bonding, the cavities were filled with the restorative composite Clearfil AP-X (Kuraray Noritake). After being stored at 100% humidity (24 h) and in distilled water (6 days), the specimens were cut to obtain one single, central micro(μ)-specimen (1x1 mm) per tooth cavity (n=10), of which the adhesive-resin thickness was measured using optical microscopy. The μ -specimens were next subjected to micro-tensile bond-strength (μ TBS) testing immediately (0kTC) or upon 100k thermocycling (100kTC) aging. Statistical analysis involved the Kruskal-Wallis test and Mann-Whitney U test (p<0.05).

Results The μ TBS of G2B applied in SE mode to class-I cavity-bottom dentin was affected by the adhesive-resin application modality and aging (graph). Gentle (G) air-blowing of adhesive resin resulted in significantly higher μ TBS than strong (S) air-blowing or no airblowing (V). No significant difference in μ TBS was found between single or double adhesive-resin applications when the adhesive resin was gently (G) air-blown. The adhesive-resin thickness varied according to the different application modalities (1L_S: 12.8±4.5 μ m; 1L_G: 35.6±22.6 μ m; 2L_G: 90.3±66.5 μ m; 1L_V: 401.9±148.5 μ m).

Conclusions A too thin or too thick adhesive-resin layer thickness adversely affected the bond strength of the 2-step UA applied in SE mode and high C-factor condition.





Gelatinolytic Activity in Dentin Upon Adhesive Treatment

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Objectives Controversy remains over the impact of dental adhesives on gelatinolytic activity in dentin. In this study, we aimed to confirm or reject the existence of a definitive cause/effect relationship between dental adhesive application and the activation of host-derived gelatinases.

Methods The considered gold-standard three-step etch-and-rinse adhesive Optibond FL (Kerr) and the two-step self-etch adhesive Clearfil SE Bond 2 (Kuraray Noritake) were tested, so the data gathered concerned well-performing adhesives. The presence of gelatinases in dentin powder upon contact with two adhesives was assessed by gelatin zymography. Gelatinolytic activity along adhesive-dentin interfaces was imaged using *in-situ* zymography. Changes in MMP-2/9 activity upon interaction with adhesives, 37°C incubation, and temperature increase during light-curing of adhesives were evaluated by a high-throughput fluorogenic DQ-gelatin assay. Furthermore, the actual degree of involvement of enzymatic activity in bond degradation was investigated by intentionally challenging adhesive-dentin interfaces with 0.01-µM activated MMP-9 (a much higher concentration than present in saliva) for 1-month, upon which the micro-tensile bond-strength (µTBS) was measured.

Results Gelatin zymography disclosed the presence of gelatinases in phosphoric acid-etched dentin powder, while the two adhesives generated no measurable MMP activation. *In-situ* zymography revealed inconsistent interfacial gelatinolytic activity within the same specimen; this challenges the reliability of this technique when used to qualitatively examine gelatinolytic activity along adhesivedentin interfaces. In solution, MMP-2/9 activity significantly decreased upon interaction with both adhesives (two-way linear mixed effects model [LMEM]: p<0.05); gelatinases were almost completely deactivated upon 1-week incubation at 37°C (general linear model: p<0.05); light-curing increased temperature up to 70°C, which appeared sufficient to dramatically decrease MMP-2/9 activity (two-way ANOVA: p<0.05). Finally, challenging adhesive-dentin interfaces did not significantly affect mTBS (two-way LMEM: p>0.05). **Conclusions** The two gold-standard adhesives did not activate but rather inhibited the release and activation of residual gelatinases in dentin.



0191 Saliva and Ferric Sulphate Contamination on Immediate Dental Sealing <u>S. OKUT</u>, N. Cobanoglu, R. Oner Faculty of Dentistry, Selcuk University, Konya, Turkey

Objectives This study was to evaluate the effect of saliva and hemostatic agent contamination to the dentin by applying total etch to be IDS on the bond strength of the indirect restoration to dentin.

Methods Caries-free molars were cut horizontally to obtain smooth dentin surfaces and divided into 4 groups according to the surface treatment before the temporary restoration: Group1: Viscostat and saliva contamination (SFC)+IDS, Group2: SFC, Group3: Non-contaminated+IDS Group4: Non-contaminated+Non-IDS. IDSs were made with a universal adhesive system in total-etch mode (Prime&Bond, Dentsply Sirona). All dentin surfaces were then sealed with light-cured temporary filling material (Diatemp). After 2 days in distilled water, the temporary filling material was removed and the surfaces were washed with water for 5 seconds and dried. Composite blocks of 1mm radius were bonded to dentin with the same universal bond in total-etch mode. The teeth were kept in distilled water for 3 days and then subjected to shear fracture test. Data were analysed by one-way Anova and multiple comparison Post Hoc (Tukey) tests (p < 0.05).

Results The highest bond strength values were obtained in group1 (52,97MPa) and group3 (42,45MPa) where IDS was applied. There was no significant difference between the bond strength values of group4 (27,97MPa) and group2 (32,83MPa) without IDS application. Only the difference between the bond strength values of group 1 and group 4 was statistically significant. In all groups, debonding occurred between two bond layers.

Conclusions IDS to dentin significantly improved the bond strength of indirect restorations. Contamination had no effect on the bond strength of the restoration to dentin in the groups with and without IDS.



Bonding Effectiveness of New Etchants and Adhesives to Enamel/Dentin

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Objectives To determine bonding effectiveness and bond durability of adhesives to enamel/dentin using different etchants. Methods One-hundred extracted human third molars were randomly assigned into 20 groups according to the combination of three variables: SUBSTRATE (enamel, dentin), ETCHANT (phosphoric-acid monomer-containing Multi-etchant [Yamakin] and four phosphoric-acid etchants: experimental high-viscous Longly400 and low-viscous Longly200 etchants (gel-thickening with silica) [Longly Biotechnology], DX.Etch 37 (gel-thickening with xanthan gum) [Sino-Dentex], and K-Etchant [Kuraray Noritake] serving as conventional etchant control), and ADHESIVE (Single Bond Universal (SBU) and Single Bond 2 (SB2) [both 3M Oral Care]). The 'immediate' and 'aged' (20k thermocycles) micro-tensile bond strengths (µTBSs) were measured. Etching patterns and adhesivedentin interfacial nanoleakage with ammoniacal AgNO₃ were examined by SEM. Surface roughness of etched dentin was measured by AFM. Water-contact angle on etched dentin was recorded by an OCA 20 instrument. Statistics involved linear mixed-effects modeling and one-way ANOVA to analyse, respectively, the µTBS data, and the roughness and contact-angle data (p<0.05). Results When bonded to enamel, the significantly lowest µTBS was recorded for the Multi-etchant/SBU and Multi-etchant/SB2 combinations. Upon aging, significant reduction in µTBS to enamel was recorded for Multi-etchant/SB2, Longly200/SB2 and DX.Etch 37/SB2. When bonded to dentin, a significantly lower µTBS was recorded for Longly400/SBU as compared with K-Etchant/SBU. The aged µTBS of all etchant/SBU combinations was significantly higher than that of the etchant/SB2 combinations, except for Longly400. SEM showed that Longly200 produced similar etching patterns as other phosphoric-acid etchants. Regarding nanoleakage, more continuous interfacial silver-particle deposition was observed for Longly400/SBU than for Longly200/SBU. The water-contact angle of Longly200 was significantly lower than that of all other etchants.

Conclusions The experimental low-viscous Longly200 etchant produced superior dentin-bonding performance than the high-viscous Longly400 variant. More durable enamel and dentin bonding was obtained when the etchants were combined with SBU.



Salivary Microbiome as a Periodontitis Diagnostic Biomarker Removing Batch Effects

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Objectives To evaluate the predictive capacity of salivary microbiota at the amplicon sequence variant (ASV) level in periodontally healthy and untreated-periodontitis patients, both before and after removing the batch effects (BEs).

Methods Unstimulated saliva was collected from 124 patients (50 controls, 74 periodontitis) in our clinical setting. Sequencing of the V3-V4 16S rRNA gene region was performed in Illumina MiSeq. Sequences and metadata were uploaded to the sequence read archive (SRA). Searches were conducted in PubMed, Scopus, Embase, and the SRA to identify previously published Illumina V3-V4 sequencing studies on the salivary microbiome in different periodontal conditions. Investigations that met the sequence and metadata criteria were included in the meta-omics analysis, comprising 796 samples. Sequences were processed under the same bioinformatics protocol, using an oral-specific database for taxonomic assignment. Predictive modelling analysis was performed with the mixOmics package before and after removing BEs with the PLSDA-batch package.

Results Before removing the BEs, models constructed using all samples (796) consisted of 16 ASVs (0.16%) and had an area under the curve (AUC) of 0.944; and models built using two-thirds of the specimens (training=531) comprised 35 ASVs (0.36%) and had an AUC of 0.955 after being validated on one-third of the samples (test=265). After BEs removal, these figures worsened as models required more ASVs (all=200-2.03%; training=100-1.01%) and had slightly lower AUC (all=0.935; test=0.947).

Conclusions Twelve (all samples) and three (training/test) times more predictive ASVs were needed to distinguish between conditions after excluding BEs. Nevertheless, before and after removal models suggested that saliva has relevant value as a biomarker for diagnosing health and periodontitis, with a small percentage of taxa having an outstanding capacity to discriminate between these conditions. The main health-predictor ASV was: *Streptococcus oralis dentisani*-AV1042; for periodontitis, these were: *Fusobacterium nucleatum vincentii*-AV10, *Mycoplasma faucium*-AV213, *Parvimonas* HMT110-AV21, *Treponema denticola*-AV38, and *Tannerella forsythia*-AV15.



Using SWATH-MS to Discover New Salivary Biomarkers for Discriminating Periodontitis

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Objectives To discover new salivary protein biomarkers capable of accurately diagnosing pre- and post-treatment periodontitis. Methods Unstimulated saliva samples were collected from 44 healthy periodontal subjects and 41 with periodontitis (stages III-IV). In the latter group, 36 received non-surgical periodontal treatment demonstrating clinical improvement after two months. Samples were analysed by the sequential window acquisition of all theoretical mass spectra (SWATH-MS), and proteins were identified employing UniProt human-specific database. The diagnostic capacity of the molecules quantified was determined with generalised additive models (GAM) to discriminate untreated periodontitis from health (first modelling), treated periodontitis from health (second), and untreated from treated periodontitis (third). The area under the curve (AUC) and other classification measures were obtained. Results A total of 377 salivary proteins were quantified. For differentiating pre-treated periodontitis from healthy periodontium, 21 molecules had an AUC \geq 0.850 and for 28 pairs was \geq 0.970 (sensitivity/specificity \geq 90%). The best univariate models were isoform 2 of tropomyosin alpha-3 chain (bias-corrected -bc- AUC=0.857; bc-accuracy=86.8%) and resistin (bc-AUC=0.848; bc-accuracy=85.0%); whereas the combination of beta-2-microglobulin with profilin-1 showed a bc-AUC=0.997 and bc-accuracy=96.3%. In the second modelling, 30 biomarkers had an AUC \geq 0.850 and for 49 combinations was \geq 0.980 (sensitivity/specificity \geq 90%). Individually, histone H3.1 and keratin, type II cytoskeletal 1 achieved the highest values (bc-AUC=0.897; bc-accuracy=87.8%; and bc-AUC=0.880; bcaccuracy=89.2%, respectively). These results increased to a bc-AUC=0.995 and bc-accuracy=97.7% by combining beta-2microglobulin with protein disulfide-isomerase A3. Regarding differentiating between pre- and post-treatment periodontitis, no single or dual model showed an accuracy of $\geq 60\%$.

Conclusions New single and combined biomarkers were discovered in saliva with excellent diagnostic accuracy for differentiating untreated and treated periodontitis from health by SWATH-MS. Univariate and bivariate models showed poor capability for distinguishing pre- and post-treatment periodontitis after two months. However, these results should be validated using other techniques.



Influence of gut Microbiome on Periodontitis

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Objectives Oral and gut microbiomes are the two most diverse ecosystems in the body, sharing a bi-directional relationship. Periodontitis being a systemic inflammatory disease, has been shown to be influenced by the gut microbiome. In this study, we aimed to identify gut bacteria that were associated with periodontitis.

Methods The cross-sectional data from a prospective population-based cohort, Study of Health in Pomerania (SHIP-TREND-0; N: 4420) was used. Periodontal examination (half-mouth, 4 surfaces) was performed to measure probing depth (PD) and clinical attachment loss (CAL). Various sociodemographic, behavioral, and oral hygiene variables were considered as covariates. Stool samples were collected, and genus-level microbiome profiles were determined by 16s rRNA sequencing using MiSeq platform (Illumina, San Diego, USA). After calculating alpha-diversity, 15 genera associated with periodontitis were selected via sparse principal component analysis (sPCA) and sparse partial least squares–discriminant analysis. Using these 15 genera as exposures, multiple regression models were performed for periodontal outcomes such as binomial CDC/AAP definition, mean CAL, mean PD, and teeth present, adjusting for covariates. P-values were adjusted for multiple testing (5% false discovery rate).

Results Our analysis sample comprised 3045 subjects (mean age: 49.08 ± 14.35 years, 48.4% males). The three components from sPCA explained a variance of 8.26%. Bacteroides were associated with no/mild periodontitis (β : -0.171 (95% C.I.: -0.261; -0.081)), mean CAL (-0.058 (-0.102; -0.015)), and mean PD (-0.039 (-0.059-; -0.019)). Butyrivibrio was associated with moderate/severe periodontitis (1.460 (0.337; 2.663)), mean CAL (0.811 (0.289; 1.333)) and mean PD (0.443 (0.196; 0.690)). Alloprevotella and Prevotella were significantly associated with moderate/severe periodontitis and mean PD. Mogibacterium and Holdemanella were significantly associated with mean PD.

Conclusions A wide range of genera were associated with at least one periodontal variable, but only a few showed significant associations with multiple stronger periodontal markers such as mean CAL, mean PD, or teeth present.



0196 The Peri-Implant Tissue Levels of Bcl-2 Family Proteins

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Objectives Intrinsic apoptosis, which is regulated by Bcl-2 family proteins, has an important role in chronic inflammatory diseases. The aim of the study was to identify the tissue levels of Bcl-2 family proteins in peri-implant diseases.

Methods 23 individuals with peri-implant mucositis, 25 individuals with peri-implantitis and 24 controls were included. The following clinical parameters were recorded: keratinized mucosa width, modified bleeding index, probing depth, modified plaque index, modified gingival index, keratinized tissue thickness. Marginal alveolar bone assessments were performed by a software program. Granulation tissues were collected during treatments of peri-implant diseases. The control tissue samples were collected during the second stage of implant surgery. The tissue levels of Bcl-2 family pro-apoptotic (Smac, Bad, Bim) and anti-apoptotic (Bax/Bcl-2 dimer, Bcl-xL/Bak dimer, Mcl-1/Bak dimer) proteins were determined by multiplex immunoassay method.

Results The pro-apoptotic proteins; Smac, Bad, Bim and anti-apoptotic proteins Bax/Bcl-2 dimer, Bcl-xL/Bak dimer, Mcl-1/Bak dimer were detected significantly higher in controls compared to patients with peri-implant mucositis (P<0.001) and peri-implantitis (P<0.001) respectively. While no significant was detected between peri-implant mucositis and peri-implantitis patients regarding on Bcl-2 family proteins .

Conclusions Our findings indicate decreased levels of pro and anti-apoptotic Bcl-2 family proteins in peri-implant diseases. This unregulated response may disturb the homeostasis of peri-implant tissue.



Elucidating the Pathological Properties of Gingival Fibroblast-Derived Extracellular Vesicles

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Objectives Extracellular Vesicles (EVs) are a heterogeneous group of nanoparticles secreted by every human cell. Recent studies suggest that EVs have a relevant influence on immune regulation in physiological, pathological, and even malignant processes. The aim of the studies presented here was to investigate the functional roles of inflamed gingival fibroblast-derived EVs in inflammation and cancer.

Methods Human gingival fibroblasts (HGF) were cultured with *P.gingivalis*-LPS and the supernatant was purified by differential ultracentrifugation (100000 x g). EVs were subjected to smallRNA sequencing, and pathway enrichment analyses were performed. Moreover, we investigated the biological effects of inflammatory EVs by incubating THP-1 macrophages with concentrations of 2-200 CFDA-SE-stained particles/cell. The uptake was evaluated by flow cytometry and laser scanning microscopy and the expression of pro-inflammatory cytokines and M1 macrophage markers was measured by RT-qPCR, multiplex immunoassay and immunoblot. **Results** RNA sequencing of purified EVs revealed differential expression for 9 miRNAs (DEmiRNA) and pathway enrichment of respective target genes suggested that EVs of inflamed fibroblasts exert significant epigenetic influence within diverse pathological processes, especially cancer. Next, Cox proportional hazards and Kaplan Meier analyses were performed with various datasets from The Cancer Genome Atlas to evaluate whether inflammatory EVs may aggravate cancer mortality. The survival analysis confirmed increased cancer mortality of patients high in respective DEmiRNA expression.

Moreover, functional assays in THP-1 macrophages disclosed a dose-dependent uptake of EVs and a significant upregulation of cytokines IL-1 β , IL-8, TNF- α , and MIP-2. Intriguingly, inflammatory EVs seemed to induce polarization towards pro-inflammatory CD86⁺ CD80⁺ M1- macrophages.

Conclusions In summary, we demonstrate that pro-inflammatory stimulation of HGF results in a biologically relevant shift in EV composition, which warrants further investigation with respect to periodontitis-associated systemic diseases. Furthermore, our results suggest that EVs may constitute a novel way of pro-inflammatory signal transduction in phagocytes.



Oral Biofilm Composition, Dissemination, and Inflammation Depend on Probiotic Strain-Specificity.

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Objectives A number of inflammatory diseases are characterized by a disruption in the equilibrium between the host and its microbiome. Due to the increase in resistance, the use of antibiotics for the widespread, nonspecific killing of microorganisms is at risk. Pro-microbial approaches focussed on stimulating or introducing beneficial species as opposed to pathobionts may be a viable alternative for restoring the host-microbiome equilibrium. Unfortunately, not all potential probiotic/synbiotic species and even subspecies (as strains) are equally effective for the designated pathology, resulting in conflicting accounts of their efficacy. **Methods** To determine the magnitude of these species- and strain-specific effects, 16 probiotic candidates were evaluated for their probiotic and synbiotic potential (with glycerol) on *in vitro* oral biofilms, dissemination from biofilms to keratinocytes, and anti-inflammatory activity.

Results Species- and strain-specific effects and efficacies were observed in how they functioned as probiotics or synbiotics by influencing oral pathobionts and commensals within biofilms and pathobiont dissemination towards keratinocytes. A minority of the candidates were also capable of mitigating the inflammatory response of LPS-stimulated monocytes.

Conclusions For a rigorous assessment of probiotic therapy for oral health, a judicious selection of a fully characterized probiotic strain for the designated pathology is required to renounce the current "form over function" perception of probiotics.



Automatized Detection of Molar-Incisor Hypomineralisation (MIH) With Artificial Intelligence

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Objectives Molar-incisor hypomineralisation (MIH) is among the prevalent diseases especially in children and adolescents and needs to be reliably diagnosed. Here, the visual investigation is the method of choice. Aiming at objectifying visual investigation the use of intraoral photographs and methods of artificial intelligence (AI) may potentially contribute to an accurate diagnostic evaluation in the future. Therefore, the present study aimed at developing an AI-based algorithm that can detect, classify and localize MIH. **Methods** An image set comprised of 18.179 anonymous dental photographs (aspect ratio of 1:1, resolution 1200x1200 pixels with no compression, jpeg format and RGB colour space) was used. All images were pixelwise labeled with the computer vision annotation tool by a group of trained annotators and independently checked and corrected by an experienced dentist. The detection and classification of MIH followed the recommendation by the European Academy of Paediatric Dentistry (EAPD). The AI-powered algorithm was trained using a pipeline of methods, mainly image augmentation and adapting a transformer network (SegFormer B5, Nvidia, Santa Clara, USA). The entire image set of single tooth photographs (N= 18,179 images) was divided into a training (N=17,179) and test set (N=1,000).

Results After 250 training epochs and finetuning of the AI-based model the following key parameters were documented: The intersection over union (IoU), accuracy (ACC) and average precision (AP) amounted to 0.671, 0.831 and 0.993 for demarcated opacities, respectively. The same parameters were determined for enamel disintegrations (IoU 0.499, ACC 0.673, AP 0.999) and atypical restorations (IoU 0.827, ACC 0.894, AP 0.999).

Conclusions It can be concluded that it was possible to achieve an excellent agreement for MIH detection, classification and segmentation using standardised, single-tooth photographs and a vision transformer model. Nevertheless, the current model (accessible online: https://demo.dental-ai.de) needs be further improved and evaluated under clinical conditions.



Semi-Supervised Dental Deep Learning for Angle Classification

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Objectives Deep learning (DL) is increasingly used for dental applications. However, most DL models are trained in a supervised manner where large amounts of expert labeled data are required. To explore the potential of unlabeled data in dentistry we applied semi supervised learning to one exemplary dental task; Angle classification of intraoral photographs.

Methods

5220 intraoral photographs of 2610 individuals (58% male and 42% female) were partly labeled by two orthodontists as Angle classes I - III, resulting in a dataset consisting of 3510 unlabeled photographs and 1710 labeled intraoral photographs (45.1%/ 34.6%/ 20.3%: Angle class I/II/III, respectively). A VGG-11 convolutional neural network was trained on the labeled dataset (teacher) and afterwards used for prediction on the unlabeled dataset. A second model (student) was trained on these predictions and fine-tuned on the labeled dataset. In a second cycle the student model was used to predict on the unlabeled dataset and became the teacher model. 5-fold cross validation was performed.

Results The first student model minimally outperformed the teacher model (mean [25-27th percentiles] area under the receiveroperating-characteristics curve (AUC) 0.80 [0.70, 0.96] and 0.79 [0.70, 0.94], respectively). The second student again minimally outperformed the first student (0.82 [0.71, 0.96]). The highest improvement (+ 4.1%) was achieved for Angle class III. Conclusions Semi-supervised learning showed minimal improvements in the specific task of Angle classification of photographs. It may, however, make models more generalizable and has the potential to reduce the need for expensive expert annotations.



Model Order Reduction for Real-Time Simulation of Tooth Autotransplantation

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Objectives Tooth autotransplantation has gained renewed attention thanks to digital dentistry, but the biomechanics of transplanted teeth remains poorly understood. Finite element (FE) models have shown promise in better understanding the biomechanical risks, but their creation is time-consuming. Model order reduction (MOR) techniques have been used in the medical field to reduce computing time, and this study aimed to develop a reduced model of a transplanted tooth using the Higher-Order Proper Generalized Decomposition method.

Methods The FE model of a previous study was used to learn von Mises root stress, and axial and lateral forces between 75 and 175N were used to simulate different occlusions. For the finite element analysis, all dental materials were supposed homogeneous and linearly elastic except for the periodontal ligament that was supposed hyper-elastic. For model order reduction, the procedure follows a two-stage offline-online decomposition. In the offline stage (learning phase), snapshots are generated with high fidelity simulations. In the online stage, the results are interpolated with respect to the model parameters.

Results The reduced model's accuracy varied between 0.1 and 5.9%, and lateral forces were less accurate. Using MOR significantly reduced the time required to deliver root stresses by an average of 5.9 hours.

Conclusions This study provides a proof of concept for real-time stress values using MOR, accurately capturing the biomechanical behaviour of transplanted teeth while significantly decreasing computing time. Future work may include development of an aid decision system based on real-time simulation of the biomechanics of the transplanted tooth to help dental surgeons decide the best position during the surgery.



Advancing Tooth Autotransplantation: in-Silico Modelling and Finite Element Analysis Insights

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Objectives Tooth autotransplantation (TAT) is a viable biological approach for tooth replacement in children and adolescents. This study aimed to develop an innovative workflow utilizing in-silico modeling to evaluate tooth autotransplantation (TAT) outcomes. **Methods** Patients were retrospectively screened from the University Hospitals of Leuven's TAT database, with the inclusion criteria being patients younger than 15 years who had undergone TAT from the upper premolar region to an upper central incisor site and had pre-operative and 1-year post-TAT cone beam computed tomography (CBCT) scans. Patient-specific segmentations were performed for all relevant structures (maxilla, tooth, enamel, pulp, and periodontal ligament), followed by meshing and finite element analysis (FEA) of all included cases based on two clinical situations: masticatory force simulation, where a 200 N load was applied perpendicularly to the vestibular face of the studied teeth. A one-way ANOVA test was used to assess pre- and post-operative stress values. Finally, a surface part comparison analysis allowed to quantify hard tissues changes following TAT.

Results A total of 20 cases were included in the study. Masticatory force simulations revealed heterogeneous stress distribution patterns at the root of the transplanted tooth compared to the control central incisor, with the control tooth exhibiting a significantly lower standard deviation of stress values (p<0.001). Notably, 47% of the transplanted teeth demonstrated high-stress distributions in the apical third of the root, correlating with increased hard-tissue gain at the 1-year follow-up[ME1]. For all cases, stress values following simulated trauma were lower at follow-up compared to the day of transplantation.

Conclusions In-silico modeling using FEA offers a promising approach for enhancing the understanding of tissue healing and remodeling following TAT.



Workflow for Augmented Reality in Endodontic Access Navigation

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Objectives The objective of this study was to develop a workflow that integrates an augmented reality system for navigation during primary access preparation in endodontic procedures through an operation microscope.

Methods A patient CBCT was segmented and combined into a 3D surface scan to generate a 3D printable *in vitro* model with integrated roots and root canals for the simulation of difficult endodontic access preparations. The crown, root as well as root canals of the specific tooth were color coded in the segmentation for visualization with the augmented reality. Small fiducial ArUco markers were laser engraved into the rubber dam clamp to enable marker-based optical tracking and 6 degrees of freedom pose estimation. The operation microscope was equipped with an optical see-through display and a camera system for live video capturing.

Results Endodontic access preparation can be successfully simulated on different teeth with the newly generated *in vitro* model. Reliable marker tracking and pose estimation were achieved with the operation microscope. The clinical position of the rubber dam clamp with integrated fiducial markers was digitalized by a 3D surface scanner and can be used to orient the CBCT during live tracking of the markers. Color coded pulp, crown and roots increased the visibility in the optical see-through display and provides orientation during canal probing.

Conclusions Integrating an augmented reality into the operation microscope for endodontic access preparation is feasible and has the potential to facilitate the direct transfer of a CBCT into the operation field.



Benchmarking Federated Learning Methods for Tooth Segmentation on Panoramic Radiographs

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Objectives Robust deep learning models need large amounts of diverse training data, while sharing sensitive medical data remains challenging due to data protection concerns. Federated Learning (FL), a collaborative learning paradigm, allows for training of interinstitutional models without sharing data. Instead, model parameters, locally trained by individual clients, are shared and aggregated to a global model. We assessed three different methods for FL parameter optimization for one exemplary dental task, tooth instance segmentation on panoramic radiographs.

Methods We simulated FL with data from 9 institutes around the globe as part of the ITU/WHO Focus Group AI for Health. The datasets consisted of 143 to 1,880 panoramics (mean age 43.8 years; 50.1% female), each containing pixelwise annotated tooth instance segments using FDI notation. A U-Net segmentation model using a ResNet-18 backbone was trained for 100 global rounds and 4 local epochs in each round. Three optimization methods, namely (1) Federated Averaging, the most common method in FL (FedAvg); (2) FedAvg including a proximal term for parameter regularization (FedProx) and (3) Stochastic Controlled Averaging for Federated Learning (SCAFFOLD), were compared. 5-fold cross-validation was employed. Model performance was tested for statistically significant differences using the non-parametric Mann-Whitney U test against FedAvg as the reference group. **Results** The global model trained using FedAvg achieved a median (IQR) F1-score of 0.895 (0.002) on the test sets of respective institutes. No significant difference against FedProx (0.894 (0.002); p = 0.69) was observed, while SCAFFOLD performed worse (0.882 (0.012); p < 0.01), however significance should not be overestimated given the low sample size.

Conclusions The assessed FL optimization methods did not yield any benefits for the task of tooth segmentation in comparison to FedAvg.



Dental Hemostasis: Clinical Trial on Real-Life Practice

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Objectives The aging of the population has resulted in an increase in the number of people being treated with drugs affecting hemostasis. In daily practice, both in hospitals and in the private sector, clinicians are likely to face more and more patients with an increased risk of bleeding. Various materials are available to manage these issues and their evaluation may be necessary. The aim of the present study is to measure the clinical performance and security of the hemostatic agent Hemocollagene in its indication of adjuvant hemostasis in routine oral surgery.

Methods This real-life, multicenter, prospective, observational study was conducted through the clinical research network ReCOL, in France and in Belgium in 10 centers including 2 hospitals and 8 private practices. The rate of achieving hemostasis after 5 minutes using the Hemocollagene agent was assessed.

The population was divided into different subgroups according to age and the presence of factors influencing coagulation (antiplatelet or anticoagulant treatment, hemostasis pathologies).

A follow-up visit was carried out at 31.4 days to evaluate the resorption of the agent, postoperative complications and gingival healing was also evaluated using the Landry's Tissue Healing Index.

Results The proportion of patients whose bleeding was stopped within 5 minutes of using the collagen sponges was 87.8% (IC95 [82.0; 93.6] %) in the total population (n=123). At the follow-up visit, the Landry Tissue Healing Index Score was classified as good, very good or excellent in 96.3% of cases after a mean time of 31.4 (SD: 9.8) days post-surgery.

Conclusions The results obtained are comparable to those reported in the literature for similar materials: they validate the efficacy of the material studied for hemostasis and gingival healing in both healthy patients and patients with factors influencing coagulation. The tolerance and safety of the product were also confirmed.



0206 Endo-Sinus Bone Formation in Lateral Sinus Lift After Membrane Suturing

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Objectives The aim of this study was to investigate the effect of membran stabilization by suturing sinus membrane compared with inserting dental implant on endo-sinus bone formation in lateral sinus lifting performed without grafting.

Methods Maxillary sinus lift surgery using lateral approach was performed in 30 New Zeland white rabbits bilaterally. Maxillary sinus areas were divided into control and test groups. In control group, a titanium screw was placed after sinus membrane elevation and in test group, the sinus membrane was sutured to the lateral walls and a titanium screw was placed in the center of alveolar crest. Animals were sacrified at 4. and 8. weeks. Samples were collected and micro-CT analysis were performed. The volume of newly formed bone, percentage of osseointegration, sinus volume, residual bone height and protrusion length of implants were measured in micro-CT analysis.

Results The sinus volume, volume of newly formed bone and percentage of osseointegration in test group were found statistically higher than in control group at 4. week. (p=0.01, p=0.04, p=0.02, respectively) While the volume of newly formed bone was 17.1±3.08mm³ in control group, those was 26.9±14.26mm³ in test group at 4. week. The volume of newly formed bone was significantly decreased from 26.9±14.26mm³ to 17±3.66mm³ at 8. week. (p=0.02) There was not significantly difference in residual bone height at 4. and 8. weeks. (p=0.07) It was not found significantly difference in implant protrusion length between control and test groups. (p=0.18) It was found that there was a negative relation between protrusion length and new bone formation in the sinus. (p=0.01).

Conclusions Suturing sinus membrane to lateral sinus wall was an effective approach to increase osseointegration, bone volume and sinus volume in short-term period. The use of a slow-absorbing suture material can be used to maintain sinus volume as well as bone volume in long-term period.



0207 Vertical Bone Deficiency Treatment Techniques: Systematic Review <u>D. Şahar</u>, I. ARI, S. Adiloğlu, A. Aktas Oral and Maxillofacial Surgery, Hacettepe Univercity, Ankara, Turkey

Objectives The aim of this study is to compare bone gain, implant survival and success rates, and bone resorption parameters at distraction osteogenesis(DO) and interpositional grafting(IG) techniques in vertical bone deficiency.

Methods An electronic literature research was performed in PubMed/MEDLINE, ScienceDirect, Scopus and Google Scholar databases. Distraction osteogenesis (DO), interpositional grafting (IBG) were searched as keywords. Randomized controlled clinical trials, prospective and retrospective studies were included, case reports and systemic reviews were excluded. Implant survival and success rates, bone gain and bone resorption values were recorded and the parameters were compared between distraction osteogenesis, interpositional grafting.

Results 243 articles were found at the electronic databases and only 39 articles were included because of the exclusion criterias. There were 251(118 women and 92 men) patients with a mean age of 45,3 in the DO group, while there were 368 patients (197 women and 123 men) with a mean age of 32 in the IG group. The median bone gains were 9.06 mm (DO) and 5.78 mm (IG,); the median bone resorptions were 1.76 mm (DO) and 1.18 mm (IG). The implant survival rate was 97% for each group, while the implant success rate was 95.4% (DO) versus 92.28% (IG). According to the results, there is not a significant difference between groups at the median bone resorption, implants survival and success rates. Nevertheless, the median bone gain at DO was higher than IG.

Conclusions Although distraction osteogenesis and interpositional grafting techniques are viable and effective treatments for vertical ridge augmentation, DO could have advantageous for the bone gain. On the other hand, the amount and type of soft tissue should be evaluated to decide the most effective treatment option at vertical bone deficiencies. Larger sample size with soft tissue evaluation are needed in literature.



Objectives Osteolytic lesions associated with impacted third molars can show different diagnoses which need confirmation by histological examination. In most cases, there is a tendency to attribute these cystic neoformations to a dentigerous cyst (DC) due to its high frequency. The purpose of this retrospective study was to identify and present the frequency of the unexpected diagnosis of unicystic ameloblastoma (UA) or odontogenic keratocyst (OK) when a presumptive diagnosis of dentigerous cyst (DC) was made due to similar clinical and radiographical characteristics

Methods This study was designed as retrospective study based on clinical and radiographical records of patients presented at the Department of Oral Surgery of the University of Naples Federico II from 2000 to 2020. The inclusion criteria were: 1) radiolucent lesions associated with an impacted third molar > 2,5 mm; 2) association between lesion and cement enamel junction 3) presumptive diagnosis of dentigerous cyst according to clinical and radiographical findings; 4) availability of histological exam. All preoperative diagnosis of DC were selected and frequency of concordance with histological exam was reported.

Results From 1358 records checked a total of 607 were selected for the study. Of those, 350 (57,7%) were from male patients and 257 (42,3%) from female. The age of patients ranged from 16 to 66 years with a mean age of 28,1± 8,1 years. Of 607 presumptive diagnoses of dentigerous cyst, 491 (80.9%) were diagnosed and confirmed as DCs, 72 (11.8%) as OKs, 26 (4.3%) as UA and 18 (3%) undetectable.

Conclusions Radiolucent lesions associated to an impacted mandibular third molar can elicit different clinical diagnosis. Although they can have similar radiographical findings, clinical behavior as local aggressiveness and recurrence rate is very different, so the histological exam is mandatory in all cases irrespective to clinical presumptive diagnosis to establish the best treatment and follow-up



Factors Involved in the Recurrence of Odontogenic Keratocyst: a Retrospective Analysis

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Objectives Odontogenic keratocyst (OK) is a benign developmental cyst of the jaw, showing an aggressive clinical behavior with high recurrence rate. OK is generally solitary, although it can present with multiple lesions, and is usually associated with nevoid basal cell carcinoma syndrome (NBCCS). Radiographically, OK presents as a well-defined radiolucent lesion with smooth and usually corticated margins. They may present as either a multilocular or unilocular radiolucent lesion. Numerous possible reasons have been suggested for the high recurrences; however, the exact reasons are still debated. The aim of this retrospective analysis was to evaluate the correlation between recurrence and clinical features of the lesion.

Methods This study was designed as retrospective study based one-hundred cases of OK treated at the Department of Oral Surgery of the University of Naples Federico II from 2000 to 2022. Age, gender, location of the OK and involved teeth were analyzed. Recurrence rate was reported and correlated with previous parameters.

Results OK occurred mainly in the 21- to 44-year-old age group with a predominance in male. The most frequent site was the mandibular angle and the most frequent involved teeth were mandibular molars. All lesions were treated with enucleation and curettage/peripheral ostectomy with or without extraction of involved teeth. The recurrence rate was 21%. The mean recurrence time was 4,5 years; one case recurred after 20 years. Remaining teeth statistically correlated with recurrence rate (p<0,05).

Conclusions The significant correlation between remaining teeth and recurrences rate may suggest the extraction of involved teeth, especially if the lesion is located between tooth roots or in the interradicular spaces, which makes the totally surgical removal of the cyst difficult. More studies with greater sample and longer follow-up are needed to provide stronger and more reliable results.



Effect of Experimental Theaflavin Varnishes on Dentin Erosion

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Objectives Theaflavins have been found to have inhibitory activity against collagen-degradable enzymes thus, they may be effective while dentin demineralization occurs. Since varnishes are more retentive than gels and solutions, the purposes of the present in-vitro study are to measure the inhibitory effect of experimental theaflavin (2a/2b) containing varnishes on dentin losses and evaluate their effect against matrixmetalloproteinases.

Methods Dentin bloc samples ($3 \times 5 \times 2$ mm) were provided from human non-erupted third molars and were demineralized with citric acid (CA-0.3%) for 60 seconds to simulate dentinal erosive lesions. Then samples were allocated to six experimental and a control groups according to the material combinations (n=6): 1)Varnish A+TF2a, 2)Varnish B+TF2a, 3)Varnish C+TF2a, 4)Varnish A+TF2b, 5)Varnish B+TF2b, 6)Varnish C+TF2b and 7)Fluoride varnish as control. The varnishes were applied over the surfaces using a micro brush. After immersion in artificial saliva for 16 hours, samples were subjected to pH cycling using CA for 5 minutes for 5 days. Then the lesion area, depth, and mineral ratio were measured with micro-computed tomography (Micro-CT), and the effect of varnishes against MMPs was evaluated with Western Blot (WB) analysis. Obtained data were evaluated with One-way ANOVA at a significance of p>0.05.

Results MicroCT analyses showed that mean lesion depth and mineral ratios were significantly reduced in experimental groups compared to the control group (p< 0.05). Lesion areas of the experimental groups were not significantly different from each other but, the control group presented significantly lower lesion depth (p<0.05). WB analysis showed significantly lower MMP-2 levels in experimental groups than in the control (p<0.05). There were no statistically significant MMP-9 levels among the groups tested (p>0.05).

Conclusions Dental varnishes containing theaflavin 2a and 2b showed promising results in reducing dentinal wear and collagen degradation, likely due to their anti-MMP action. Therefore, using theaflavin varnishes may be suggested as natural-based agents for preventing dentin erosion.



The Role of Calcium in the Prevention of Dental Erosion.

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Objectives To review and critically appraise the scientific literature regarding the role of calcium formulations in the primary and secondary prevention of erosive tooth wear.

Methods A literature search was conducted in electronic databases and *in situ* randomized controlled trials evaluating the prevention of ETW following the application of calcium formulations prior, during or after an erosive challenge were included. Study characteristics and outcomes of included studies were summarized. Cochrane's Risk-of-bias tool 2.0 was used to assess the quality of eligible studies and meta-analyses using a random effects model was performed.

Results The search retrieved 440 studies of which 21 were considered eligible. The results from the first quantitative syntheses performed showed that there was no statistically significant difference in mean surface microhardness of eroded enamel between chewing gum with CPP-ACP and that without (MD 2.22 [95% CI -4.53, 14.21], p = 0.31, $l^2=71\%$). The second synthesis indicated statistically significant decreased mean enamel loss when blackcurrant juice with added calcium was compared to orange juice (MD - 2.61 [95% CI -3.95, -1.27], p = 0.0001, $l^2=89\%$).

Conclusions This study systematically evaluated the evidence and summarized all available data on the role of calcium in the prevention of erosive tooth wear providing useful recommendations for clinical practice. The addition of calcium in juice drinks led to reduced enamel loss, with the blackcurrant juice with added calcium presenting with 2.6 times less enamel loss compared to orange juice. Concerning the effect of milk and CPP-ACP pastes on dental erosion prevention the results were contradictory. No statistically significant difference in mean surface microhardness of eroded enamel was recorded between chewing gum with CPP-ACP and that without.



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Objectives It was hypothesized that an individual's chronotype profile has an effect on the performance of work or study tasks. Dental students have to cope with both academic and clinical workloads, and the latter requires extra concentration. The aim to assess sleep quality among dental students and to identify psychological factors associated with self-reported sleep bruxism (SB) and awake bruxism (AB) and chronotype profile. The null hypothesis was that there would be no association between psychological factors, sleep quality, and SB/AB in this population.

Methods The present cross-sectional descriptive study involved 225 dental students whose ages ranged between 18 and 30 years. In order to gather data, students were required to respond to a questionnaire, which aimed to evaluate possible SB and possible AB occurrence and demographics. For the assessment of the chronotype profile, the morningness-eveningness questionnaire (MEQ) was used. While excessive daytime sleepiness was analysed through the Epworth Sleepiness Scale (ESS). The chi-square test, the Mann-Whitney U test analyses were performed to evaluate the factors associated with SB, AB and chronotype profile.

Results Possible SB and AB was more frequently observed in females than in males. An association was also found between possible SB and chronotype profile. (p=.0,019) The prevalence in the eveningness profile who reported possible SB was 37,2%, while it was 20,2% in intermediate individuals and 6,7% in the morningness profile. No association was found between possible AB and chronotype profile. ESS score is higher in both SB/AB groups (6,14±,538/ 6,08±,374) however the difference is not statistical significant. (p=,274/p=,122)

Conclusions An association was found between possible SB and eveningness chronotype profile; however, no significant association was found between possible AB and chronotype profile. There was a positive correlation between the MEQ and ESS (total) scores.



Non-Carious Cervical Lesions: Experimental Spectral Loading Model

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Objectives Non-carious cervical lesion (NCCL) is considered a highly prevalent pathology, yet, its etiology remains unclear. The current study aims to explore the effects of mechanical loading and biocorrosion on the cervical tooth region, using a random spectrum loading model and innovative micro-CT analysis.

Methods Thirty extracted human premolars were randomly divided into three groups: teeth immersed in acid without load (biocorrosion group: Bc), teeth immersed in acid with load (biocorrosion with spectrum loading group: Bc-SL), and teeth immersed in distilled water with load (spectrum loading group: SL). The teeth were subjected to a range of random loads that simulate oral mastication by applying loads of varying magnitudes. Before and after the experiment, the teeth were scanned by micro-computed tomography (micro-CT). The loss of cervical tissue was evaluated circumferentially and in regions subjected to tension and compression using a newly developed 3D analysis technique.

Results The results revealed a statistically significant difference in circumferential volumetric loss between the three experimental groups, with the Bc-SL group exhibiting the greatest volume loss (p < 0.001). In addition, regions under tension (Bc-SL and SL groups) experienced a greater loss than regions under compression (p < 0.001, p = 0.007). In each experimental group (Bc, Bc-SL, and SL), the loss of dentin tissue was significantly greater than that of enamel (p < 0.001).

Conclusions The study highlights the significance of the cumulative effects of mechanical loading and biocorrosion in the development of NCCLs and the need to consider both factors in clinical management. The innovative 3D analysis provides important insights into the etiology of NCCLs and may be utilized in future research.



In-Vitro Assessment of Caries Lesion Remineralisation by µCT and Surface-Microhardness

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Objectives To determine the feasibility of X-ray computed tomography (µCT) and surface- microhardness (SMH) to accurately monitor remineralisation of artificial caries lesions after treatment with fluoride-containing dentifrices.

Methods 44 polished human enamel samples were initially demineralised for 14 days at 37°C by placing the samples in a methylcellulose suspension combined with 0.1 M lactic acid (pH 4.6) to create a "caries-like" lesion with a depth of 50-70 μ m. The samples were divided into 4 treatment groups (n=11): Pronamel Active Shield, Pronamel Intensive Repair, Crest Densify Active Repair, and a fluoride-free control. After demineralisation, reference area was created by covering half of the area with silicone glue. PH-cycling was conducted for 10 days with 5x15min demineralization (pH4.8) and dentifrices slurry treatment for two minutes twice per day. For times without demineralisation or dentifrices treatment, samples were stored in a remineralisation solution (pH7). After 5 days, 3 samples per test group were removed to obtain results from this time point. On 2 samples per test group an additional area was covered with silicon glue to obtain an additional reference area after 5 days of treatment and the treatment procedure was continued to day 10 for all remaining samples with subsequent μ CT and SMH investigation. For μ CT images, grayscale value line profiles corresponding to mineral density were taken from de- and remineralised regions to quantify the remineralisation. **Results** μ CT images showed a progression of remineralisation over 10 days for all fluoride-containing dentifrices compared to the control. The SMH measurements showed that all treatments increased the microhardness of the enamel lesions apart from the control.

Conclusions This in-vitro study has shown µCT and SMH can accurately monitor the remineralisation of artificial caries lesions, and that treatment with fluoride-containing dentifrices can lead to significantly higher lesion remineralisation after 5 and 10 days compared to a fluoride-free dentifrice.



The Influence of Air-Polishing With Erythritol on Exposed Dentin

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Objectives

Air-polishing (AP) is a common procedure within professional tooth cleaning for the removal of extrinsic stains and biofilm removal. Low-abrasive powders like erythritol allow application even on sensitive surfaces such as dentin. The aim of this clinical study was to verify whether the surface roughness increases after AP with erythritol powder and what influence subsequent classical polishing with cup and polishing paste has on surface roughness.

Methods

Using a split-mouth design, 54 non-adjacent, single-rooted teeth with vestibular exposed dentin surfaces were treated using either AP with erythritol, polishing cup and paste (test) or polishing cup and paste only (control). Finally, potential polishing paste residues were removed using a sonic toothbrush. At the beginning (baseline) and after each individual treatment step, A-silicone impressions of the respective teeth were taken, from which precise epoxy resin replicates were generated. The replicates were measured and analyzed by optical profilometry with respect to the arithmetic mean surface roughness value (sRa) and averaged surface roughness depth (sRz) and given as mean±standard deviation in µm. **Results**

After AP, in comparison to baseline, sRa increased slightly (0.168 \pm 0.143, p<0.001), while sRz did not change significantly (-0.471 \pm 4.857, p=0.936). Subsequent polishing with cup and paste followed by cleaning with a sonic toothbrush did not result in a smoother surface after AP (difference sonic to AP, sRa -0.044 \pm 0.081, p=0.218; sRz -0.551 \pm 3.563, p=0.903). **Conclusions** The use of AP with erythritol leads to a slight increase in roughness on dentin surfaces, which is not reduced by polishing with cup and polishing paste.



Structural Analysis of the Pericanalar Resorption Resistant Sheet After External Cervical Root Resorption

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Objectives Structural analysis of Pericanalar Resorption Resistant Sheet (PRRS) after External Cervical Root Resorption (ECR). To achieve this the structure and cell morphology of PRRS layers found in teeth with ECR need to be investigated. **Methods** In this multidisciplinary study three indicative cases with teeth having external cervical resorption (ECR), were analysed. After extraction, the internal and external tooth structure were assessed with a high performance NanoTom scanner (GE Measurement and Control Solutions, Wunstorf, Germany), which provided accurate images with a resolution of 7 µm. 3D modelling was done by using the CTAn, CTvol CTvox and DataViewer softwares (Bruker micro-CT, Kontich, Belgium). The micro-morphology was analysed with Scanning Electron Microscopy (SEM). The cellular structure was evaluted with histology (paraffin sections, Masson's trichrome, Hetatoxylin-eosin staining).

Results We have observed that, in vital teeth a resistant pericanalar layer remains around the vital pulp space. This layer has a fluctuating thickness of around 210 µm depending strongly on the location. It is thinner at the cervical tooth part, thicker in the middle root, whereas it is absent in the apical root third. It consists of predentin, dentin and bone tissue. Micro-analysis showed that this layer was relatively homogenous, apart from some scale areas where the pulp was altered. Further analysis showed that in these areas localized absence of the odondoblastic layer and inflammation occurred.

Conclusions The microstructure of the PRRS appeared to be homogenous without gaps or cracks. It was consisted of dentin and occasionally bone tissue. However, in areas with inflammation and absence of the odontoblastic layer the PRRS was interrupted. This suggests that the PRRS is resistant as long as the pulp remains vital and the odontoblasts remain active.



Novel Nanocomputed Tomography (NanoCT) Techniques Applied to Dental Research

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Objectives X-ray computed tomography (CT) has developed rapidly over the last decade, and the technological advances and user friendliness have made the technique applicable to virtually all branches of the natural sciences and manufacturing industries. TTo introduce a methodology designed to simultaneously visualize dental ultrastructures, including cellular and soft tissue components, by utilizing phosphotungstic acid (PTA) as a contrast-enhancement agent.

Methods Sound third molars were collected from healthy human adults and fixed in 4% buffered paraformaldehyde. To evaluate the impact of PTA in concentrations of 0.3%, 0.7% and 1% on dental soft and hard tissues for CT imaging, cementum and dentine-pulp sections were cut, dehydrated and stained with immersion periods of 12, 24 h, 2 days or 5 days. The samples were scanned in a high-resolution nano-CT device using pixel sizes down to 0.5 µm to examine both the cementum and pulpal regions.

Results Dental cementum, periodontium, odontoblasts, and predentine were made visible through PTA staining in high-resolution three-dimensional nano-CT scans. Different segments of the tooth required different staining protocols. The thickness of the cementum could be computed over the length of the tooth once it was made visible by the PTA-enhanced contrast, and the attached soft tissue components of the tooth's interior could be shown on the dentine-pulp interface in greater detail. Three-dimensional illustrations allowed a histology-like visualization of the sections in all orientations with a single scan and easy sample preparation. The segmentation of the sigmoidal dentinal tubules and the surrounding dentine allowed a three-dimensional investigation and quantitative of the dentine composition, such as the tubular lumen or the ratio of the tubular lumen area to the dentinal surface.

Conclusions Using a laboratory-based nano-CT technique, the staining protocol made it possible to visualize hard tissues along with cellular layers and soft tissues in teeth. The protocol depended on both tissue type and size. This methodology offers enhanced possibilities for the concomitant visualization of soft and hard dental tissues.



Dentine–pulp interface of untreated and PTA contrast-stained cuboid samples. A sagittal section of the nano-CT scan (a) and the 3D models of the reconstruction (b and c) show the untreated region of interest. A section (d) and the 3D reconstructions of the PTA-stained sample (e–f) enable visualization of the soft tissue (arrow) attached to the interface. 3D models use computer-generated colours, where the highest attenuation is indicated by red (odontoblasts), the lowest by black and a middle attenuation by light blue (arrow). P-pulp, D-dentine, PD-predentine.



Expression of Specific Ion Channels in Ageing of Human Odontoblasts

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Objectives Human pulp odontoblasts are multisensory cells and express multifunctional ion channels. Their potential sensory role in mediation of early stage of sensory process is not clarified well. The aim of the study is to examine and compare the age-dependent immunohistochemical distribution of three ion channels: TRPC5, KCNK2 (TREK1) and PANNEXIN1, responsible for thermo-mechanical activation and transmission of information between cells.

Methods Twenty intact teeth of healthy individuals were enrolled in the study and arranged in four groups (n=5 in each group) regarding the patients' age: tooth germs with young pulp (14-16 years old), adult pulp (18-22 years old), mature pulp (30-35 years old) and senescent pulp (55-61 years old) groups. All teeth were freshly extracted due to orthodontic indications (dental germs of third molars), difficult eruption (third molars) and periodontal and bone lost (premolars and incisors). The specimens were fixed overnight in 10% buffered paraformaldehyde, decalcified in a 3% hydrochloric acid (HCl) for 6 hours and paraffin embedded. Immunohistochemistry using mouse polyclonal antibody TRPC5, KCNK2 (TREK1) and PANNEXIN1, Thermo Fisher Scientific Inc., USA was performed by Leica-Bond Max automated system (Leica Biosystems, Germany). Statistical analysis including Kruskal-Wallis and Mann-Whitney tests were applied (p<0.05) by IBM SPSS Statistics 25.

Results In cellular ageing, significantly more KCNK2 (TREK1) was expressed in odontoblasts in the senescent group (p<0.05). Expression of TRPC5 was grater in mature and senescent groups but no significant difference was shown (p>0.05). Distribution of PANNEXIN1 revealed no age-dependent differences (p>0.05).

Conclusions Within the limitations of our study, with cellular ageing odontoblasts express more ion channels responsible for greater response to mechanical and thermal stimuli, whereas the transmission of information between cells does not show differences.



0227 Matrix-Based Oral Tissue Grafts: 3D-Printing of Bioarrays for Tissue Regeneration I. Redenski, A. Zigron, R. Fadoul, S. Srouji

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Objectives Both surgeons and bioengineers are constantly engaged to reestablish significant tissue defects. These defects necessitate approaches that promote wound healing, construct engraftment, and vascularization while avoiding a harsh immune reaction from hosts. To date, no single tissue replacement can bridge large defects with minimal scar tissue, support neovascularization and prevent a severe inflammatory response. When tissue-specific anatomy is considered, this goal becomes even more attainable. Herein, we propose a 3D-based methodology to assess the wound healing effect of autologous tissue grafts, their paracrine, and structural response on relevant cells at the engraftment site, as well as an anatomically-accurate fabrication of matrices for tissue grafting purposes.

Methods Several autologous tissue components are used in the current study for soft tissue-graft fabrication. Adipose-derived stromal cells and soft-tissue matrices from inguinal tissue pads in rats are harvested, and a heat-processed tissue graft is compared to naïve grafts. A polydimethylsiloxane array is fabricated based on a 3D design. These are loaded with either fibroblastic monocultures or vascularized co-cultures to assess the response of the grafts on cells relevant for engraftment. The effect is evaluated using confocal microscopy, viability assays, and paracrine assays. Eventually, grafts are utilized in an oral mucosa defect to assess their potential for defect healing.

Results Compared to the controls, tissue grafts that underwent heat processing exhibited extensive penetration by stromal cells, fibroblasts, and matrix components. In vitro vessel development was comprehensive and robust in these grafts as well. In a live animal model, these samples showed less immune response under histological examination, with extensive penetration of capillaries by hosts.

Conclusions The proposed methodology may aid in the evaluation of tissue grafts before their implementation. It may help promote simple and clinically relevant tissue replacements for patients needing tissue grafting.



Implant Material and Performance of Metal-Artifact Reduction in CBCT Images

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Objectives The aim of this study is to quantitatively investigate the effect of metal artifact reduction (MAR) algorithms in CBCT images on contrast-to-noise ratio (CNR) in the vicinity of zirconium and titanium implants

Methods In this in vitro study, zirconium and titanium implants of identical sizes were inserted in the retromolar region of sheep hemimandibles. The hemimandibles were inserted in a water container and CBCT images were acquired with and without activation of MAR. The images were then evaluated by two observers. CNR values in different angles and distances from the center of the implants were calculated and compared (α =0.05).

Results CNR values were not significantly different between the active and inactive modes of MAR for both zirconium and titanium implants (P>0.05).

Conclusions MAR algorithm was not effective in increasing the CNR values in the vicinity of zirconium and titanium implants.



Clinical Use of CBCT in Western Norway

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Objectives To investigate clinical issues in referrals for CBCT examinations. Further, the dental specialities of referring clinicians were verified to reflect current status in the justification process.

Methods We analyzed 3031 referrals for CBCT examinations at two dental centres in Western Norway, namely the Department of Clinical Dentistry, the University of Bergen (UiB), and the Oral Health Centre of Expertise in Western Norway (TkVestland). The referrals and reports to and from oral- and maxillofacial radiologists were assessed. Patient age, gender, relevant medical and dental history, clinical issue, and tooth/jaw region were noted, as well as the dental speciality of the referring clinician. The project was a quality assurance project reported to the Norwegian Centre for Research Data (TkVestland project number 60564, UiB project number 51391).

Results CBCT examinations had been carried out on 2680/3031 (88%) of the referrals, of which 1209 were from TkVestland, and 1471 were from UiB. The mean age of the TkVestland-patients was 20 years compared to 44 years of the UiB-patients (p<0.001). The most common clinical problems referred for CBCT were impacted teeth, endodontic issues, cleft lip palate issues, and root resorptions, making up two-thirds of the referrals. Interestingly, third molars were the most common retained teeth at UIB, while canines were the most common at TkVestland. Molars were the most common teeth with endodontic issues at UiB, while incisors were the most common at TkVestland.

The majority of referrals were from orthodontists (n=679), oral surgeons (n=602), endodontists (n=484), and prosthodontists (n=128). The remaining were from pediatric dentists, periodontists, and medical doctors (n=244), and general dentists (n=543).

Conclusions The majority of patients were referred by dental specialists, for assessment of impacted teeth, endodontic issues, cleft lip palate issues, and various root resorptions. The two dental clinics had distinct profiles regarding referral questions and patients' age.



CBCT to Quantify Maxillary Changes After Secondary Alveolar Bone Grafting

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Objectives Secondary alveolar bone grafting SABG is a centric intervention for the cleft team. However, the three-dimensional (3D) effect of SABG on maxillary dimensions is still uncertain.

Our aim is to explore (3D) outcome of SABG on skeletal growth of maxilla using Cone-beam Computed Tomography (CBCT), and to provide pre-postoperative-specific skeletal dimensional measurements of the maxilla, which could be helpful for cleft surgeons and reference for pre-postoperative orthodontics.

Methods Radiological datasets of unilateral cleft lip and alveolus (UCLA) were recruited retrospectively and divided into two different groups: preoperative-CBCTs with mean age 9 and postoperative with mean age 10. Inclusion criteria consisted of patients having a good quality CBCT image of maxillary skeletal region, and successful SABG. Linear measurements were performed to evaluate 17 distance-based variables, which included anterior nasal spine-posterior nasal spine (ANS-PNS)distance, cleft side (C) and normal side (N) maxillary first molar central fossa (CF) to midline, bilateral (CF) distance, palatal-vault-depth (PVD), (C) and (N) palatal Enamel-cement junction (PCEJ) to midline, bilateral (PCEJ) distance, (C) and (N) vestibular Enamel-cement junction (VCEJ) to midline, bilateral jugular distance (JUG), (C) and (N) arch length (AL) to midline and total (AL). **Results** Out of the total dataset of (n=155), 48 were selected based on the selection criteria. ANS-PNS, PVD and JUG showed the highest increase in dimensions postoperatively. On the other hand, AL and CF showed the least increase. While (NCF) decreased insignificantly. Slight skeletal asymmetry of maxillary regions was observed in the transverse analysis.

Conclusions Maxillary linear measurements varied in all dimensions, having significantly higher dimensions postoperatively in the vertical and sagittal planes. Correspondingly, SABG did not inhibit maxillary growth. The presented maxillary data could act as a reference guide for pre-postoperative-orthodontic treatment and cleft surgeons. Moreover, CBCT could overcome cephalometric imaging limitations in (UCLA).


Metal Artifact Reduction for Detecting Implant-Related Injuries to Mandibular Canal

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Objectives The aim of this study was to evaluate the performance of metal artifact reduction algorithms in detecting implant-related injuries to the inferior alveolar canal in CBCT images.

Methods In this in-vitro study, mono-cortical bone windows were created in 12 fresh sheep hemi-mandibles, the inferior alveolar canals were revealed and 36 implants were placed. Two types of canal injury, pilot drill injury and penetration of the implant tip into the canal were stimulated. The implants in the control group were considered with 1-2 mm distance between the implant and the canal roof. CBCT images were obtained with and wothout activation of MAR option. The images were then evaluated by two observers. The values of area under the receiver operating characteristic (ROC) curve, specificity, and sensitivity for different imaging techniques were calculated and compared. Level of significance was set at 0.05.

Results In the active MAR mode, area under the ROC curve, specificity, and sensitivity were 0.889, 83.33%, and 91.67%, respectively for the detection of pilot drill injury. The difference between the area under curves in the active and inactive state was 0.0347)P=0.584(. The detection of penetration injury in both active and inactive states was correctly diagnosed in all images with an area under curve of 1.000 (P>0.999).

Conclusions MAR algorithm increased the specificity and area under ROC curve for the diagnosis of pilot drill injury. However, the difference with the inactive state was not statistically significant.



Biomimetic Engineered Osteoinductive Scaffold: in Vivo and in Vitro Study.

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Objectives The aim of this research was to create and evaluate mechanical characteristics, biocompatibility and osteoinductive ability of an innovative biomimetic composite bone scaffold consisting of a mixture of PLA, HA and gelatin dissolved in an N-methyl-pyrrolidone solvent.

Methods Different formulations were initially evaluated to identify the most performing mechanical profile. Cylindrical acellular scaffolds were created and uniaxial compression (N), compressive stress (MPa) and Young module (MPa) tests were determined. Subsequent analyses were performed on the most mechanically performing scaffold only. Rheological analysis, washout resistance, optical and scanning electron microscopy were performed. *In vitro* phase was carried out using adipose stem cells (retropatellar Hoffa's fat-pad samples). AD-MSCs were grown with or without scaffold in normal growth medium or osteogenic medium respectively and the RNA extracted for quantitative Real-time PCR evaluation (RUNX2 and OSX). Chicken CAM was used to test *in vivo* scaffold biocompatibility. The experiments started on the 7th day of development (time point: T1) and all embryos were evaluated.

Results BG3 scaffold showed the best mechanical performance (Young's Mod. 6.9 ± 1.31 , 6.6 ± 0.75 and 7.38 ± 0.94 MPa at 10, 25 and 50% of deformation) and highly biocompatibility. Liquid BG3 (viscosity 26 ± 2 Pa * s) showed rheometrical qualities of a weak gel. RT-PCR analysis showed better RUNX2 expression at 5 days than the control group. The expression of OSX was not statistically different between two mediums but values were significantly higher than the baseline.

Conclusions Mechanical and biological characteristics of BG3 resulted encouraging but further studies are needed to evaluate its clinical efficacy.



Effect of Silver Fluoride on Elastic Modulus and MMP Activity

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Objectives The activity of matrix metalloproteinases (MMPs) are responsible for the degradation of dentin collagen matrices. Aim of the study is to evaluate the effect of silver fluoride treatments on the total MMP activity and elastic modulus of dentin beams. **Methods** Dentin beams (0.3mm x 3mm x 7 mm, n=10/group) were demineralized in 10% phosphoric acid for 30 minutes and were distributed into 5 balanced groups based on their initial elastic modulus measurements. Groups were treated with %38 silver diamine fluoride (Riva Star, SDI; SDF+potassium iodide (Riva Star, SDI; SDF+KI), %38 aqueous silver fluoride (Riva Star Aqua, SDI; AgF) or AgF+KI (Riva Star Aqua, SDI) for 60 sec. Untreated demineralized specimens served as control. Initial MMP activity of each sample was measured using a generic MMP assay (Sensolyte, Anaspec, USA). The inactivation of treatment groups was calculated as the percentage of untreated control. Following the MMP activity assay, the elastic modulus of each dentin beam was remeasured by three-point flexure testing (0.5mm/min speed; %3 strain). The beams were incubated in 1mL calcium and zinc containing artificial saliva at a shaking bath for 1 week and total MMP activity and elastic modulus were evaluated with the same protocol. Data were analyzed with two-way ANOVA at α =0.05.

Results Following the treatment, all treatment groups showed significant reduction in total MMP activity compared to untreated control (p<0.05). After 1-week incubation all treatment groups showed a significant inactivation of around 85% ± 5% (p<0.05). All treatments increased the initial elastic modulus compared to the control (p<0.05). The elastic modulus of SDF and AgF groups remained significantly higher than the control (p<0.05) after 1-week incubation.

Conclusions Silver fluoride treatments can effectively inactivate the total MMP activity and increases the elastic modulus of demineralized dentin.



Osteogenic Potential of a New Collagenated Bone Substitute

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Objectives Collagenated bone substitutes have been shown to promote bone regeneration for alveolar ridge preservation. GTO® is a new thermosensitive dual-phase bone substitute made of a combination of thermosensitive gel containing collagenated xenogenic bone particles which facilitates its handling and surgical procedures. The aim of this study was to investigate, *in vitro*, the osteogenic potential of GTO® as compared to Gen-Os® and Bio-Oss® bone substitutes.

Methods The bone-filling materials were prepared according to the manufacturers' instructions and incubated in culture medium (20 mg/mL) for 24 hours to obtain the extracts. Human periodontal ligament (hPDL) cells, from extracted third molars, were injured, and incubated with the extracts. After 24h, BMP-2 and C5a secretion was quantified by ELISA and the effect of hPDL supernatants on human Bone Marrow Stem Cell (hMSC) migration was investigated using Boyden chambers. Osteogenic differentiation of hMSCs was studied using Alkaline Phosphatase (ALP) enzyme activity quantification.

Results All materials significantly induced C5a secretion by hPDL cells. However, this increase was significantly higher with collagencontaining materials (Gen-Os® and GTO®) than Bio-Oss®. BMP-2 secretion was significantly induced by collagen containing materials but not with Bio-Oss®. All materials significantly increased ALP activity by hMSCs as compared to the control, but the secretion level was higher with GTO®. Finally, all bone substitutes stimulated hMSC migration. The increase observed with Gen-Os® and GTO® was significantly higher than with Bio-Oss®.

Conclusions This study highlights the osteogenic potential of GTO® which appears promising as a scaffold for bone regeneration. Thus, in addition to maintaining the socket space after tooth extraction, this osteogenic potential represents an added value for bone regeneration and implant stabilization.



Analysis of Functional Chewing Patterns Using Machine Learning – a Pilot Study

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Objectives Masticatory movement patterns are of great variance across individuals, and evaluation of this high-dimensional data is complex. A pilot study was conducted applying machine learning on chewing pattern data of patients with normal occlusion to identify chewing characteristics.

Methods 6863 chewing cycles of 50 patients with normal occlusion were recorded using a jaw tracking device, Kinesiograph (K7-I; Myotronics, Tukwila, WA, USA), under different conditions (soft/hard bolus, left/right bolus side) at the orthodontic division of the department of Surgical Sciences in Turin (Italy). Surface electromyography (EMG) signals were simultaneously collected from the masseter and temporalis muscles. Thirty-five descriptive, numerical indices derived from the jaw movement pattern and 16 numerical indices from the EMG signals were computed for each chewing cycle (Chew Easy Report tool, Motion Analysis DAta Manager – MADAM, MerloBioengineering, Parma, Italy). A random forest algorithm was trained to classify chewing side and bolus type based on these indices. The dataset was split into training and testing sets (75%/25%).

Results An area under the curve (AUC) of 1 could be obtained for binary classification of the chewing side. An AUC of 0.94 was achieved for the binary classification of the bolus type. Indices derived from the EMG data (maximum EMG signal of masseter and temporalis muscle, among others) were of importance for the bolus type classification task, whilst indices derived from the movement pattern (closing angle and lateral closing velocity among others) influenced the classification of the bolus side.

Conclusions Machine learning was suitable for analyzing chewing pattern data. Further analyses should focus on providing insights into the physiology of the chewing motions, or their association with possible clinical pathologies.



HPMC Mucoadhesive Films: a New Antifungal Drug Delivery System.

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Objectives Oral fungal infections are prevalent especially in patients with risk factors such as xerostomia or immunodeficiency. Chronic *Candida* infection can lead to malignant transformation; therefore, effective treatment is crucial. Current topical antifungal agent delivery methods, like suspensions and gels, are ineffective in infected site drugs retention. Meanwhile, systemic treatments are relatively ineffective in reducing the *Candida* biofilm and has a high side effects profile. Fabricating mucoadhesive films loaded with antifungal drug (chlorohexidine) with certain drug release potential and physical properties can help improving these problems. **Methods** Hydroxproplymethyl cellulose (HPMC K4M/K15M) polymer films were fabricated using solvent casting with a mixture of HPMC (2g), chlorohexidine (1g) and water (100ml). One surface of HPMC layer was protected by ethylene cellulose (2.5g) backing layer, formed with ethanol (50 ml). Ethylene glycol and castor oil (1ml) were used as a plasticizer for each layer respectively. Disk (11mm diameter) samples are submerged in water (5ml) at 37°C and weighed at pre-determined time intervals until they dissolved to measure swelling indexes. Drug release was tested by analyzing the immersion solution using UV spectrometry. **Results** Drug-loaded K15M-HPMC films reached maximum swelling (~934%) at 30 minutes and K4M films, ~744.% at 35 minutes. Complete dissolution of HPMC occurred after 7 hours. Peak drug release occurred at 20 minutes, with 76% and 63% from K15M and K4M discs respectively. 90% release occurred at 40 minutes (K15M) and 80 minutes (K4M) Positive correlation between rates of film

swelling and drug release, maximum swelling and peak release percentages can be noticed. **Conclusions** The data provides insight into the potential clinical applications of these systems. For example, a directional drug

administration on fungal infection sites. Further objective is to fabricate films capable of steady long-time drug releases.



Different Bone Substitutes Elicit Diverse Responses From Bone Marrow

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Objectives 1. To histologically, and histomorphometrically evaluate the regenerative potential of FDBA, Xenografts, and HA-TCP formulation used for sinus lift augmentation using the Movat's staining method.

2. To evaluate different features of the augmented bone i.e trabecular volume and thickness of the trabeculae, the distance between the trabeculae, the formation of new blood vessels as a function of the distance from the sinus floor, the presence of osteoclasts, osteocytes, presence of young bone vs. mature bone, osteons and the type of bone marrow.

Methods Immediately prior to implant placement,9 months after sinus augmentation biopsies were harvested from the implant sites using trephine drills. Sixteen (16) decalcified stained specimens were stained using Movat's pentachrome and photographed using a digital camera under a light microscope.

Results Graft particles were identified by their typical structure and color. Allograft particles were identified by their lack of nucleus in the lacunas. New bone trabecular content ranged between 11%-69 % with a mean of $39.8 \pm 20.9\%$ in the FDBA specimens and 23.3%-49.1% with a mean of $16 \pm 5.07\%$ in the BCP specimens. The difference in new bone formation fraction was statistically significant. The mean percentage of marrow and connective tissue was $54.0 \pm 21\%$ for the FDBA specimens and $62.1 \pm 16.5\%$ for the BCP specimens.

The average percentage of the residual graft was significantly lower in the FDBA specimens $6.18 \pm 4.24\%$ (range: 0.9 - 12.4%) than in the BCP specimens $22 \pm 13.5\%$ (range: 8.6 - 42.4%). The mean osteoconductive value of the FDBA specimens of $33.4 \pm 19.18\%$ -not significantly different from that of the BCP specimens ($40.8 \pm 8.5\%$).

Conclusions 1. FDBA induced higher new bone formation fraction than BCP.

2.All FDBA specimens induced fatty bone marrow similar to the pristine bone marrow whereas the BCP specimens induced inflammatory cellular bone marrow.

3. The differences between the newly formed bone marrow induced by the different bone substitutes, demonstrates the necessity to identify the factors that result in new tissue formation when used in maxillary sinus augmentation and disclose its clinical meaning.









Comparison between FDBA and BCP

Newly formed bone(%)	39.8±20.9	16±5.07	p=0.009
Residual graft (%)	6.18±4.24	22±13.5	p=0.058
Osseoconductive value(%)	33.4±19.18	40.8±8.5	p=0.434



Wear, Mechanical and Chemical Properties of Castor Oil Toothbrush Bristles

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Objectives The manual toothbrush with polyamide bristles is a classically used device for daily oral hygiene. Toothbrush bristles made from alternative raw materials like castor oil are increasingly produced but scarcely investigated.

Methods Five medium hardness toothbrushes with bristles made of castor oil (Alterra_Bambus_toothbrush (ALT), Alverde_toothbrush (ALV), Dr._Best_Green_Clean_toothbrush (DRB), Hydrophil_Bambus_toothbrush (HYD), Prokudent_Recycling_toothbrush (PRO)) and one control toothbrush (ADA_control (ADA)) (n=8) were investigated for their wear and associated dentin abrasion, elastic modulus and chemical composition (EDAX). Toothbrushes were subjected to 12.5k, 25k, 37.5k and 50k cycles (horizontal strokes) in a toothbrush-simulator simulating a total of 6 months of tooth brushing. Macroscopic and microscopic (50x magnification, SEM) images of bristle-ends (n=9/interval) were evaluated before and after mentioned intervals using a template according to DIN_EN_ISO_20126, also bristle-surface quality and overall evaluation (bristle-ends and bristle-surfaces). Data were statistically analyzed: Friedman-Test for repeated measures of bristles after mentioned intervals, ANOVA for dentin-abrasion, dentin-roughness and elastic modulus.

Results No obvious wear was visible in macroscopic images. SEM-images showed that bristle-ends were acceptable in ADA, DRB (100%), PRO (96%), ALV (87%), ALT (82%) and HYD (73%), where bristle-surfaces were unacceptable only in HYD at 0 and 12.5k cycles. Overall evaluation was acceptable in ADA and DRB (100%), PRO (96%) ALV (84%), ALT (82%) and HYD (51%). A significant difference was observed in ALV and HYD at different intervals. Dentin-abrasion ranged from 60-95µm (ALV-ALT), dentin-surface-roughness ranged from 3.4-3.8µm (HYD-ALT) and elastic modulus ranged from 1.14-1.81MPa (PRO-ALT), all without significant differences. All bristles had similar compositions of elements: carbon (54.6-62.7%), nitrogen (19.4-24.3%) and oxygen (16.0-21.1%), in agreement with ADA.

Conclusions Bristles of all investigated toothbrushes except HYD have acceptable bristle-ends and bristle-surfaces. Wear, dentin abrasion, dentin roughness, mechanical and chemical properties of bristles made of castor oil were similar to those by conventional polyamide bristles.



Figure 1: SEM-images at 50x magnification: overlying the transparent mask over the top bristle for evaluation of the respective bristle-end (a), acceptable (b) and unacceptable (c) bristle-ends, bristle-surface with grade-I is acceptable (d), with grade-II is still acceptable (e) and surface with grade-III is unacceptable (f)



Institutionalized Elderly's Dentition and Its Association to Their Masticatory Performance

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Objectives An increased number of elderlies are living nowadays in nursing homes and need dental care. This study aimed to determine the chewing ability of institutionalized elderly and its relevance to their status of dentition and type of prosthetic rehabilitation.

Methods TThe study was designed as cross-sectional study with a sample of 97 institutionalized participants that were at least 70 years old. The participants were categorized according to their dental status (fully edentulous, restored or not with complete dentures (CDs), partially edentulous restored or not with fixed or removable prostheses and/or implants). The chewing ability was determined by semi-quantitative evaluation of a color-changeable chewing gum and by recording the personal perception of the participants on a similar scale.

Results The colorimetric (objective) means of the participants were significantly lower compared to their own perception (subjective) means, whereas their sex and age don't play a role on their masticatory ability. One-third of the participants had at least one jaw restored with CD and only a 17% was restored with FDPs. According to the colorimetric method the edentulous participants chew significantly worse than every other group and the ones that have at least one jaw restored with a CD chew significantly worse than those who have their own teeth or are restored with FPDs.

Conclusions Many studies have highlighted the importance of an adequate chewing ability for the mental and physical health. As the institutionalized elderly seem to overestimate their chewing efficiency, the color-changeable chewing gum could be used in nursing homes as a simple and reproducible method to determine their real status, leading to nutrition adjustments and/or improvement of dental care.



0329 Oral-Health Related Quality of Life (OHQoL) in Cognitive Impairment Patients <u>E. Calabria</u>, N. Armogida, L. Esposito, F. Iaculli, D. Adamo, G. Spagnuolo

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Objectives The oral health related quality of life (OHRQoL) is one of the main factors which may influence the general well-being of geriatric patients presenting cognitive impairment (CI). However, there are few studies assessing the OHRQoL in this population. Therefore, the aim of the present study was to evaluate the OHRQoL and its relationship with the oral health status, the psychological profile and general quality of life (QoL), in subjects affected by mild-to-moderate CI.

Methods A total of 80 patients with mild-to-moderate CI and 80 controls matched by age and gender was enrolled in the present study. The Oral Health Impact Profile (OHIP 14), the General Oral Health Assessment Index (GOHAI), the Numeric Rating Scale (NRS), the Hospital Anxiety and Depression Scale (HADS), the 36-Item Short Form Health Survey (SF-36), were administered to all the participants. In addition, the oral health status was evaluated by assessing the periodontal status (stage and grade), and the DMFT. **Results** Interestingly, a poorer OHRQoL was appreciated in the controls compared to the CI group (OHIP-14 total score: p<0.001, GOHAI total score: p<0.001), with a higher level of pain (p<0,001). Despite the better OHRQoL perceived by the CI patients, similar scores of periodontal diseases and DMFT were recorded in both groups (Periodontal Staging: p=0.269 and DMFT: p=0,045]. With regard to the psychological profile and QoL, no statistically significant difference was detected among the groups in the HADS and SF-36 scores (HADS anxiety and depression scores p-values: 0.351, 0.418 respectively).

Conclusions Findings of the present study possibly suggest that patients with CI may not be able to recognize their oral diseases and therefore to promptly seek appropriate dental treatments. Oral health care needs to be improved within geriatric patients, promoting prevention and early diagnosis of oral diseases and increase of the prognosis and patients' QoL.



Does Periodontitis Affect the Impact of Biological Aging on Mortality?

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Objectives The prevalence of periodontitis is increasing with the aging of the global population. Periodontitis has been suggested to accelerate aging and increase mortality. The present nationwide prospective cohort study aimed to determine whether periodontitis could modify the impact of biological aging on all-cause and cause-specific mortality in middle-aged and older adults. Methods Participants ≥40 years of age from the Third National Health and Nutrition Examination Survey (NHANES III) were included (n = 6,272). Phenotypic age acceleration (PhenoAgeAccel) was used to evaluate the biological aging process. Moderate/severe periodontitis was defined using a half-reduced CDC/AAP (Centers for Disease Control and Prevention and American Academy of Periodontology) case definition. Multivariable Cox proportional hazard regression was conducted to estimate the association between PhenoAgeAccel and mortality risk, followed by effect modification analysis to test whether periodontitis modified the association. Results During a median follow-up of 24.5 years, 3,600 (57.4%) deaths occurred. The positive relationships between PhenoAgeAccel and all-cause and cause-specific mortality were non-linear. After adjusting for potential confounders, the highest guartile of PhenoAgeAccel was associated with increased all-cause mortality in individuals with no/mild periodontitis (hazard ratio for Q4 vs. Q1 [HR _{04vs01}] = 1.789, 95% confidence interval [CI]: 1.541–2.076). In contrast, the association was enhanced in patients with moderate/severe periodontitis (HR Q4vsQ1 = 2.446 [2.100-2.850]). Periodontal status significantly modified the association between PhenoAgeAccel and all-cause mortality (P for interaction = 0.012). In subgroup analyses, the modifying effect of periodontitis was observed in middle-aged adults (40–59 years), females, and non-Hispanic whites. Although cause-specific mortality showed a similar trend, the PhenoAgeAccel × periodontitis interaction did not reach statistical significance.

Conclusions In conclusion, periodontitis might enhance the association of biological aging with all-cause mortality in middle-aged and older adults. Hence, maintaining and enhancing periodontal health is expected to become an intervention to slow aging and extend lifespan.



Schematic diagram illustrating the effect modification. Periodontitis modified the effect of aging measures on all-cause and specific cause mortality in the middle-aged and older adults.



Older With Cognitive Impairment Improves Oral Health Using Powered Toothbrush

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Objectives The study aimed to investigate whether introducing a powered toothbrush in older individuals with mild cognitive impairment reduces levels of dental plaque (PI), bleeding on probing (BOP), and periodontal pockets (PPD) \geq 4 mm and if oral health can be maintained or improved over a period of 24 months.

Methods Two hundred and thirteen individuals aged 55 or older living without formal care with a Mini-Mental State Examination (MMSE) score between 20-28 and a history of memory problems in the previous six months were recruited and screened for the study. The individuals received a powered toothbrush and thorough instructions on how to use it. Clinical oral examinations and MMSE tests were conducted at baseline, 6, 12, and 24 months. The intervention group was further divided into a MMSE high group (MMSE>26) and a MMSE low group (MMSE<26 or decreasing two steps or more in MMSE score over 12 months). The intervention group was compared to matched control groups matched for age, gender, and MMSE status from the general population at baseline and at the 24-month examination.

Results At the 24-month follow-up, the intervention group showed better values for PI, BOP, and percentage of PPD≥4mm compared to control groups. PI, BOP, and PPD≥4mm improved both in the MMSE high and low groups over 24 months. **Conclusions** Introducing a powered toothbrush improved PI, BOP, and PPD≥4mm over 24 months, even among individuals with low or declining MMSE scores.



Periodontitis Associates With Need for Hospitalization Later in Life

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Objectives Chronic infections upregulate cytokines and other inflammatory mediators causing subclinical inflammation with systemic effects that may lead to hospitalization. Associations are known between poor oral health and many diseases. This study, using hospital database from Sweden, hypothesized that patients having periodontitis in 1985 suffered during the following decades from diseases that called for hospitalization.

Methods This long-term cohort study investigated the associations between periodontitis and medical problems later in life. The cohort of 1655 persons were used from initially >100000 file of inhabitants of Stockholm area. The hospital register of Swedish National Board of Health was used in the follow-up of the baseline oral health data between years 1997-2017.

Descriptive statistics and step-wise logistic regression were used in the analyses.

Results Based on WHO ICD-10 categories and baseline oral health data (periodontitis/no periodontitis) the following diagnose categories for hospitalization were found. Neoplasms (20.9%, p= 0.0355, OR = 1.42 CI 1.015-1.996); endocrine, nutritional and metabolic diseases (26.2% p=0,0265, OR = 1.72 CI 0.949- 3.128); mental and behavioural disorders (27.4%, p = 0.003, OR = 1.66, CI 1.027-2.689); circulatory diseases (24.5%, p < 0.001, OR = 1.64, CI 1.188-2.249); respiratory diseases (27.8%, p = 0.0025, OR = 1.76 CI 1.078-2.864); diseases of genitourinary system (22.4%, p = 0.0385, OR = 1.57, CI 1.030-2.402); and symptoms not elsewhere classified (22.1%, p = 0.013, OR = 1.44, CI 1.022-2.022), respectively.

Conclusions The study hypothesis was confirmed by showing that baseline chronic infection (periodontitis) indeed reflected later in life in the need for hospital treatment due to systemic diseases.



Diet-Related Aging Mediates the Association Between Chewing Capacity and Mortality

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Objectives Masticatory dysfunction due to tooth loss is a potentially modifiable risk for shortened healthy longevity, but the pathway behind that remains to be investigated. This prospective study examined the mediating role of 'diet-related aging' in the associations between chewing capacity and long-term mortality.

Methods Data from the participants involved in six cycles National Health Nutritional and Health Survey (NHANES) (*n* = 22900) were analyzed. Chewing capacity was determined by the number of functional tooth units (FTUs). Diet quality was measured by three index-based dietary patterns: the nutrition index, energy-adjusted dietary inflammatory index, and healthy eating index. The biological aging process was reflected using phenotypic age acceleration (PhenoAgeAccel) and frailty index. The overall associations of impaired chewing capacity (ICC) with all-cause, cardiovascular disease (CVD), and cancer mortality were studied using multivariable Cox regression. Mediation analyses were conducted to assess the role of diet quality in the association between FTUs and aging, as well as the role of aging in the ICC–mortality association.

Results Participants with more FTUs showed a slower aging process. Diet quality scores were estimated to mediate 9.0%–23.0% of the association between chewing capacity and biological aging. A positive association was found between ICC and the increased risk of all-cause mortality (hazard ratio [HR]=1.28 (95% confidence interval: 1.19–1.38). Also, ICC was significantly associated with a 28.9% higher risk of CVD mortality and a 32.7% higher risk of cancer mortality. Mediation analyses indicated that PhenoAgeAccel mediated the effect of ICC on all-cause, CVD, and cancer mortality with proportions of 18.1%, 17.3%, and 12.5%, respectively. Similar mediating proportions were observed in the frailty index (11.6% to 23.5%).

Conclusions ICC was associated with poorer diet quality and accelerated aging, resulting in higher mortality risk. Therefore, oral rehabilitation and dietary interventions might promote healthy longevity.



Effect of DM1 on TMJ and Dentofacial Morphology: a CBCT-Analysis

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Objectives This study aimed to investigate the morphological analyses of the bone components of temporomandibular joint (TMJ), and dentofacial morphology in myotonic dystrophy type 1 (DM1) patients by cone-beam computed tomography (CBCT). Methods Sixty-six individuals (33 DM1, and 33 healthy subjects) age ranging from 20 to 69 were included in the study. Clinical examinations of the patients' TMJ regions and evaluation of dentofacial morphology (maxillary deficiency, open-bite, deep palate, and cross-bite) were performed. Dental occlusion was determined based on Angle's classification. CBCT images were evaluated regarding mandibular condyle morphology (convex, angled, flat, and round) and osseous changes observed in the condyle (normal, osteophyte, erosion, flattening, sclerosis). DM1-specific morphological and bony TMJ alterations were determined. Results DM1 patients showed a high prevalence of morphological and osseous TMJ changes, and statistically significant skeletal alterations. The analysis of CBCT scans indicated the prevalent condylar shape among patients with DM1 was flat, the main osseous abnormality was flattening, there was a tendency towards skeletal Class II, and a posterior cross-bite was frequently detected in DM1 patients. There was no statistically significant difference between the genders on the parameters evaluated in both groups. Conclusions Adult patients with DM1 presented a high frequency of crossbite, tendency to skeletal Class II and morphological osseous alterations of TMJ. The analysis of the morphological condylar alterations in patients with DM1 may be beneficial in the diagnosis of TMJ disorders. This study reveals DM1-specific morphological and osseous TMJ alterations to provide an appropriate dental-treatment planning to patients.



Morphological classification of mandibular condyle in coronal cone-beam computed tomography view. (a) Convex; (b) Angled; (c) Flat; (d) Round.



Sagittal cone-beam computed tomography view of five osseous changes observed in the mandibular condyle. (a) Normal; (b) Osteophyte; (c) Erosion; (d) Flattening; (e) Sclerosis.



Distribution of mandibular condyle morphology and osseous changes observed in the condyle in 33 DM1 patients, and 33 healthy controls

	DM1	Control	Total	р
Condyle morphology				
Convex	11(16.7)†	33(50.0)	44(33.3)	0.001*‡
Angled	8(12.1)	3(4.5)	11(8.3)	
Flat	32(48.5)†	20(30.3)	52(39.4)	
Round	15(22.7)	10(15.2)	25(18.9)	
Osseous Changes				
Normal	6(9.1)+	36(54.5)	42(31.8)	0.001*‡
Osteophyte	21(31.8)+	11(16.7)	32(24.2)	
Erosion	8(12.1)	4(6.1)	12(9.1)	
Flattening	25(37.9)†	10(15.2)	35(26.5)	
Sclerosis	6(9.1)	5(7.6)	11(8.3)	
Total	66(100)	66(100)	132(100)	

DM1: Myotonic dystrophy type 1. Data are shown as n(%). ‡ Chi-square test. † indicates a statistically significant difference between the DM1 and control groups († p values corrections with Bonferroni method). * p < 0.05.

Distribution of malocclusion types and Angle's classification in 33 DM1 patients, and 33 healthy controls.

	DM1	Control	Total	р
Malocclusion Type				
Max deficiency	5(15.2)	3(9.1)	8(12.1)	0.708§
Openbite	5(15.2)	1(3.0)	6(9.1)	0.197§
Deep palate	8(24.2)	13(39.4)	21(31.8)	0.186‡
Cross-bite	14(42.4)	5(15.2)	19(28.8)	0.014*‡
Angle's classification				
Class I	9(27.3)+	18(54.5)	27(40.9)	0.031*‡
Class II	18(54.5)†	8(24.2)	26(39.4)	
Class III	6(18.2)	7(21.2)	13(19.7)	
Total	33(100)	33(100)	66(100)	

DM1: Myotonic dystrophy type 1. Data are shown as n(%). ‡ Chi-square test, § Fisher's exact test. † indicates a statistically significant difference between the DM1 and control groups († p values corrections with Bonferroni method). * p<0.05.



Objectives The aim of this review was to evaluate scientific evidence regarding gender estimation by odontological methods in Forensics.

Methods This review adhered to the PRISMA (the Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement requirements. Four electronic databases; PubMed, Web of Science, Scopus and Cochrane Library, were searched for articles published from January 2018 to March 2023. Studies were evaluated and considered according to inclusion and exclusion criteria. The essential information was recorded using a predefined data extraction form. The Cochrane risk of bias and ROBINS-I tool were applied to assess the quality of evidence.

Results A total of 561 articles were initially retrieved, after the duplicate removal of 291 articles, the remaining 270 were assessed for their relevance to our research question. Finally, 25 articles were eligible for this systematic review. Analysis of the data demonstrated that 2 articles studied skeletal collections, 7 casts, 1 clinical evaluation of living individuals, 1 of intraoral scanning, 2 of extracted teeth, 9 OPGs, 1 CT and 2 CBCT examinations. The sample consisted of 1095 casts and 42.127 dental radiographs.

Gender estimation accuracy ranged from 34% to 98%. Canines presented findings of greater correlation related to gender, than other teeth.

The accuracy of gender estimation was 83,7% when both upper and lower canines were evaluated. Nevertheless, gender accuracy diminished to 79,5% for lower canines and 74,4% for upper canines, when examined solely.

Conclusions This review supports the importance of gender estimation by odontological methods in Forensics. Further high-quality research is needed to verify the outcomes of this systematic review.



Mandibular 2nd Premolar Agenesis and Condition of Retained Primary Molars

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Objectives to investigate the prevalence of mandibular 2nd premolar agenesis and condition of corresponding primary molar among 11-14 year old Latvian adolescents attending Riga Stradins University Institute of Stomatology.

Methods Retrospective cross-sectional panoramic X-ray analysis of 2692 11-14 year-old patients (39.9% males and 60.1% females) with average age of 13y (SD=13m). Data of mandibular 2nd premolar agenesis were registered. Retained primary molars were classified as good or poor based on root resorption, infraocclusion and restorations. Poor condition was given to primary molar if any of following was present: 1) ³/₄ or more of root resorbed, 2) infraocclusion of 50% or more, 3) restorations on 3 or more surfaces, 4) infection-related root resorption. Descriptive statistics were used for analysis.

Results Prevalence of mandibular 2nd premolar agenesis was 5.8%. A total of 234 congenitally missing mandibular 2nd premolars among 156 patients were identified. Out of 234 missing premolars only 139 (59.4%) retained primary molars were present. 63% (n=87) of retained primary molars were good condition. Average age of patients with lost primary molars or those in poor condition was 13y (SD=13m).

Conclusions Prevalence of mandibular 2nd premolar agenesis in this study was 5.8%. Out of 234 missing premolars only 37% (n=87) of corresponding primary molars were present and in good condition.



Fractal Dimension Analysis in Patients With Familial Mediterranean Fever

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Objectives Familial Mediterranean fever (FMF) is a genetic condition that may cause loss of bone mineral density (BMD) due to chronic inflammation. Previously, fractal dimension (FD) analysis values of mandibular cortical bone were shown to be lower in osteoporosis. Therefore, FD might be considered as an auxiliary tool to refer patients for dual-energy x-ray absorptiometry (DXA), which is the gold standard for BMD measurement. The purpose of this cross-sectional retrospective study was to evaluate microarchitecture of the mandible with FD analysis on panoramic radiographs in a subpopulation of FMF. Also, the effect of colchicine use was investigated.

Methods Forty-three FMF patients, aged between 10-71 years, and a control group consisting of patients, who had no systemic diseases, were included. Demographic information such as age and gender, and colchicine use were recorded. In terms of age, the patients were classified as <30 and 30< years. On each panoramic radiographs five regions of interest were selected on the mandible as: 1- premolar, 2- molar, 3- angular, 4- condylar, and 5- basal cortical bone regions on right (R) and left (L) sides. Statistical significance was accepted at p<0.05 level.

Results . Intra- and inter-observer agreements demonstrated good to excellent consistency. In FMF patients, L3 and L4 values were higher, whereas L5 values were lower (p<0.05) than the control group. In terms of age, the difference between groups was insignificant in FMF patients (p>0.05), whereas in control group R3, L1, and L4 values were higher, while R5 values were lower in the 30< age group (p<0.05). Regarding gender and colchicine use, the difference between groups was insignificant (p>0.05). **Conclusions** FMF disease might be a candidate for referral to DXA examination based on decreased bone density in the mandibular cortex detected by FD measurements on routine panoramic radiographs. Further studies are warranted to ascertain this relationship.



Flow chart of the study design



Comparison of ROI measurements obtained on right and left sides on the OPGs of FMF and control groups

	FMF	Control	
	mean±SD median (IQR)	mean±SD median (IQR)	р
R1	1.241±0.117 1.262 (1.191-1.314)	1.260±0.089 1.255 (1.204-1.339)	0.880
R2	1.277±0.076 1.299 (1.229-1.328)	1.243±0.111 1.255 (1.176-1.332)	0.133
R3	1.227±0.113 1.226 (1.152-1.301)	1.246±0.112 1.255 (1.156-1.350)	0.429
R4	1.221±0.135 1.250 (1.159-1.301)	1.201±.105 1.218 (1.120-1.279)	0.310
R5	1.115±0.094 1.119 (1.056-1.172)	1.130±.096 1.133 (1.073-1.170)	0.613
L1	1.234±0.117 1.255 (1.159-1.314)	1.182±0.163 1.195 (1.093-1.314)	0.158
L2	1.254±0.105 1.271 (1.168-1.323)	1.208±0.121 1.217 (1.129-1.314)	0.126
L3	1.236±0.119 1.240 (1.166-1.301)	1.144±0.171 1.147 (1.021-1.286)	0.013*
L4	1.273±0.131 1.264 (1.184-1.342)	1.162±0.154 1.214 (1.090-1.293	0.002*
L5	1.110±0.073 1.105 (1.052-1.165)	1.155±0.078 1.160 (1.089-1.221)	0.010*



Dental Age Estimation in Greek Subadults Based on London Atlas

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Objectives To assess the accuracy of dental age estimation in Geek subadults based on the London Atlas. Methods In this retrospective study, the sample consisted of 500 OPGs (panoramic radiographs) belonging to 250 males and 250 females age ranged from 6 to 16 years. The participant's gender, birth date, and the date the OPG was performed were recorded. Eligible for the study were OPGs of individuals, with detailed recording DOB and date that each OPG performed, aged 6–16 years, that did not suffer from any medical conditions or syndromes with all permanent present bilaterally in each jaw. Excluded were OPGs of individuals aged younger than 6 and older than 16 years, with hypodontia, with medical conditions or syndromes, and OPGs of poor image quality. All OPGs were coded and randomly assessed under the same conditions by two calibrated observers, acting independently and blindly concerning the patient's personal identification information, chronological age, and gender. Dental age was estimated with the London Atlas method. To evaluate intra-observer reliability, the observer revalued all of the OPGs after a onemonth period. Statistical analysis of the data aimed at comparing the chronological age with the dental age as estimated by the London Atlas. Analysis of Variance was performed to test the differences between the two genders. The agreement between the CA of the subjects and the DAE based on the London atlas was assessed using the standard Pearson Correlation Coefficient. Results Intra and inter-observer reliability were excellent. The results showed a high level of agreement between chronological age and the London DAE estimates. Overall, the estimated age was somewhat higher than the actual chronological age. Conclusions The London Atlas is a trustworthy method of DAE, at least for the age range of our sample group. Our results come to an agreement with the results from other researchers.



Prevalence of Zygomatic Air Cell Defects in a Turkish Subpopulation

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Objectives The objective of this research is to determine the occurrence rate of zygomatic air cell defects (ZACD) in the temporal component of the temporomandibular joint (TMJ) among the Turkish subpopulation utilizing cone beam computed tomography (CBCT).

Methods CBCT images of 308 patients were selected from the archive after the application of the inclusion and exclusion criteria and then evaluated retrospectively. Paracoronal and parasagittal images of the TMJ were evaluated. The prevalences of the ZACD by age, sex, type (unilocular or multilocular), and laterality were determined. ZACD were classified in the anteroposterior direction using grades ranging from 0 to 3. The data were analyzed using IBM SPSS Statistics 22 (SPSS Inc., Chicago, IL, USA). The chi-square test and analysis of variance were used to determine the significance of differences between variables. The values of p<0.05 were interpreted as significant.

Results A total of 308 patients (131 male and 177 female) were examined. The mean age was 39.05 (13.82), with a range of 16 to 76 years. The prevalence of ZACD was 64.6% (n=199), with 71.4% (n=142) of cases being bilateral. Unilocular type was observed in 2.3% (n=14), while multilocular type was found in 53.1% (n=326) of all the TMJs. Grades 1–3 were detected in 31.7% (n=195), 17% (n=105), and 6.8% (n=42), respectively.

Conclusions Since they are sites of minimal resistance, pneumatization in the osseous components of the TMJ may facilitate the spread of fractures, inflammatory, or neoplastic processes into the joint and may complicate TMJ surgery. Therefore, it is imperative for clinicians to assess radiographic imaging thoroughly before the surgery and to take into consideration any zygomatic air cell defects that may be present in the patient.



Evaluation of the Prevalence of Retention Pseudocyst Using Panoramic Radiography

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Objectives The aim of this study is to determine the incidence and seasonal distribution of retention pseudocysts in the right, left and bilateral maxillary sinuses by using digital panoramic

radiographs, according to age and gender.

Methods In this study, 1800 digital panoramic radiographs taken between January 1, 2022 and December 31, 2022 from the archive of the Usak University Dentomaxillofacial Radiology Department were used. Radiographs were evaluated according to gender, age, localization and the size of the retention pseudocyst. It was divided into three groups according to size: 1-less than 1-10 mm, 2-between 10 and 20 mm, and 3- more than 20 mm. Unilateral or bilateral involvement of the lesions were recorded. Statistical analysis of the data was performed using descriptive statistics and chi-square tests.

Results Retention pseudocysts were detected in 112 (6.2 %) patients, of which 54 patients (6.7%) were male and 58 patients (5.9 %) were female. There is a significant relationship between the incidence of retention pseudocyst and seasonal changes. (p<0.05) 5 retention pseudocysts were under 10 mm, 57 were between 10 and 20 mm, and 58 were measured over 20 mm.

Conclusions The prevalence of retention pseudocysts of the maxillary sinus was low. Although there was no significant difference between age groups, it was statistically significant that more retention pseudocysts were seen in males between the ages of 21-40.



Validity of Diagnosis and Dentist's Treatment Preferences for Enamel Defects

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Objectives Enamel defects in anterior teeth, including caries as well as developmental defects such as molar-incisorhypomineralization (MIH) or fluorosis, may lead to significant aesthetic and functional impairment. Differential diagnosis of such defects is challenging due to their similar but also heterogeneous appearances. Diagnosis, in turn, may affect treatment decision. The aim of this study was to evaluate the validity of dentist's diagnosis of enamel defects based on clinical images and to assess the preferred treatment option for the different entities.

Methods Ten images (two caries, four fluorosis and four MIH) were presented to 175 dentists. The reference diagnosis was established based on the majority vote of three independent experienced examiners. Participants were asked to diagnose each case (caries, MIH, fluorosis, mixed lesions) and to select the preferred treatment option (no treatment; non-invasive treatment, e.g., remineralization; bleaching; micro-invasive treatment (resin infiltration); composite restoration; veneer; crown).

Results Caries lesions were correctly diagnosed by 51.5% of the participants, fluorosis by 62.5% and MIH by 59%. When asked how confident participants were to diagnose lesions (strongly agree, agree, neither agree or disagree, disagree, strongly disagree), 76.5% felt confident (strongly agree/agree) for caries lesions, 71,6% for fluorosis and 72% for MIH. 73% felt confident to treat caries lesions, 67,3% to treat fluorosis and 68.2% to treat MIH. Independently from diagnosis, most participants preferred a micro-invasive approach to treat lesions. Participants were more likely to choose invasive approaches for more pronounced lesions such as (moderate to severe) fluorosis and MIH regardless of their given diagnosis (caries 3,4%, fluorosis 14,7%, MIH 19,7%).

Conclusions Within the limitation of our study employing clinical images, we demonstrated the difficulty of dentists in diagnosing enamel defects. Fluorotic and MIH lesions are more likely to be treated invasively than caries lesions.



Competitive Conversion in Photo-Polymerised Dimethacrylate Dental Monomer Blends

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Objectives To investigate how polymerisation rate drives competitive conversion between constituent monomers within experimental photo-activated dental monomer resins.

Methods A series of different weight.% dimethacrylate resin blends of Bis-GMA and partially deuterated TEGDMA (d-TEGDMA) were prepared, with either Lucirin TPO (TPO) or Camphorquinone (CQ) as the photo-initiator to introduce extremes in the rate of polymerization. Partial deuteration of the d-TEGDMA reactive end groups i.e. CH₂ to CD₂, provides vibrational contrast to enable discriminative conversion measurements between constituent resin monomers when observed with IR spectroscopy. Specimens (n=3) were photo-polymerised for 20s using a consistent regimen (Bluephase Style 20i), at an irradiance of 1200 mW/cm². FTIR-ATR spectroscopy was used to characterize the degree of conversion 48 hours after the samples were photo cured. Degree of conversion was calculated using the percentage decrease of the respective aliphatic absorbance IR band intensity (wavenumber for non-deuterated Bis-GMA at ~1637cm⁻¹, partially deuterated d-TEGDMA at ~1591 cm⁻¹) relative to the monomer. Differences in conversion were statistically analysed using a one-way ANOVA test between different sample compositions (p = 0.05).

Results Accelerating polymerisation conferred greater total conversion for all unique resin blends. Systems polymerised more rapidly demonstrated a significantly greater proportion of d-TEGDMA converted than Bis-GMA compared with slower polymerisation regimes (p<0.05). For a given photo-initiator system, the conversion for each constituent monomer within the resin blend is similar to the terminal conversion for the reported homo-polymerisations of Bis-GMA and TEGDMA.

Conclusions Competitive conversion between monomers is likely mediated by relative differences in mobility. Accelerating polymerisation facilitates the more mobile monomer species to form the majority of the polymer network, i.e. greater degree of conversion (d-TEGDMA), compared with the less mobile monomer (Bis-GMA). This phenomenon may explain why materials with equivalent holistic conversions but polymerised at different rates demonstrate discrepancies in physico-mechanical properties.



Embryotoxicity and Monomer Release From Copper-Doped Mesoporous Bioactive Glass Composites

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Objectives Copper-doped mesoporous nanospheres (Cu-MBGN) are embedded in dental composites to obtain antibacterial and remineralising properties. The study aimed to investigate the monomer release and to evaluate the effects of the tested composites on the early development of *Danio rerio*.

Methods Seven experimental composites were prepared using bisphenol A-glycidyl methacrylate (Bis-GMA)/triethylene glycol dimethacrylate (TEGDMA) matrix and silanised baruim-glass as a base. The experimental composites additionally contained 1, 5 or 10% Cu-MBGN. The control composites had either inert silica or conventional 4555 bioactive glass. The disc-shaped specimens with an average class II restoration surface area were light-cured and stored in absolute alcohol for 7 days. Monomer release (bisphenol A (BPA), Bis-GMA, TEGDMA) was measured after 24h, 48h and 7 days with high-performance liquid chromatography. To determine the possible adverse effects of the tested materials on the early development of *Danio rerio*, a zebrafish embryotoxicity test was performed according to OECD 236 (2013).

Results BPA release was not detected in any of the samples. Bis-GMA was found in the inert control and in the composites containing 45S5. TEGDMA release was found in all samples, with the highest concentration after 7 days of exposure. The release of TEGDMA was highest in the control materials with 10% and 14% 45S5 with concentrations of 1.248±0.112 and 1.187±0.055 µmol/cm² after 7 days of exposure, respectively. The tested solutions of the dental materials did not affect the embryonic development of the exposed zebrafish. No statistically significant increase in mortality and abnormality rates was recorded in the tested and control groups during exposure to eluates.

Conclusions The composites with Cu-MBGN did not release BPA or Bis-GMA and had the lowest TEGDMA release of the tested materials. Despite the TEGDMA release, none tested materials showed embryotoxicity in *Danio rerio*.



Physicomechanical Stability of Dental Composite With Novel Bisguaiacol-Based Monomer

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Objectives The elution of Bisphenol-A (BPA), constituting the core part of bisphenol A dimethacrylate (BisGMA) as often contained in dental resin-based composite (RBC), raises public concern. The KU Leuven bio-based platform of bisguaiacols enabled to synthesize biosafer BisGMA analogues. This study aimed to analyse material stability in terms of water absorption (Wa) and solubility (Ws), and Knoop hardness (KH), when measured before and after water immersion. Two experimentally prepared composites, containing either bisguaiacol P dimethacrylate (BGPGMA) or BisGMA in combination with TEGDMA and loaded with barium borosilicate glass, were compared with the commercial composite Clearfil Majesty ES-2 Classic (Clearfil-M; Kuraray Noritake), serving as reference. **Methods** Twenty-four bar-shaped specimens were prepared following a standardized protocol. Upon KH measurement using a micro-hardness tester, the specimens were weighted following complete drying and randomly divided in 3 groups. Eight specimens per group were immersed in distilled water for 1 week (1w), 1 month (1m) and 4 months (4m). Upon water removal, the mass was recorded for a second time. A third mass recording was done after complete drying, when KH was also re-measured. Statistical analysis involved repeated measures two-way ANOVA and Tukey's multiple comparisons testing (p<0.05).

Results No significant difference in KH and Ws was recorded at all time points for all materials. Wa significantly increased for all materials at time points 1w and 1m. This increase was also significant for Clearfil-M at time point 4m.

Conclusions All materials exhibited good physicomechanical stability based on Ws and KH measured after water immersion at different time points. The experimental BGPGMA and BisGMA composites revealed an increase in Wa that slows down at 4m, while the Wa of Clearfil-M continues to increase at the same rate at 4m.



Cytotoxic Assessment of Eluates From Vacuum Thermoforming Plastics

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Objectives This study aimed to evaluate the possible cytotoxic effects of thermoplastic materials commonly used for occlusal splints and orthodontic appliances.

Methods In this study, seven different thermoplastics used for the fabrication of occlusal splints and orthodontic appliances were included: three variants of the Essix sheets (C+, Plus, and Tray Rite) (Dentsply Sirona, DE, USA), three variants of the VacuFormer sheets (Bleach Heavy, X-Heavy, and Splint) (Cavex, Netherlands), and Invisalign (Align Technology Inc., CA, USA).

According to ISO 10993-5, cylindrical specimens (n=24) (diameter=10mm) were prepared and incubated in cell culture medium for 24 hours and 14 days, respectively. After incubation, the medium was collected, serially diluted, and dosed to primary human gingival fibroblasts in triplicates. Cell viability was evaluated by XTT and LDH assay to evaluate the influence of eluates on metabolic activity and membrane integrity, respectively.

Results The 24-hour and 14-day extracts did not cause cytotoxic effects on the cells after 24-hour incubation. No significant differences in cell viability were observed between the different materials in XTT and LDH assays, respectively (two-way ANOVA, α =5%).

Conclusions The materials tested in the study demonstrated biocompatibility without evident cytotoxic effects, however, further investigation is needed to assess other potential (cyto)toxic effects, materials composition, and leachates.



0352 Dental Composites With RAFT-Mediated Polymerization: Elastoplastic and Viscoelastic Behaviour N. Ilie

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Objectives Reversible addition-fragmentation-chain transfer (RAFT)- mediated polymerization has been successfully implemented in two commercially available dental composites. We directly compare their elastoplastic and viscoelastic behavior at 24 h post-curing and 3 months of artificial aging.

Methods Two RAFT-mediated RBCs (Filtek[™]One/FO and Tetric PowerFill/TPF) were evaluated. Flexural strength/FS and modulus/E were determined in a 3-point bending test at 24 h post-polymerization. A fractographic analysis determined the origin of fracture. The elastoplastic (indentation hardness/H_{IT}, indentation modulus/E_{IT}, elastic/plastic indentation work, creep) and viscoelastic (storage modulus/E', loss modulus/E'', loss factor/tan δ) behavior were monitored with an instrumented indentation test (IIT) equipped with a DMA module (0.5-5 Hz) with 24 h post-polymerization and 3 months artificial aging. Filler systems have been described by SEM analysis. One and multiple-way analysis of variance (ANOVA), Tukey honestly significant difference (HSD) post-hoc tests (α=0.05), and Weibull statistics were applied.

Results Statistically similar E-values were found in both materials (p=0.072), but significantly higher FS (p<0.01) and slightly higher reliability in FO. At 24h of storage, the parameters measured in the quasi-static test were similar, with the exception of creep, which was lower in TPF. Storage modulus was slightly higher and H_{IT} lower in TPF, while the viscos behaviour (loss modulus and loss factor) was similar. Aging evidenced a significantly stronger influence (higher partial eta-squared values) on the measured parameters than the material in all parameters. The values for both materials deteriorate with aging, with TPF more than with FO.

Conclusions Despite their different chemical composition and microstructure, the materials differ less from each other, but age differently.



Surface Topography of Different Types of CAD/CAM Restorative Materials

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Objectives The successful bonding between prepared tooth surfaces and the CAD/CAM restorative materials is obtained adhesive cementation technique. Bonding between the restorative material is attributed to combination of chemical bonding (facilitated by the silane and/or primer) as well as micromechanical retention through acid-etching or air-particle abrasion or both. The aim of this study was to evaluate effect of two different surface treatment procedures both air-particle abrasion (APA) and hydrofluoric acid gel (HF) on the short fiber reinforced composite (SFRC) and hybrid types of CAD/CAM restorative materials.

Methods Surface morphology of one experimental SFRC (a mixture of UDMA / TEGDMA (70 / 30) resins with 23%wt short fiber ($\theta7\mu$ m, 200-300 μ m), 25%wt glass fiber and 52%wtbarium particulate glass) and three hybrid type CAD/CAM materials; one is hybrid ceramic (VITA ENAMIC, VITA Zahnfabrik) and the other two composite resin (CERASMART 270, GC and CERASMART 300, GC) were evaluated under scanning electron microscope (SEM). 2 mm thick rectangular shape test specimens were prepared by sectioning CAD/CAM blocks under water cooling using a low-speed diamond saw (Secotom-50, Struers) Outer surfaces of the test specimens were treated with two different surface treatments Group 1 (APA): 50 µm aluminum oxide particles was applied for 10 seconds at a distance of 5 mm (Coject,3M-ESPE) Group 2 (HF): 5% Hydrofluoric Acid Gel (VITA Ceramic Etch, VITA Zahnfabrik) was applied for 60 seconds. After surface treatment all test specimens were rinsed with distilled water for 10 seconds, and let dry for 24 hours before gold-sputtering followed observation using a scanning electron microscope (SEM) (JEOL 5500, JEOL Ltd) with different magnifications x500, x1000, x1500 and x2000.

Results Different types of CAD/CAM materials showed different topography. For all tested materials etching with HF acid showed smooth surfaces comparing with APA treatment.

Conclusions Etching with HF acid or APA treatment showed irregular surfaces which is important for better adhesion irrespective of all tested materials.



Evaluation of Surface Micro-Hardness of Chlorhexidine Diacetate Added Glass-Ionomer Cement

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Objectives Modern restorative dentistry procedures aim to remove infected tissues and restore the teeth with bio-interactive materials. The presence of bacteria underlying the restorations can lead to many problems in the long term. Thus, the use of antimicrobial materials is essential in preventing such problems. In recent studies, chlorhexidine compounds have been added to GICs to enhance their antibacterial activities. The aim of this study was to evaluate the surface micro-hardness of GICs with different ratios of chlorhexidine diacetate additions.

Methods Nova Glass-L (Imicryl, Konya, Turkey) without chlorhexidine diacetate addition was used as the control group (group 1). Chlorhexidine diacetate was added to GIC at concentrations of 1.25% (group 2), 1.75% (group 3), and 2.5% (group 4). Twenty-disc specimens (8x5mm) (5 for each group) were prepared following the manufacturer's instructions with plastic molds. Vickers's micro-hardness measurements (Shimadzu Micro Hardness Tester HMV-2, Shimadzu Corp., Kyoto, Japan) were performed on day 1 and 1 week after the initial setting reaction by applying a 100-gram load for 15 seconds with a pyramidal tip. The results were analyzed using ANOVA and Tukey tests (p < 0.05).

Results The addition of chlorhexidine diacetate decreased the micro-hardness values of GICs in both time periods in groups 2, 3, and 4 compared to the control group (p<0.05). The less affected group was group 3 with 1.75% additions. All samples, including the control group, showed increased micro-hardness values after 7 days (p<0.05).

Conclusions GICs with 1.75% chlorhexidine diacetate addition can be a promising option for restoring cavities with a bio-interactive approach as its surface micro-hardness was the less affected group regarding this addition. Further *in vitro* studies are needed to evaluate the mechanical properties of this new chlorhexidine diacetate-added GICs.



Effects of Nisin and Phytic Acid on the Dentin Wettability

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Objectives Nisin, an antimicrobial peptide, and phytic acid, a natural chelating agent, are relatively new solutions. The solutions used for irrigation can cause changes in the chemical and structural composition of dentin, which can change dentin's properties such as permeability and wettability. Wettability which can influence the adhesion of bacteria, regulate the interaction between dentin and materials, and has an essential role in developing a suitable contact time of an irrigant with dentine is one of the important physicochemical properties of solutions. The aim of this study is to compare the effects of nisin, phytic acid, chlorhexidine and NaOCI on the wettability of the canal dentin using contact angle measurement.

Methods Twenty-five extracted single-rooted human teeth were decoranated and splitted longitudinally into fifty-halves. The sectioned surfaces were smoothed, polished, and embedded in resin blocks to expose the dentinal surface and randomly divided into five groups (n=10): 0.25%nisin, 2%phytic acid, 2%chlorhexidine, 5.25%NaOCl, and distilled-water (control). For each sample, a solution of 1-mm diameter was dropped onto the dentin surface using a precision injector attached to the device, and the contact angle values were recorded by video recording for 10-seconds. The contact angles were recorded by video recording for 10-seconds from the moment the solution came into contact with the root dentin. Statistical analysis was performed using the one-way analysis of variance and tukey post-tests at p=0.05.

Results The results of study showed that there were significant differences in the contact angles of solutions (p<0.05). Nisin and phytic acid showed the lowest contact angle values, whereas distilled-water had the highest. The contact angles of the solutions were listed as distilled-water>NaOCI>chlorhexidine> phytic acid > nisin.

Conclusions These findings indicated that both nisin and phytic acid have high surface-free energy and have the potential to be used in root canal irrigation due to their hydrophilic properties.



Short Fiber-Reinforced Direct and Indirect MOD Overlay Restorations

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Objectives The goal of this research was to assess how incorporating a short fiber-reinforced composite (SFC) core would affect the fracture behavior of direct and indirect overlay restorations. Furthermore, the study aimed to examine the relationship between the thickness ratio of SFC-core to conventional particulate filled composite (PFC) veneering and the fracture behavior of bilayered structured composite restorations.

Methods 120 intact molars were used to create MOD cavities, with palatal cusps removed. Four different groups of direct overlay restorations were then made (n=15/group), all of which featured a SFC-core (everX Flow) with varying thicknesses (0, 1, 4, and 5 mm), as well as a surface layer of PFC (G-aenial Posterior), with the overall thickness of the bilayered structuredrestoration set at 5 mm. Additionally, four groups of CAD/CAM restorations were created (Cerasmart 270 and Initial LiSi Block), with or without 2 mm of SFC-core fiber reinforcement. Following the fabrication of these restorations, cyclic fatigue aging was carried out for 500,000 cycles (Fmax=150 N) before each was loaded quasi-statically until fracture. The fracture mode was then assessed visually using optical microscopy and SEM. Data were analyzed using ANOVA (with p=0.05).

Results The results showed no statistically significant differences (p>0.05) in the load-bearing capacities of indirect overlay restorations that were reinforced with 2 mm SFC-core (bilayered) and those that were made from plain restorative materials. However, ANOVA analysis indicated that direct overlay restorations constructed from plain SFC or with a 4 mm layer thickness of SFC-core had significantly higher load-bearing capacities (2674 ±465 & 2537 ±561 N) (p<0.05) compared to all other tested groups. **Conclusions** Effective method for restoring large MOD cavities was found to be direct restoration using SFC either alone or as a bulk-core in combination with conventional PFC composite, resulting higher load-bearing capacity.



0357 Fracture Strength of Endocrowns and Overlays From two Different Materials

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Objectives Partial coverage restorations for endodontically treated molars have been advocated as an alternative to post and crowns, as they require minimal invasive tooth preparation. However, literature offers conflicting information regarding the material and the type of restoration needed. This study evaluated the fracture strength and the failure mode of endodontically treated molars restored with monolithic lithium disilicate and zirconia endocrowns and overlays.

Methods 48 extracted mandibular molars were endodontically treated, decoronated 2mm above the cementoenamel junction and divided into four equal groups.

In 2ld (endocrown-lithium disilicate) and 2zr (endocrown-monolithic zirconia) groups the restoration extended in the pulp chamber 2mm, whereas in 0ld (overlay-lithium disilicate) and 0zr (overlay-monolithic zirconia) groups did not extended in the pulp chamber at all. 2ld and 0ld groups were restored with lithium disilicate, whereas 2zr and 0zr groups were restored with monolithic zirconia. After adhesive bonding the specimens where subjected to thermocycling (x5,000 cycles) and then to fracture resistance testing at lateral static loading (1mm/min) at a universal testing machine. The failure mode of the specimens was qualitatively evaluated. Differences in means were compared using two-way ANOVA and Holm-Sidak (α =0.05). Weibull distribution analysis was also performed.

Results The most statistically significant fracture resistant group was 2ld with mean value 4169N (p=0,001). Groups 2zr, 0zr and 0ld showed mean values 2312,25N, 2256N and 2254N, respectively, not significantly different. Weibull distribution presented higher shape (0) for group 2ld (4583.6) than that of the other groups, 0ld (2479.1), 2zr (2558) and 0zr (2459.4).

Conclusions The mechanical performance of lithium disilicate endocrowns was better than the other groups.

Lithium disilicate endocrown is the most reliable and strongest restoration than the others.

Lithium disilicate endocrowns showed more statistically significant catastrophic failures than lithium disilicate overlays. Lithium disilicate overlays and zirconia overlays performed equally in fracture resistance.



0358 **Clinical Performance of Short Fiber-Reinforced Composite Restorations Used Without Coverage** R. Abd ElAziz¹, S. Abd ElAziz¹, P. Abd ElAziz¹, P. K. Vallittu², L. Lassila², <u>S. Garoushi²</u>

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Objectives The aim of this study was to evaluate the clinical performance of posterior composite restorations reinforced by bulk base of flowable short-fiber composite SFRC (everX Flow, GC, Japan) exposed to approximal area, i.e. the SFRC was used without proximal surface coverage.

Methods A total of 70 patients (20 males, 50 females; mean age: 30±10 years old) were randomly enrolled in this trial and received either SFRC covered only from occlusal surface (1-2 mm) by conventional composite (G-ænial Posterior, GC) or plain conventional composite (G-ænial Posterior) in Class II cavities in premolar and molar teeth. One operator made all the restorations using one-step, self-etch bonding agent (G-ænial Bond, GC) according to manufacturer's instructions. The lost proximal wall was replaced using an appropriate pre-contoured sectional matrix with the associated separating ring. Two blinded trained operators evaluated the restorations directly after placement (baseline), at six months, and at one year using modified USPHS criteria.

Results In both groups and at different follow-up intervals, according to evaluated criteria, the restorations were mostly rated with best score (Alpha) (p>0.05). For the marginal integrity after 6 months, a single case in the intervention (increased to 3 (8.8%) after 12 months) and 3 (9.7%) cases of the control group (increased to 4 (12.9%) after 12 months) had bravo score but with no significant difference (p>0.05). For color match measured after 6 and 12 months, three (8.8%) cases had bravo score in the intervention group. While, regarding marginal discoloration, a single case in the intervention had bravo score after 12 months.

Conclusions The use of SFRC composite without any surface coverage proximally showed an acceptable clinical performance along the 1 year follow-up period.


Objectives The aim of this study is to compare the push-out bonding values of glass fiber posts bonded with two different resin cement.

Methods In the study, 10 extracted single-rooted mandibular canine teeth were used. After the endodontic treatment of the teeth, they were randomly divided into 2 groups to apply different resin cements (n=5). Panavia resin cement and Nova Resin self adhesive cements were used in this study. Post restorations were made with the Polydentia glass-fiber post system. A total of 6 slices of 1 mm thickness in the transversal direction were obtained, 2 from each of the coronal, middle, and apical sections of the prepared samples. The push-out test was performed from apical to coronal at a speed of 0.5 mm/min. One-way analysis of variance test was used to compare the data. Multiple comparisons were evaluated with the Tukey HSD test (p<0.05).

Results The observed highest push-out binding values in the Panavia group was (5.04±0.45); the lowest values were seen in the Nova group (4.01±1.06). When the two resin groups are compared with each other; there was no significant difference between push-out binding values. In the Panavia group; while there was no significant difference between the push-out binding values of the apical-middle region samples; the difference between the push-out binding values of the apical-coronal and mid-coronal region samples was found to be statistically significant. In Nova group; there was no statistical difference between the push-out binding values of the apical, middle and coronal region samples.

Conclusions The use of different luting cements did not cause a significant difference in the push-out bonding values of the post system. In the Panavia group, the binding values were statistically different in different regions of the root. In the Nova group; similar push-out binding values were observed in different regions of the root.



Partial-Ceramic-Crowns and Self-Adhesive Resin-Cement: Impact of Selective-Enamel-Etching After 15 Years.

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Objectives This follow-up of a randomized clinical split-mouth study aimed to investigate the influence of selective enamel etching on the long-term clinical performance of partial ceramic crowns (PCCs) luted with a self-adhesive resin cement.

Methods 43 patients received two PCCs (Vita Mark II; Cerec 3D) each for the restoration of extensive lesions with multiple cusp coverage inserted with a self-adhesive resin cement (RelyX Unicem, RXU). Using a split-mouth design, additional selective enamel etching was applied for one PCC (RXU+E) and no further pretreatment in addition to the self-adhesive resin cement was applied for the other PCC (RXU-E). Patients were clinically evaluated at baseline and after up to 15 years (median observation period 176 months) using modified USPHS and FDI criteria. Data were analyzed non-parametrically (χ 2 tests, α =0.05). Clinical survival of all restorations after up to 15 years was evaluated using Kaplan-Meier analysis followed by log-rank tests (Mantel-Cox).

Results After up to 15 years, 19 patients were available for clinical assessment (recall rate: 56%). Kaplan-Meier analysis showed a cumulative survival of 78.1% for RXU+E and of 42.9% for RXU-E, indicating a significantly higher survival rate for RXU+E. Regarding clinical performance of the PCCs available for 15-year evaluation, no statistically significant differences were found between RXU-E and RXU+E using either of the evaluation methods (modified USPHS and FDI criteria). Both, RXU+E and RXU-E, revealed a significant decrease of surface lustre and marginal adaptation and a significant increase of marginal discoloration over time.

Conclusions For PCC restorations in the posterior region, selective enamel etching can be recommended based on higher survival rates after up to 15 years.



Five-Year Performance of Glass-Hybrid and Nano-Hybrid Restoratives: Multi-Centre Clinical Trial

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Objectives This multi-centre longitudinal 5-year split-mouth clinical study aimed to compare the performance of a glass-hybrid restorative system to a nano-hybrid resin composite for moderate to large two-surface restorations.

Methods The study was conducted by dental schools in Zagreb, Croatia; Izmir, Turkey; Belgrade, Serbia; and Milan, Italy. A total of 180 patients were recruited, each requiring two 2-surface restorations in molar teeth of the same jaw. Teeth were randomly restored with either a glass-hybrid (EQUIA Forte, GC) or a nano-composite material (Tetric EvoCeram, Ivoclar Vivadent). The restorations were placed in accordance with the manufacturer's instructions: glass-hybrid material was placed in bulk and the nano-hybrid resin composite in 2-mm incremental layers with a two-step self-adhesive system (Adhese, Ivoclar Vivadent). During the 5 years follow-up, two calibrated evaluators in each centre scored the restorations annually using the FDI-2 scoring system. The groups were compared using the nonparametric matched pair tests (p<0.05).

Results No statistically significant differences (p>0.05) were observed in the overall success rates and survival rates of the two types of restorations. The success rates (FDI-2 score 1-3) was 81.9% for EQUIA Forte (average annual failure rate 3.6%) and 90.7% for Tetric EvoCeram (average annual failure rate 1.9%). The survival rates (FDI-2 score 1-4) were 94.5% and 94.4%, respectively for EQUIA Forte and Tetric EvoCeram, with the average annual failure rate of 1.1% for both materials.

Conclusions The success and survival rates of the glass-hybrid restorative system are shown to be satisfactory and comparable to the nano-hybrid resin composite for moderate to large two-surface restorations of molar teeth.



0364 Clinical Study of Different Composite Resin Systems in Class I Cavities

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Objectives To examine the clinical performance of Thermo-Viscous Bulk Fill composite, Self-Adhesive Flowable composite, and Filtek Bulk Fill Composites restorations in Class I cavities over a period of 18 months

Methods Twenty individuals between the ages of 30 and 45 participated in this research. Each patient should have at least three occlusal Class I carious lesions on their molars. They were dispersed at random, with n=20 teeth representing each tested material. Group I (Futurabond M+ and VisCalor Bulk Fill), Group II (Fusio Liquid Dentin self-adhesive composite), and Group III (Single Bond Universal and Filtek Bulk Fill Posterior composite). Using (USPHS) criteria, all restorations were assessed clinically at baseline, 6 months, 12 months, and 18 months. Using an inverse replica, the marginal seal of the investigated restorations was further evaluated under SEM (x200) magnification.

Results After 18 months of follow-up, the retention rate among the three studied groups was one hundred percent. Concerning marginal adaptation, marginal discoloration, anatomical form, surface texture, and color matching, there was a significant difference between the three tested groups after 12 & 18 months of follow-up (group II Fusio Liquid Dentin self-adhesive composite had the highest rate of deterioration for these clinical criteria). None of the examined restorations exhibited secondary caries during any time of clinical examination. After 12 & 18 months, SEM analysis of the marginal seal revealed a statistically significant difference between the three groups.

Conclusions Viscalor Bulk Fill composite demonstrated excellent results with considerable changes in marginal integrity as a consequence of thermal viscous technology and increased adaptability of restorations toward cavity walls and margins.



Loading Capacity of Core Build-Ups Anchored With Parapulpal Pins

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Objectives Parapulpal pins (PP) were a common tool in the era of amalgam-fillings and in the early days of composite restorations to stabilize large restorations. With significant advances in adhesive-techniques, PP have gradually lost importance. At the same time, epigingivally decayed teeth with intact pulp are increasing, especially in older patients. In those cases, the use of PP may potentially avoid the need for devitalization associated with post placement. This study examined whether debonding and fracture forces for core build-ups could be improved by use of PP.

Methods Sound Human premolars were collected, embedded in metal molds and cut horizontally just above the pulp chamber. Remaining enamel was removed and the teeth were digitized in a laboratory scanner to evaluate the cross-sectional area. All teeth were evenly divided into 10 groups (n=8) with similar mean cross sectional tooth areas. In two test groups core build-ups were pinretained, with the pin center positioned at 0.5mm or 0.75mm from the tooth margin respectively. One control group consisted of teeth with solely adhesively anchored core build-ups, in the second control group glass fiber posts were used together with the core build-ups. After core build-up fabrication and preparation, samples were stored at 37°C under moist (24h) and subsequently wet (3d) conditions. Half of the samples underwent additional aging (thermocycling and chewing simulation) before fracture load testing (1mm/min.) in a modified four-point bending test setup. Forces corresponding to first damage and fracture were evaluated and statistically analyzed.

Results Without aging, the highest fracture loads (p<0.05) were recorded for post group with 279N. The PP-group (0.5mm margindistance) reached the highest mean values (p>0.05) for the first damage at 90N and were more reliable compared with the other test groups.

Conclusions Without the influence of aging, PP provide similar force values in terms of the clinically important first failure compared to fiberglass post anchored core build-ups.



Natural Radioactivity Measurements in Dental Zirconia Materials

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Objectives Zirconia based ceramics have gained wide popularity in dentistry as an alternative to metal ceramic restorations due to its superior mechanical properties. However, there are some concerns about the radioactivity of zirconia resulting from the impurities of natural radionuclides in zirconia powders. The aim of this study was to measure ²²⁶Ra, ²³²Th and ⁴⁰K activity concentrations of dental zirconia materials.

Methods Specimens were prepared in powder form by grinding commercially available zirconia disc samples obtained from 5 different manufacturers. Before the measurement procedure, the specimens were stored in sealed plastic containers for 4 weeks in order to ensure the equilibrium conditions between ²²⁶Ra, ²²²Rn and its short-lived daughters. Gamma spectrometry measurements were performed using a Nal(Tl) detector.

Results The results showed that the ²²⁶Ra activity concentrations in five dental zirconia powders ranged from 12.0 Bq kg⁻¹ to 16.7 Bq kg⁻¹ while the measured activity concentrations of ²³²Th in the samples were varied between 7.7 Bq kg⁻¹ and 16.0 Bq kg⁻¹ and ⁴⁰K activities of the specimens reached up to 71.2 Bq kg⁻¹ with the concentrations starting from 26.2 Bq kg⁻¹. The natural radioactivity levels of all the specimens subjected to this study were obtained above the minimum detectable values. The spectrometric analyses revealed that the average activity concentrations of ²²⁶Ra, ²³²Th and ⁴⁰K in the samples were determined as 14.5 Bq kg⁻¹, 12.8 Bq kg⁻¹ and 51.3 Bq kg⁻¹, respectively.

Conclusions None of the activity concentration measurements exceeded the permissible limits.



Novel Algorithm for Surface-Wide Pointwise Trueness and Precision

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Objectives Current studies on 3D printing accuracy often rely on visual inspection of a few "representative" prints, providing only qualitative information at the point level. The objective of this study was to develop a method to derive the surface-wide accuracy distribution based on scans of multiple 3D-printed restorations, to gain deeper insights into local trueness and precision. **Methods** An experimental 3D printer was constructed based on the direct ink writing principle, which was used to fabricate high-fidelity occlusal veneers (n = 20, maxillary molar) by extrusion and solidification of FDA-approved dental composites (Beautifil Flow Plus, Shofu Dental). The printed veneers were scanned using a high-precision confocal optical scanner (KF-30, Syndicad), and their surfaces were aligned with the reference model (iterative closest point algorithm) in open-source CloudCompare software. The unsigned dimensional deviation was then calculated and stored in the reference model. The deviation of the 20 prints was imported into R and combined as 20-component vectors at every surface point, to derive surface-wide pointwise trueness (mean) and precision (standard deviation, SD).

Results Three-dimensional accuracy maps were produced based on the pointwise trueness and precision. The trueness map showed that 95% of the surface points had a mean deviation of less than 58.5µm, while the precision map indicated that 95% of the points had a between-print deviation SD of less than 23.3µm. High deviation and variation areas were concentrated on the non-extruding moves within the G-code, indicating a correlation between material oozing and dimensional deviation. Therefore, print accuracy can be further improved through optimizing the oozing control.

Conclusions The study introduced a new paradigm that can condense scans of multiple printed surfaces into pointwise accuracy maps, thus providing valuable insights into local accuracy for deviation identification. These insights can facilitate rigorous optimization of 3D printing systems to improve their reliability and performance.



As indicated in the diagram, the algorithm collected dimensional deviation from all prints and condensed the information into threedimensional maps of surface-wide trueness and precision. The results are provided in the lower panel. Left: reference model. Middle: trueness map. Right: precision map. Units are in µm.



0368 Comparison of Surface Roughness R_a/R_z With Different Measuring Devices

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Objectives The aim of this in-vitro study was to compare surface characteristics R_a and R_z , which were determined with mechanical and optical measuring devices on different materials and surface finishing.

Methods Mechanical (contact profilometers (**CP**): Perthometer S6P, Perthen Mahr, G) and optical (confocal 3D laser scanning microscope (**CLSM**): VK-100, Keyence, J; scanning electron microscope (**SEM**): Phenom, FEI, NL) measuring devices were used to determine the surface roughness R_a and R_z . Glass-ceramic (Empress, Ivoclar-Vivadent, FL), zirconia (Cercon HT, Dentsply, D), composite (Grandio, Voco, D), denture base material (Palapress, Kulzer, D) and titanium (grade 4) were investigated (n=10 measurements) after surface finishing: sandblasting (Al₂O₃; 50 µm), sandblasting (Al₂O₃; 250 µm), diamond treatment (80 µm; wet) and polishing (grit 4000; wet). Statistics: Shapiro-Wilk, ANOVA, Bonferroni post-hoc test (α =0.05).

Results Surface characteristics R_a and R_z , which were determined with mechanical and optical measuring devices on different materials and surface finishing showed significant (p<0.001, ANOVA) differences. Significant (p<0.038, Bonferroni) differences between CP, SEM and CLSM were found, mainly for R_a .

Conclusions With CLSM the line roughness of the samples could not be differentiated. CP and SEM revealed differentiable roughness between surface finishing. Despite comparable processing, the individual materials exhibited different roughness.

material/measuring	СР	CLSM	SEM
glass-ceramic	2.36-0.04/12.20-0.39	10.18-3.52 / 75.26-23.53	3.02-1.06/7.35-4.57
zirconia	0.77-0.09/4.79-0.88	3.25-6.44 / 45.39-48.47	2.58-1.02/10.46-4.33
composite	3.65-0.05/18.22-0.68	7.58-4.85/70.74-39.68	2.52-1.12/10.19-5.92
denture base material	2.57-0.05/13.68-0.59	5.24-3.52/62.01-23.78	6.77-1.75 / 19.84-5.37
titanium	1.86-0.09 / 10.73-0.71	4.942-4.86 / 87.13-35.30	6.00-1.66 / 23.26-6.59

Tab: mean R_a/R_z (µm) of the materials with different finishing (sandblasting (250 µm) - polishing)



0369 Medication Purchases Associate With the Number of Dental Treatments

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Objectives There is an established bidirectional connection between oral infections and systemic diseases. Systemic medication also affects the oral cavity. Still little is known whether the number of systemic medications, indicating worsened health, affects the number of oral appointments needed. We hypothesized that patients purchasing more systemic medications would have an increased number of dentist appointments, as well as an increased need for dental treatments, than patients who did not purchase as many drugs.

Methods The cohort consists of 1580 subjects, initially examined in 1985, from the greater Stockholm area, Sweden. Using the Swedish national population and patient registers spanning years 2008 to 2017, we analyzed medication purchases and dental appointments. Descriptive statistics, chi² tests and logistic regressions were used in analyses.

Results Patients with medication purchases above the median (n=789, median=86) had more dental appointments in general (56.8%, p=<0.001, OR 1.76, Cl 1.43-2.16), more gingivitis (52.7%, p=0.044, OR 1.30, Cl 1.05-1.60), periodontitis (53.1%, p=0.033, OR 1.25, Cl 1.10-1.54) and peri-implantitis (60.2%, p=0.005, OR 1.65, Cl 1.18-2.31) compared with those below the median (n=791). Purchasing above the median also associated with more dental check-ups (51.9%, p=<0.001, OR 2.65, Cl 1.77-3.97), anti-infective treatments (51.6%, p=0.024, OR 1.31, Cl 1.04-1.66), extractions (55.8%, p=<0.001, OR 1.45, Cl 1.18-1.78), fillings (52.4%, p=<0.001, OR 1.93, Cl =1.44-2.58), and more root canal treatments (n=278, 57.6%, p=<0.001, OR 1.52, Cl 1.22-1.90), respectively.

Conclusions The hypothesis was confirmed by showing that the number of purchased medications associated with the number of dental appointments indicating worse dental health compared with those in need for less medications.



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Objectives Interferon Regulatory Factor 6 (IRF6), which is often found mutated in certain cleft lip/palate (CLP) forms, is a crucial regulator of craniofacial development. Recently, we have observed that IRF6 might also act as a tumor suppressor in various carcinomas. Hence, we have hypothesized a potential shared genetic etiology between CLP and cancer.

The aim of this study was to investigate whether IRF6 might be a common gene underlying oral squamous cell carcinoma (OSCC) progression and CLP.

Methods To this purpose, we made use of keratinocytes isolated from a healthy gingiva, an oral dysplastic lesion (POE9n) and an OSCC (SCC-68). While gingiva keratinocytes expressed the highest amount of IRF6, POE9n and SCC-68 displayed moderate and low levels, respectively. To determine whether POE9n and SCC-68 could still regulate *IRF6* similar to normal cells, we tested two mechanisms known to induce the gene: serum stimulation and cell density/contact inhibition. Thereafter, IRF6 levels were assessed in the two conditions by qPCR, immunoblot and immunofluorescence.

Results Upon both stimuli, *IRF6* regulation was shown to be impaired in SCC-68 cells, but still active in POE9n, although at a lower extent compared to healthy cells. Similar to POE9n, syndromic CLP lip-derived keratinocytes, isolated from a Van der Woude syndrome (VWS) patient exhibiting IRF6 haploinsufficiency, displayed a limited response to density-dependent *IRF6* regulation. Based on these observations, we speculate that there is a putative threshold for IRF6 levels that determines the risk of developing OSCC. **Conclusions** These results might indicate that IRF6 is a potential common etiological factor for OSCC and CLP in a fraction of CLP individuals. Clinically, a regular oral cancer screening of CLP patients harboring pathological *IRF6* variants might be warranted.



Salivary Bacteriome and Mycobiome of Oral Cancer Patients

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Objectives Oral squamous cell carcinoma (OSCC) has been linked to changes in oral microbiome. Recently, the focus has switched from single species to the entire oral microbiome of patients. The objective of this study was to gain new information on bacterial and fungal salivary profiles of patients at time of OSCC diagnosis. We compared these profiles to those of healthy controls. **Methods** Paraffin-stimulated whole saliva was collected and salivary flow rate was measured from 81 OSCC patients prior to cancer surgery. Additionally, 85 healthy controls were examined, and their saliva sampled. After DNA extraction and purification, the V4 hypervariable region of 16S rRNA gene and the internal transcribed spacer 2 (ITS2) were amplified using PCR and sequenced using Illumina MiSeq. The merged read pairs were quality-filtered using USEARCH. The 16S rRNA gene data were denoised with UNOISE3 and the ITS2 data were clustered at 97% with cluster_otus. The RDP classifier was used to assign a taxonomy to the representative sequences. A bacterial taxonomy was assigned to the representative zOTU sequences using HOMD, while UNITE was used as reference to assign a fungal taxonomy for the OTU data. Descriptive statistics were used to study the differences in profiles of OSCC patients vs. controls.

Results Bacterial and fungal salivary profiles of the OSCC patients differed significantly from those of controls (F= 3.27, p= 0.0012 and F= 4.41, p= 0.0001, respectively). Bacterial alpha-diversity (Shannon diversity index) did not significantly differ between OSCC patients and controls, whereas fungal alpha-diversity was significantly lower among OSCC patients (p= 0.0005). The zOTUs and OTUs that had significantly higher relative abundance in OSCC patients included zOTU1 *Streptococcus sp.*, OTU1 *Candida albicans*, and zOTU56 *Abiotrophia defectiva*.

Conclusions Salivary microbial profiles of OSCC patients differ from healthy controls in diversity and composition. These results might have implications in treatment planning.



Oral Bacteriophages, a Novel Antimicrobial Strategy Targeting Periodontal Pathogens.

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Objectives With increasing antibiotic resistance, population ageing and escalating incidence of periodontitis and peri-implantitis, a new therapeutic strategy for oral biofilm control is imperative. Application of bacteriophages as antimicrobials for dysbiotic oral biofilms has vast potential for treating periodontal diseases. To date very few oral bacteriophages have been isolated. Thus, the main objective of this project was to isolate bacteriophages against two important periopathogens, *Aggregatibacter actinomycetemcomitans* (Aa) and *Fusobacterium nucleatum* (Fn).

Methods Twenty healthy individuals' pooled, centrifuged, and filtered saliva was used for bacteriophage isolation. During the enrichment procedure, a mixture of saliva and growth media was inoculated with host bacterial cultures and incubated under appropriate conditions. Enriched samples were then centrifuged and filtered to remove the remaining bacteria. The presence of bacteriophages in bacterial lawns was determined with the spot assay. Clear lysis zones were observed on agar plates, and clear plaques were selected for further propagation. After three cycles of phage purification during which the morphologies of plaques were selected for observation by electron microscopy and further morphological examination.

Results Obtaining an even and thick bacterial lawn for plaque visualization in anaerobic conditions proved to be challenging and required several modifications. After saliva samples screening, distinct lysis zones were observed on both bacterial strains, as well as single plaques with different morphologies, indicating the possible existence of a diverse phage community. Some phage isolates were able to produce clear lysis zones and plaques.

Conclusions With used methods we were able to detect and isolate bacteriophages against Aa and Fn. Further studies will involve phage characterisation, host range determination and testing phages activity against biofilms. Results of our research will contribute importantly to further clinical studies on phage use for prophylactics and therapeutics in oral healthcare.



Type 1 Diabetes Mellitus and Salivary Microbiota

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Objectives Type 1 diabetes mellitus (T1DM) is related to increased severity of periodontal inflammation via its potential influences on the composition of the oral microbiota. The aim of this study was to characterize and compare the salivary microbiota of children and adolescents with and without T1DM in relation to their periodontal status in a longitudinal approach. **Methods** Overall, 55 children and adolescents aged between 4-15 years (n=26 T1DM patients, n=29 systemically healthy controls)

completed the study. Unstimulated salivary samples were collected from all participants prior to oral examination (Plaque index (Pl%), bleeding on probing (BOP%), Decayed, Missing, Filled Teeth Index (dmft/DMFT)). Oral examination and saliva sampling were performed for all participants at baseline and 1st year follow-up. Salivary microbiota was characterized by 16S rRNA gene amplicon sequencing of the V1-V3 region, and sequences were referenced against the Human Oral Microbiome Database.

Results At baseline, both PI% (*P*=0.019) and BOP% (*P*=0.031) were found statistically significantly higher in T1DM group while at 1st year follow-up only BOP% (*P*=0.031) was found higher. Beta diversity based on the Bray-Curtis distance indicated more clear separation between the healthy group and the T1DM group at baseline than 1-year follow-up. Moreover, linear discriminant analysis effect size (LEfSe) analysis identified significant differences between groups. At baseline, T1DM group was associated with higher abundance of *Prevotella, Fusobacterium and Capnocytophaga* genera and at 1st year follow-up, the T1DM group favored *Leptotrichia* and *Fusobacterium* genera whereas the healthy group favored *Rothia* and *Abiotrophia* genera. No statistically

significant difference was found in alpha diversity of both groups in different sampling time.

Conclusions Our results demonstrated that the salivary microbial profile of children and adolescents with T1DM is significantly distinct from healthy controls in both baseline and 1st year follow-up.



Effects of Different Hyaluronic Acids on Periodontal Biofilm-Immune Cell Interactions

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Objectives Recent studies have demonstrated the positive role of hyaluronic acid (HA) in improving clinical outcomes of periodontal therapy. This study aims to investigate the impact of four different HAs on interactions between periodontal biofilm and immune cells. **Methods** The four HAs included: high-molecular-weight HA (HHA, 1000 kDa, non-cross-linked)), low-molecular-weight HA (LHA, 398 kDa), oligomers HA (OHA, 6 kDa), and cross-linked high-molecular-weight HA (CHA, 1000 kDa). Serial experiments were conducted to verify the influence of HAs on: (i) 12-species periodontal biofilm (formation and pre-existing); (ii) bacterial growth and virulence factor activity (gingipain); (iii) inflammatory activity and reactive oxygen species (ROS) generation of monocytic cells (MONO-MAC-6) and periodontal ligament fibroblasts (PDLF) with or without exposure to periodontal biofilms.

Results The results showed that HHA and CHA reduced bacterial counts on four-hour biofilm with log10 reductions of 0.6 and 0.3. On a pre-existing five-day biofilm, HHA and CHA decreased the total biofilm mass. Concentrations below 10 mg/ml did not inhibit growth of periodontal bacteria. None of the HAs affected gingipain activity. Without biofilm challenge, OHA triggered inflammatory reaction by increasing IL-1 β and IL-10 levels in MONO-MAC-6 cells and IL-8 in PDLF in a time-dependent manner, whereas CHA suppressed this response by inhibiting IL-10 expression in MONO-MAC-6 cells and IL-8 expression in PDLF. Under biofilm stimulus, HAs decreased the expression of IL-1 β while increasing IL-10 in MONO-MAC-6 cells in a molecular-weight-dependent manner, with CHA having a longer-lasting effect. Only HHA slightly depressed the high generation of ROS by biofilm stimulation in both cells. The statistical analysis was performed using ANOVA, and *p*<0.05 was considered statistically significant.

Conclusions Overall, these results indicate that HHA and CHA have anti-biofilm, anti-inflammatory, and anti-oxidative activities in periodontal environment, which could provide insight into the use of different HAs at different time points in periodontal disease treatment.



Generative Deep Learning for the Fabrication of Inlays

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Objectives To develop a data-driven approach for the reconstruction of occlusal surfaces for the fabrication of inlays. **Methods** A data-set that comprises 3D mesh files (n=91) of full dental crowns was aligned, centered and projected into the 2D space to integrate with the chosen Generative Adversarial Network (GAN) architecture. The processed 2D data-set was used to train the StyleGAN-2 network. The reconstruction task is based on a modified Bayesian Image Reconstruction method. The trained GAN is used as the underlying model for the iterative optimization process. The proposed reconstruction method was quantitatively validated using individual crowns. Additionally, it was qualitatively compared to a clinical procedure for CAD inlay fabrication. The inlays were evaluated by dentists (n=6) using the original tooth as reference.

Results The network learned to generate an arbitrary number of different occlusal surfaces from the same class of molar teeth. The root mean square errors for the quantitative individual inlay validation ranged from 0.02mm to 0.18mm with relative sizes ranging from 30% to 80% of the original occlusal surface. The qualitative evaluation yielded that the GAN method was consistently preferred for the three largest restorations.

Conclusions StyleGAN-2 was able to learn the correct representation of various occlusal surfaces based on a limited data-set. The modified Bayesian Image Reconstruction method enabled the generation of arbitrary inlay geometries. The restorations showed adequate quantitative and qualitative results.



The Effect of Sex and Ethnicity on Palatal Geometry-Based Identification

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Objectives The palatal scan has been recognized as a potential factor for human identification in mass disasters, but sex and ethnicity identification remains unclear. This study aims to investigate the effect of sex and ethnicity on geometric-based discrimination between individuals using palatal scans made by intraoral scanners.

Methods Twenty-three participants (16 women and seven men, aged 23-35) from 11 countries in Asia and Europe were scanned by an Emerald intraoral scanner (Planmeca) three times. Palatal width, depth, and height were measured in the GOM Inspect software (GOM GmbH, Germany). The differences in the three parameters were calculated for a possible combination of the scan pairs and squared. Two (identity and stranger)previously developed (on homogenous population) linear discriminant functions calculated discriminative scores for each scan combination. The highest score predicted the scan pair in identity or stranger groups. The sensitivity and specificity of the identification were calculated based on the correct hit. Logistic regression analysis was used to investigate the effect of the longitude and latitude between the country of origin (covariate independent) and sex difference (categorical independent) on the successful hit.

Results The study utilized 58 identity pairs and 1658 stranger pairs for identification. The sensitivity and specificity for distinguishing between identity and stranger pairs were 91.2% and 97.1%, respectively. While there was no significant effect of latitude (odds ratio=1.010, p=0.735) and longitude (odds ratio=1.000, p=0.972) on the number of correct matches, the opposite sex increased the prediction rate of strangers by 5.4 times.

Conclusions The study demonstrates the potential of palatal scans in forensic identification by utilizing simple linear measurements. The previously developed discriminant functions based on palatal geometry can be used ubiquitously in different ethnical populations.



Pre- to Post-Pandemic Learning Effectiveness in Oral Radiology Courses

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Objectives The COVID-19 pandemic forced undergraduate dental education to shift towards online-only formats. This may have negatively impacted students' skill development, and it remains unclear whether blended-learning concepts could compensate for this effect. The present study aimed to longitudinally compare students' diagnostic skill development in oral radiology courses between pre- and post-pandemic blended and pandemic online-only learning.

Methods From October 2018 until July 2022, 255 undergraduate dental students were enrolled in three consecutive radiology courses (C1, C2, and C3). Students were divided into three groups according to the time point of participation (pre-pandemic, pandemic, and post-pandemic). In pre-pandemic courses, students received conventional blended learning. During pandemic semesters, online-only blended learning with additional video-based e-learning modules (VBLMs) was implemented. In post-pandemic courses, blended learning resumed, enhanced with VBLMs. C1, C2, and C3 received 2, 4, and 6 VBLMs, respectively. We assessed the knowledge gain (KG) by calculating the difference in scores between baseline and final exams (FE) of each semester. Furthermore, the results of the questions covered by VBLMs were compared.

Results Regarding the scores in FE and KG, no significant differences were found between pre- and pandemic semesters, between pandemic and post-pandemic semesters, and between pre- and post-pandemic semesters. Comparing pandemic to post-pandemic results, no significant differences were found in C1 and C3, while students in C2 significantly improved in questions covered by the VBLMs (p = .001). Comparing pre- to post-pandemic semesters, students in C1 significantly deteriorated, while students in C2 significantly improved (p = .03 and p < .001, respectively). No significant difference between pre- and post-pandemic semesters was found in C3.

Conclusions Within the limitations of this study, results indicate that pandemic online-only learning may be as effective as prepandemic blended learning. Blended-learning concepts enhanced with VBLMs seem to compensate for the COVID-19-associated skill-development gap.



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Objectives Objective, valid and reliable evaluations are needed in order to develop haptic skills in dentistry education, especially in the preclinical phase. The aim of this study is to investigate the validity and reliability of evaluating the performance and the haptic skills of dentistry students during the dental restoration stages with the deep machine learning method.

Methods 150 dentistry 6th-semester students in a preclinical exam have performed a Class II amalgam and a composite resin restoration, in which all stages were evaluated with Objectively Structured Clinical Examination (OSCE) forms. The final phase of this exam was graded by 3 trainers and 3 supervisors separately. Standard photographs of the restorations in the final stage were taken from different angles in a special setup and transferred to the Python program. With a library and a Structural Similarity algorithm (SSIM) prepared in this program, the quantitative and qualitative percentage difference of each restoration compared to a master model prepared by the supervisors was calculated. The validity and reliability analysis of inter-examiner evaluation (including SSIM) was tested by Kappa statistics and average values above 0.85 were considered high inter-examiner reliability.

Results For amalgam restorations high mean values of Kappa were obtained in both examiner groups (κ = 0.94). Moreover, the compatibility of the examiner and SSIM was constant when considering the proximal surfaces (κ =0.91), and acceptable in occlusal surfaces (κ = 0.86). For composite restorations, although acceptable Kappa values were acquired in both examiner groups (κ =0.85). the compatibility of examiner and SSIM was inconsistent when considering the proximal surfaces (κ = 0.79), and occlusal surfaces (κ =0.76).

Conclusions Although deep machine learning is an advanced and promising tool in evaluation of haptic skills, further improvement and alignments are required for fully objective and reliable validation in all cases of preclinical dental education in restorative dentistry.



Co-Morbidities in Temporomandibular Disorders - Machine Learning and Statistical Analytics

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Objectives To analyze the association between Temporomandibular disorders (TMD) and systemic co-morbidities. **Methods** This research analyzed data from the Dental, Oral, Medical Epidemiological (DOME) records-based study, which integrates comprehensive socio-demographic, medical, and dental databases of a nationwide sample of dental attendees to military dental clinics for 1 year aged 18- 50 years. Statistical and machine learning models were performed with TMD as the dependent variable. **Results** 132,529 subjects were included, of those 1899 (1.43%) had been diagnosed with TMD.

TMD was positively associated with the following parameters in the univariate analysis: age [Odds Ratio (OR) and 95% confidence interval (CI) =1.07 (1.06-1.07)], female sex [OR=2.31 (2.11-2.53)], Former Soviet Union (FSU) [OR=1.45 (1.04-2.02)], and Asia [OR=1.91 (1.12-3.260] birth countries, smoking [OR=2.42 (2.11-2.780], hypertension [OR= 1.9 (1.6-2.3)], hyperlipidemia [OR=2.84 (2.51-3.22)], diabetes [OR=2.59 (1.68-4.00)], obesity [OR=2.58 (2.26-2.94)], cardiovascular disease [OR=2.20 (1.82-2.660], sleep apnea [OR=3.98 (2.53-6.25), fatty liver [OR=3.24 (2.42-4.360], and anemia [OR=3.25 (2.89-3.66].

The following parameters maintained a statistically significant positive association with TMD in the multivariate analysis: **fe**male sex [OR=2.65 (2.40-2.93], anemia [OR= 1.68 (1.48-1.92), FSU birth country (OR= 1.46 (1.06-2.08)], and age [OR=1.07 (1.06-1.08)]. We also performed clinical features importance based on XGBoost machine learning algorithm with TMD set as the target variable and received an area under the curve (AUC) of 0.748. Among the major features that are increasing the risk of TMD there were: sex, age, and anemia located as the most important in feature importance.

Conclusions Anemia was the only systemic parameter which retained statistical significance in the multivariate statistical model, and was also ranked highest compared to other systemic conditions in the machine learning model. Anemia of inflammation is prevalent in patients with a growing list of diseases that cause prolonged immune activation. Metabolic morbidity and anemia should be included in the systemic evaluation of TMD patients.



Laryngeal Cartilage Calcifications on Lateral Cephalometric Radiographs

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Objectives To determine the influence of age and gender on the incidence of calcification in laryngeal cartilage diagnosed on lateral cephalometric radiographs routinely taken for orthodontic diagnosis.

Methods The lateral cephalometric radiographs of 957 patients who met the study criteria were analyzed from among the 1000 lateral radiographs originally collected. The images were evaluated independently by two investigators. Given the dichotomous dependent variable (calcification or no calcification), a mixed logistic regression model was used to test how age and gender affected calcification.

Results The effect of age and gender reliably determined the likelihood of laryngeal cartilage calcification. The greatest differences in the degree of calcification by gender were found at ages 20-25 years. The degree of calcification increased with age, reaching 100% in women at age 30 and in men at age 50. In women, the degree of calcification was higher than in men from the age of 13 years and levelled off at the age of 50 years. The interrater agreement was strong k = 0.97, z = 30.0, p < .001.

Conclusions Calcification can be detected by orthodontists trained in lateral cephalogram analysis and can be used as a screening or diagnostic tool to detect calcified areas in the larynx. Based on the results, the effects of age and sex reliably determined the probability of laryngeal cartilage calcification.



Figure 1. Frequencies and percentages of the occurrence of calcifications in the laryngeal cartilage within sex groups (A) and within age groups (B) with results of the Pearson Chi-square test (χ^2). N - sample size, n- group sample, df – degrees of freedom, p – p-value of statistical test, φ – measure of relationship strength Phi, φ_c – measure of relationship strength Cramer's V.





Figure 2. Expected probabilities of calcification in the laryngeal cartilage as a function of sex and age terms.



Predictive Model of Skeletal-Class-III-Malocclusion Sub-Phenotype in Southern European Population

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Objectives Accurate diagnosis of skeletal class III malocclusion phenotype (SCIII) is critical for precise clinical treatment and research on the efficacy and efficiency of orthopedic and orthodontic treatments. This study aimed to evaluate the accuracy of a developed predictive model for sub-phenotype classification in two independent southern European population cohorts exhibiting SCIII. **Methods** Data were collected from two cross-sectional studies of independent southern European population cohorts of Spanish origin using varimax rotation and cluster analysis. 54 skeletal cephalometric variables were measured on radiographic records and a predictive model was developed and tested for accuracy in these two independent cohorts affected by SCIII by means of discriminant analysis and classification tree analysis.

Results A total of 310 Spanish subjects were included: Cohort_S1 (n=99) and Cohort_S2 (n=211). Both cohorts were subclassified into 5 and 6 clusters, respectively, which allowed for the identification of different sub-phenotypes of SCIII. Discriminant analysis showed that Cohort_S2 had better classification accuracy (94,3% original grouped cases and 81,0% cross-validated grouped cases correctly classified) compared to Cohort_S1 (91,9% original grouped cases and 61,6% cross-validated grouped cases correctly classified). Classification tree analysis revealed that Cluster_2 (95.0%) and Cluster_5 (88.2%) in Cohort_S2 and Cluster_1 (82.6%) and Cluster_3 (81.5%) in Cohort_S1 had the highest prediction percentages. The most informative variables in these sub-groups were SN-GoGn°, SND°, Y-Axis°, PFH:AFH% , Co-Go(mm), Ar-Go(mm), S-Go(mm), ANS-Me(mm), Face Height Ratio(%), UFH(%), ANS-Xi-Pm°, Ar-A(mm), ANS-PNS(mm) and Co-A(mm).

Conclusions The subgrouping analysis method was effective (>90%) in predicting sub-phenotypes of skeletal class III malocclusion in southern European population affected by SCIII. A good classification accuracy was achieved in both cohorts (91.9% Cohort_S2; 94.3% Cohort_S1); however, these results decreased when cross-validated (61.6% Cohort_S2; 81.0% Cohort_S1). These results may contribute to refine and improve future predictive models for more accurate classification of SCIII and to extend it to other populations.



Impact of Laser Biostimulation and Vibrations on the Orthodontic Pain

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Objectives Pain is one of the most common complaints from patients undergoing orthodontic treatment. The aim of this study was to assess the impact of low level laser therapy (LLLT) and low-frequency vibration therapy (VT) on the intensity of pain in patients at the initial stage of orthodontic treatment with fixed appliances.

Methods Eighty patients (50 females and 30 males, mean age 22.03 years) were selected for this study from the Department of Orthodontics in Pomeranian Medical University in Szczecin who were beginning orthodontic treatment. The patients were randomly divided into three groups: LLLT group - 20 patients who received daily LLLT for five consecutive days after the appliance was installed (MED. 701 diode laser, Lasotronic, Switzerland), VT group - 20 patients who received daily low-frequency VT for five consecutive days after the appliance was installed (BitePod 2.0, Orlando, Florida, USA), and control group - 40 patients who did not receive any pain therapy. Pain levels were evaluated using a visual analogue scale (VAS). The results were statistically analyzed.

Results The analysis of the data revealed that the peak intensity of pain in all groups occurred on the second day after the fixed appliance was installed and gradually decreased in the following days. There was a significant reduction in pain intensity in the LLLT and VT groups compared to the controls. There were no significant differences in pain intensity between the LLLT and VT groups. **Conclusions** Laser biostimulation and vibration therapy significantly reduce pain and the dynamics of its changes during the first five days after the installation of fixed appliances. Comparative analysis showed similar efficacy of LLLT and VT in reducing pain in patients undergoing orthodontic treatment.



Assessment of pain in a visual analog scale in the examined groups during the first days after the installation of the fixed appliances



MED. 701 diode laser, Lasotronic, Switzerland





BitePod 2.0, Orlando, Florida, USA



0386 Sagittal Malocclusions and Patient Motivation When Seeking Orthodontic Treatment

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Objectives The proposed study aims to determine the role played by the self-perception of dentofacial aesthetics in a selected population and on the motivation for orthodontic compromise and ortho-surgical treatments.

The secondary objectives of this study were to determine the barriers to treatment, preferences among tratment options as well as treatment satisfaction factors.

Methods A questionnaire comprising 21 questions, addressed to people who had an anomaly of sagittal development and who had or had not had recourse to treatment before (orthopedic, orthodontic or ortho-surgical treatment) was established. The questions were formulated on google forms and were then shared on discussion platforms (social networks) specifying who the targeted people are, with the aim of questioning them on their own facial and dental aesthetic perception, as well as their motivation to undergo compromise orthodontic or ortho-surgical treatment. The collection of these data was subject to the informed consent of the respondents in order to include their response in the study. 58 complete responses, out of 126 total resposes were analyzed. **Results** Among the most pertinent interpretation we found that the breakdown of reasons for seeking treatment shows that 34.5% of people would like treatment to improve their dentofacial appearance, 1.7% would like treatment to improve function, 36.2% would like improve both (appearance and function) and 27.6% do not wish to have treatment.

34.5% of people would like ortho-surgical treatment, 37.9% of people would like compromise orthodontic treatment, and 27.6% of people do not want to have treatment.

Conclusions Successful treatment is individualized treatment that considers clinical parameters, clinician judgment, and patient desires within a trusted therapeutic relationship, which are key factors in achieving patient satisfaction.



Oral Status in two Ancient Italian Populations: an Observational Study.

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Objectives The purpose of this study is to evaluate the oral status of two ancient Italian populations.

Methods Skulls from two Italian archeological sites were examined: Opi (central Italy) VI-V century BC; Herculaneum (southern Italy) 79 AD.

Inclusion criteria: adult skulls with permanent dentition and at least one dental arch and one dental element.

Exclusion criteria: skulls without jaws or edentulous or with mixed dentition.

Gender and age have been assigned by anthropology experts.

Skulls were examined for:

- Complete/incomplete jaws;
- Number of teeth;
- Number of ante-mortem/post-mortem missing teeth;

- Distance between the residual alveolar ridge (RAR) and the cement-enamel junction (CEJ) of the worst site of the most compromised tooth;

- Stage of the New Classification taking into account only the CAL measure;
- Number of infrabony defects;
- Number of teeth with calculus;
- Number of decayed teeth;
- Number of worn teeth;
- Presence of dehiscences/fenestration;
- Number and stage of furcations according to Hamp et al.;
- Bone lumps/osteolysis;
- Presence and number of supernumerary.

Teeth were examined using a HuFriedy™ UNC 15 PCP periodontal probe.

Results A total of 233 skulls were examined, of which 134 from Opi (O) and 99 from Herculaneum (H). 70 skulls from Opi and 77 from Herculaneum were included for a total of 147 skulls. M: 66.44% (99), F: 28.86% (43), Unknown: 3.40% (5), and 2906 teeth (1047 Opi; 1859 Herculaneum).

Age distribution, sex distribution and the main results are shown respectively in Table 1, 2, 3.

Conclusions Herculaneum population showed better periodontal conditions and a lower number of decayed teeth. Opi population showed two osteolysis regions in different skulls. The collection of oral data in ancient skulls has been effective for evaluation of the periodontal status which has to be related to eating habits, oral hygiene, lifestyle and general health of ancient populations.





RAR/CEJ



Fenestrations.



Osteolysis.

Age distribution

Age	Opi (70)	Herculaneum (77)
Adolescents (< 18 y.o.)	2.86% (2)	12.29% (10)
Young adults (18-25 y.o.)	14.29% (10)	7.79% (6)
Adults (25-35 y.o.)	14.29% (10)	33.77% (26)
Mature Adults (35-45 y.o.)	38.86% (23)	20.78% (16)
Elderly (> 45 y.o.)	34.29% (24)	24.68% (19)
Unknown	1.43% (1)	0% (0)



Sex distribution

Sex	Opi (70)	Herculaneum (77)
Female	28.57% (20)	29.87% (23)
Male	68.57% (48)	66.23% (51)
Unknown	2.86% (2)	3.90% (3)

Parameters

Parameter	Орі	Herculaneum	
Ante-mortem missing teeth	40.31% (422)	10.33% (192)	
Post-mortem missing teeth	40.59% (425)	20.71% (385)	
Mean value RAR/CEJ	11.17 ± 4.05 mm	8.37 ± 3.78 mm	
New Classification Stages	I 1.43% (1); II 4.29% (3); III 41.43% (29); IV 52.86% (37)	I 0%; II 23.38% (18); III 64.94% (50); IV 11.69% (9)	
Mean # infrabony defects	5.14 ± 4.11	5.24 ± 4.00	
Skulls with dehiscences/fenestrations	75.72% (53)	59.74% (46)	
Decayed teeth	10.98% (115)	3.39% (63)	
Worn teeth	81.38% (852)	78.26% (1455)	
Teeth with calculus	43.08% (451)	26.9% (500)	
Furcations	I 101; II 33; III 26	62; 21; 8	
Bone lumps/osteolysis	Lumps 0%; Lysis 4.29 % (3)	Lumps 0%; Lysis 0%	
Supernumerary teeth	0%	0%	



A PDMS Membrane to Attenuate Composite Restorations Stresses

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Objectives To evaluate an experimental stress breaker device (membrane) that compensates for the stresses inside resin-based dental restorations.

Methods a PDMS stress breaker device (membrane) was developed to be introduced inside the composite resin restoration at the time of insertion and before polymerization. Cavities were prepared on the occlusal surface of Mandibular wisdom teeth, which were then restored with resin composite. 3 groups were formed; a first Control group with bulk insertion, a second Control group with Incremental insertion, and a third group with bulk insertion and the stress breaker membrane concomitantly. After polymerization for 40 seconds, the teeth were thermal cycled for 5000 cycles. Filled teeth were then immersed in a silver nitrate solution, and Micro CT images were obtained, the teeth were then sliced and observed under stereomicroscope and SEM. Microbars were obtained from teeth of the 3 groups and subjected to Microtensile assay on a universal testing machine. Finally, obtained data were submitted to One-Way Anova (α =0.05).

Results The microscopy and the Micro CT results showed significant differences between the 3 groups, with higher leakage around the control groups. The microtensile test demonstrated significantly higher values compared to the control groups. SEM analysis showed the membrane remained intact after aging.

Conclusions The experimental stress breaker device demonstrated the ability to absorb polymerization and thermal stresses and could protect resin-based restorations from discoloration risk and potential restoration failure. From clinical perspectives, these findings implicate its potential benefit in reducing infiltration along the restorative interface, with the aim of enhancing restoration longevity and recurrent caries inhibition.



Selective Micro-Scale Conversion Measurements in Photo-Polymerized Dental Resin-Based-Composites

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Objectives To investigate how the chemical structure of constituent resin-matrix monomers impacts their respective inter-particulate conversion in photo-polymerized dimethacrylate resin-based-composites.

Methods A photo-polymerizable experimental composite was fabricated by combining Bis-GMA and partially deuterated TEGDMA (d-TEGDMA) monomers (50:50 weight.% ratio) with a 1 weight.% CQ photo-initiator and monodispersed 7.75 μ m diameter silica microspheres. Films of composite were photo-polymerized on CaF₂ optical substrates for 20s at an irradiance of 1200mW/cm². Fourier Transform Infrared (FTIR) spectro-microscopy was conducted using an Agilent Cary 670 spectrometer with a Cary 620 Microscope and 128x128 pixel Focal Plane Array detector to visualise inter-particulate conversion. Deuterium labelling of the d-TEGDMA reactive end-groups (CH₂ to CD₂) introduced vibrational contrast, when observed with FTIR spectroscopy, enabling discriminative conversion measurements for each monomer over the same sample region. Spatially resolved conversion was calculated for each monomer as the percentage decrease in the aliphatic absorption bands (non-labelled~1637cm⁻¹, labelled~1591cm⁻¹) in the polymer relative to the monomer.

Results Radially increasing conversion was observed for Bis-GMA from the centre of each filler particle (~7%) outwards into the interparticulate resin-matrix (~25%), whilst d-TEGDMA showed little variability in conversion in proximity to filler particles (~70±2%). Reduced conversion at the resin-filler interface is attributed to a low mobility boundary-layer mediated by the chemistry of the resinmatrix. Bis-GMA likely constitutes the largest fraction of the boundary layer per monomer, attributed to aromatic rings, carbonyl and hydroxyl groups reducing mobility and conversion through inter-molecular π - π stacking and hydrogen bonding interactions with the surface of silica particles.

Conclusions We have demonstrated that deuterium labelling coupled with FTIR spectroscopic-imaging provides valuable insight into the micro-structure of resin-based-composites. This novel approach illustrates how the chemical structure of constituent resin-matrix monomers affects conversion at the resin-filler interface, which will impact the mechanical performance, failure and ultimately the clinical lifetime of dental composites.



Fast 3D-Printing Maintains Resin-Composite Physical Properties and Color Stability

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Objectives To evaluate the effect of fast-printing mode (15 minutes) and different post-curing protocols on the physical properties and color stability of 3D-printed composites

Methods Disc-shaped samples were fabricated using two 3D-printed resin composites (Saremco Crowntec - SAR and Senertek P-Crown - SEN) and subjected to no post-curing, 4-, 8- or 16-minutes post-curing (n=8). The degree of conversion (DC) of the printed resin composites was detected using an FTIR. The samples' surfaces were polished with sandpaper discs, cloth, and polishing suspension, and the Knoop surface hardness (KHN) was measured using an automatic micro-indenter. The surface area roughness (Sa) was measured using an Atomic Force Microscope (AFM). The color stability was measured according to the CIEDE2000 (deltaE00) after immersion in a coffee solution for 1 day, 1 week, and 2 weeks. The data were analyzed using two-way ANOVA followed by a Bonferroni post-hoc test (p=0.05).

Results The DC increased with the increase of the post-curing time and ranged between 89.94% and 97.90% for SAR and between 91.64% and 95.88% for SEN. Similarly, the KHN ranged between 16.55 and 28.93 for SAR and between 16.83 and 28.07 for SEN. The highest SBS was recorded for SEN when cured for 8 min (27.18 MPa), while the lowest was recorded for both SAR and SEN no-cure groups (18.98 and 18.49 MPa, respectively). In contrast, Sa decreased with increasing the post-curing time and ranged between 48.11 nm and 21.81 nm for SAR and between 64.13 nm and 22.90 nm for SEN. The highest color stability was recorded for SAR when cured for 16 minutes (deltaE00=1.44), and the lowest was recorded for both SAR and SEN when they were not post-cured (deltaE00=4.72 and 4.56, respectively).

Conclusions The fast 3D-printing mode is a viable method that yielded resin composite with acceptable physical properties and color stability, given that sufficient post-curing protocol is followed.



Mechanical and Surface Properties of Titanium Dioxide Nanotubes Addition to Conventional Glass-Ionomers

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Objectives This in vitro study evaluated the addition of titanium dioxide (TiO_2) nanotubes to conventional glass-ionomer cement(GIC) on mechanical and surface properties.

Methods GIC (Ionofil Molar, Voco GmbH) was reinforced with varying amounts of TiO₂ nanotubes (wt 0.1%, 0.5%, 1%, 2%) and functionalized TiO₂ (f-TiO₂) (wt 0.1%, 0.5%, 1%, 2%). The specimens will be assigned to 9 groups:1) Group IM0: no addition TiO₂(control), 2)Group IM1: 0.1% TiO₂, 3)Group IM2: 0.5% TiO₂, 4)Group IM3: 1% TiO₂, 5)Group IM4: 2% TiO₂, 6)GIM1f: 0.1% f-TiO₂, 7)GIM2f: 0.5% f-TiO₂, 8)GIM3f: 1% f-TiO₂, 9)GIM4f: 2% f-TiO₂. After the synthesis of TiO₂ nanotubes, characterization was performed with X-ray diffraction (XRD), FTIR spectroscopy, specific surface area (BET), transmission electron microscope (TEM) and scanning electron microscope (SEM). The recommended powder/liquid ratio of 4/1 for GIC was used for all prepared specimens. For Vickers microhardness (VHN) and surface roughness(Ra), disc-shaped specimens (5mmx2mm) were fabricated(n=10) and measured with HMV Microhardness Tester and contact profilometer. For the three-point bending test, bar-shaped specimens(2mmx2mmx25mm) were fabricated(n=10) and measured with a universal test machine(crosshead speed:0.5mm/min). Flexural strength, flexural modulus and resilience modulus were calculated. The fractured surfaces and surface morphology were observed under SEM. Two-way ANOVA and Bonferroni tests were used for statistical analyses(p<0.05).

Results When comparing the reinforced groups to control group, Group IM4f showed statistically higher surface roughness while Group IM4 showed statistically higher resilience modulus and lower flexural strength (p<0.05). The flexural modulus of Group IM1 and Group IM2f were found statistically lower than the ones of control group (p<0.05). Regarding functionalization of TiO₂ nanotubes, Group IM3f exhibited statistically higher resilience modulus and flexural strength than Group IM3(p<0.05). The VHN of Group IM2f significantly decreased than Group IM2(p<0.05).

Conclusions For GIC material, reinforcement with %2 (wt) TiO₂ nanotubes could improve the resilience modulus and decrease the flexural strength. The addition of TiO₂ nanotubes with other amounts did not affect the mechanical and surface properties of this material, positively.



Representative SEM images of TiO₂ nanotubes



Representative TEM images of TiO₂ nanotubes



0396 Chairside Materials' Retentive Strength on Titanium After Aging: Pilot Study P. Mourouzis, D. Dionysopoylos, K. Tolidis

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Objectives Implant-supported prostheses can now be created in a single visit using computer-aided design and computer-aided manufacturing, which has become a common procedure in dentistry. Clinical studies and systematic reviews report high survival rates for implants. However, technical complications are still expected in the mid- to long-term. The purpose of this study was to compare the retentive strength of resin nanoceramic and ceramic materials cemented with intraoral universal bonding systems or extraoral permanent cementation systems on the titanium base abutment after thermocycling and artificial aging.

Methods Ninety crowns were milled with identical anatomy and cemented to titanium base implant abutments. They were divided into three groups (n=30) based on the material used: a) 3Y-TZP zirconia, b) lithium disilicate, and c) resin-ceramic CAD/CAM material. All crowns were cemented either with universal bonding systems or extraoral permanent cementation systems under a 50 N load for 15 minutes. After taking baseline measurements, the crowns were artificially aged according to their fabrication material. The crown retention procedure was performed using a universal testing machine, while the degree of conversion was assessed by ATR-FTIR spectroscopy. Data were analyzed using one-way Analysis of Variance and Tukey's post-hoc test to evaluate the effect of material and artificial aging on retention strength (p = 0.05).

Results The choice of materials and cementation system had a significant effect on the retention of the titanium base abutment for single visit chairside restorations. IPS e.max CAD material had the strongest bond, followed by inCoris TZI C meso. Vita Enamic was the material with the most catastrophic failures. There was a strong negative correlation between the choice of cementation system used.

Conclusions The cementation of chairside materials to titanium bases suggests that clinical dentistry can use chairside cementation systems to bond restoration materials to titanium bases.







Results of retention test of polymer-infiltrated and glass-ceramic crowns on titanium bases using different cements.

Tibase	Material	Retention bond (N) (Mean ± std)
Multilink Hybrid Abutment	Zirconia (inCoris TZI C meso)	456 ± 46
	lithium disilicate (IPS e.max CAD A16L)	486 ± 72
	P.I.C.N. (Vita Enamic IS)	293 ± 72
Relax Ultimate	Zirconia (inCoris TZI C meso)	602 ± 34
	Lithium disilicate (IPS e.max CAD A16L)	352 ± 76
	P.I.C.N. (Vita Enamic IS)	563 ±78



Effect of Magnification and Press-on Force on Composite Polishing Efficiency

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Objectives Evaluation of surface roughness (Ra) and gloss of two resin-composites after finishing/polishing with two different polishing systems using a novel 'press-on force guided (PFG) polishing simulator'.

Methods A total of 80 specimens of two types of resin-composites (microhybrid, Essentia Universal (EU), GC; nanohybrid, Universal Injectable (INJ), GC; both A2, 2mm) were prepared and the surface standardized with SiC abrasive papers (600, 800, 1000 grit). Initial surface roughness (Ra) (Mahr Marsurf ps10) and gloss (Novo-Curve glossmeter) were measured, and specimens were randomly divided into 16 subgroups (n=5) according to finishing/polishing system (Sof-Lex (3M), Twist Dia (Kuraray Noritake)), presence/absence of x3.5 magnification, and controlled (2-4N)/uncontrolled press-on force. Each disc and wheel from the finishing/polishing system was used for 30s at 10000rpm under dry conditions. After finishing/polishing, surface roughness and gloss were measured. Data were analyzed using a generalized linear model and Tukey HSD test (p < 0.05).

Results Mean Ra and gloss values were significantly influenced by composite type and finishing/polishing procedure. In addition, mean gloss values were also significantly influenced by type of finishing/polishing system and press-on force difference. INJ presented statistically higher gloss than EU, while EU exhibited statistically higher surface roughness than INJ (p<0.001, for each). Twist Dia presented statistically higher gloss than Sof-Lex. In Sof-Lex group, magnification resulted in statistically higher gloss values (p=0.009), while in Twist Dia group magnification did not lead to a significant difference (p=0.553). Regarding press-on force, the gloss values of uncontrolled group (more than 2-4N force) were statistically higher than those of the controlled group (2-4N) (p<0.001, for each).

Conclusions All tested materials and conditions presented lower roughness and higher gloss after finishing/polishing procedures, however Universal Injectable exhibited smoother and brighter surfaces. Magnification is a time-demanding enhancement in restorative treatments.



Fluoride Release From Fiber-Reinforced Glass Ionomer Cement

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Objectives This study aimed to compare fluoride release from a commercially available glass ionomer cement to a formulation reinforced by the addition of short glass fibers in different percentages.

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 (6µm in diameter, average length of 140µm) to the powder portion of cement, while the control group contained no fibers. The material was hand-mixed according to the manufacturer's instructions. Samples of 2mm thickness and 8mm diameter were prepared using Teflon molds and stored in deionized water for 24 hours, 7 days and 30 days respectively, after which a reading was taken by the ion-selective electrode. 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 values of fluorides (mg/l) after 24 hours, 7 days and 30 days respectively were 12,75±1,01, 11,03±0,85 and 19,97±2.02 for the control group; 9,52±1,25, 8,98±0,71 and 19,31±1,36 (10% of glass fibres); 9,12±1,20, 9,02±1,60 and 20,77±1,09 (15% of glass fibres); 6,53±1,15, 6,48±1,30 and 21,06±1,65 (20% of glass fibres). According to the repeated measures variance analysis results, the difference between the groups, was found to be statistically significant (P<0.001) at the end of 24 h and 7 days. On the other hand, after 30 days, no significant difference among groups was detected (P=0.3226).

Conclusions The addition of fibers reduces the initial fluoride release, however, in later stages, the release is not affected significantly.


Angiogenic Potential of a Thermosensitive Collagenated Bone Filling Material

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Objectives In addition to the activity of bone forming cells, neo-angiogenesis is a major requirement for bone regeneration. Indeed, neo-angiogenesis is essential for providing the healing tissue with oxygen/nutrients and for paving the pathway for stem cell recruitment. Upon applying bone grafting materials for post-extraction ridge preservation, an intimate interaction occurs between the bone grafting material and the injured periodontal ligament tissues. This work was designed to investigate the angiogenic potential of a thermosensitive collagenated bone filling material GTO ® as compared to two references materials: Gen-Os ® and Bio-Oss ®. **Methods** Bone grafting materials prepared according to the manufacturer's instructions were incubated in MEM medium (20mg/mL) for 24 hours to obtain the extracts. Human periodontal ligament (hPDL) cells, from extracted third molars, were injured, and incubated with the extracts. After 24h, VEGF and FGF-2 growth factors secretion was quantified (ELISA). Endothelial cells were incubated hPDL cell supernatants to evaluate their proliferation (MTT assay) while neo-angiogenesis was investigated by measuring the tube-like formation on the Matrigel ® matrix.

Results A significant increase in VEGF and FGF-2 secretion was obtained with all materials as compared to the control and this increase was higher with GTO®. Endothelial cell proliferation significantly increased with both Gen-Os® and GTO® as compared to that of Bio-Oss®. Finally, angiogenesis was stimulated by all materials as demonstrated by an increased formation of capillary-like structures. Of note, the capillary-structure organization was highest with the collagen containing materials (GTO® and Gen-Os®). **Conclusions** These findings demonstrate an enhanced angiogenic potential of GTO® bone grafting materials when applied on PDL cells, most likely by increasing VEGF/FGF-2 production, endothelial cell proliferation and organization into tube-like structures. Thus, in addition to maintaining the space and providing a stable support in the extraction socket, GTO® plays major roles in bone regeneration by inducing neo-vascularization.



0400 Intrinsically Disordered Peptides Enhance Regenerative Capacities of Bone Composite Xenografts <u>H. Haugen</u>, M. Rahmati Department of Biomaterials, University of Oslo, Oslo, Norway

Objectives To investigate the potential of proline-rich IDPs in bone reconstruction, we studied the *in vivo* effects of SBN + P2 and SBN + P6 in a randomized, controlled study in critical size craniotomy defects in 16 young pigs. The observation times after surgical reconstruction of the skulls were 8 and 16 weeks. The long-term goal of the research is to provide safe, biofunctionalized composite bone graft substitutes for bone traumas in challenging bone reconstructions. We hypothesized that encapsulating IDPs into SBN will enhance its osteoinductivity and osteoconductivity by increasing the bone anabolism. We hypothesized that these composites will have a better emergence with the surrounding bone tissue through the remodeling of the old xenograft and stimulating new bone formation.

Methods this *in vivo* study investigated their functions in critical size craniotomy defects in 16 domestic pigs after 8 and 16 weeks of healing. For this purpose, we used cone beam computed tomography (CBCT), microCT (µCT), histology, immunohistochemistry, fluorescent labeling of abundant reactive entities (FLARE), synchrotron SAXS/XRD, optical photothermal IR (O-PTIR) microscopy and nanoscale atomic force microscopy-infrared (AFM-IR) analyses.

Results Our results represent new synthetic IDPs as potential candidates for directing bone formation and biomineralization by means of microCT, IHC, histology, AFM. The SBN + P6 stimulated significantly higher bone formation and biomineralization after 8 weeks of healing compared to other groups indicating its potential in stimulating early biomineralization. After 16 weeks of healing, the SBN + P2 induced significantly higher bone formation and biomineralization and biomineralization and biomineralization and biomineralization and biomineralization and biomineralization processes.

Conclusions Overall, P2 and P6 are promising candidates for bone augmentation strategies in critical clinical applications. We concluded that FLARE and O-PTIR are promising tools in evaluating and diagnosing the biochemical structure of bone tissue and the bone-biomaterial interface.



IDPs are key in directing molecular and cellular signalling pathways such as regulating transcription, translation and cell cycle. Because of their regulatory role in cell functions, IDPs are involved in intermolecular interactions of biomineralization processes. Therefore, IDPs can adapt to several binding configurations due to their one-to-many and many-to-one signalling capacities.



Compression and Tensile Strength Testing of Individualized Biodegradable Augmentation Scaffold

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Objectives 3D reconstruction of bone tissue is extremely challenging, with the titanium mesh augmentation technique, the Khoury procedure, and distraction osteogenesis currently being the most popular methods. Those methods have considerable drawbacks and limitations, and demand for exceptionally skilled operators. The solution could be individualized biodegradable augmentation scaffolds (IBAM) which provide space for the new bone growth, and can be constructed into complex 3D designs. Because of simple design and production procedures, biocompatibility, and planned biodegradability, PLA has found its use in tissue engineering. **Methods** In order to examine the mechanical characteristics of biodegradable scaffold, the mechanical properties (compression and tensile strength) of 3D-printed PLA specimens were investigated on the universal testing machine (Inspekt Duo 5kN-M). The maximal load for the compression test was set at 150 N, while for the tensile strength test the maximal load of 50 N was used. Test speed was set at 0.5 mm/min for both tests. Hanks' balanced salts solution was utilized to imitate physiological pH conditions.

Results Results of the compression strength testing demonstrated that specimens which were not immersed in Hanks' balanced salts solution (baseline) and specimens which were immersed for 2 and 4 weeks managed to endure forces of 150 N. Tensile strength testing showed that specimens which were immersed for 4 weeks showed lesser values (46.6 \pm 2.53 N) when compared to baseline (50 N) and specimens which were immersed for 2 weeks (50 N).

Conclusions The obtained values of compression and tensile strength testing indicate that tested IBAM specimens can resist forces similar to which tongue and cheeks can create in the oral cavity. Hanks' balanced salts solution did not significantly ($p \ge 0.05$) influence mechanical properties of specimens which were immersed for 2 and 4 weeks.



ORal Mucosa 3D-Simulation Model Using Organ-on-Chip Technology and SLA-Printing

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Objectives The objective of this study was to develop an innovative microenvironment for oral epithelial, endothelial, and human gingival cells recapitulating in vitro the oral mucosa physiology and architecture (oral-mucosa-on-chip/OMC). Microfluidic devices and 3D-printing technologies, especially stereolithography (SLA) have supported the fabrication of the OMC system. Methods A microfluidic device was designed using a CAD software (SolidWorks) and printed in parts by an SLA 3D printer using a biocompatible resin (BioMed_Clear_V1) and Flex_50A for sealing. TR146-oral epithelial cells were cultured in multilayer in the upper chamber at the air-liquid interface (ALI), while at the lower chamber, a co-culture of primary human gingival fibroblasts (HGF) and endothelial (HUVEC) cells was established, mimicking the oral mucosa by two approaches (static vs. dynamic). For dynamic culture, a microfluidic platform was used delivering in the lower chamber a flow rate of 2 µl/min, simulating the in vivo physiology. Cell populations of the OMC were assessed for viability via live-dead staining. The permeability of the oral epithelium barrier was evaluated by spectrofluorometric analysis, while its integrity by transepithelial electrical resistance testing (TEER) and histology. **Results** This study established a dynamic organotypic co-culture system of oral epithelium with HGF and endothelial cells, closely mimicking the native oral mucosa in terms of tissue components and architecture. All cell populations showed high viability on the OMC, as observed by the live-dead staining. Spectrofluorometry showed that the permeability of the barrier of the squamous epithelial cells statistically increased over time, as also confirmed by TEER and histology of the tissue-engineered oral mucosa. Conclusions A microfluidic OMC device was developed allowing the interlayer communication of relevant cell populations and recapitulating near-physiological conditions of the oral mucosa. This system could be further refined and tuned for high-throughput biocompatibility assessment of dental materials or other pharmaceutical agents.



Tissue-Engineered vs ex-Vivo Oral Mucosa: Epithelial Barrier, Lamina-Propria and Salispheres.

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Objectives In this study, a tissue-engineered 3D model of the oral mucosa was developed as a biocompatibility assessment tool. *Ex vivo* cultured oral mucosa biopsies were used as "golden" control for comparison of the properties of the developed model in terms of structure, marker expression, and permeability as epithelial barrier.

Methods Human oral squamous epithelial cells (TR146) were cultured under different conditions (submerged or at air-liquid interface/ALI) and media (with/without keratinocyte growth supplements-KGS), for up to 44 days. The epithelial barrier formation was evaluated via transepithelial electrical resistance (TEER) and the permeation of the fluorescent dye calcein by spectrofluorometry. Human gingival fibroblasts (HGFs), human endothelial cells (HUVEC), and salispheres developed from minor salivary gland stem cells were co-cultured in a collagen I/fibrin hydrogel. *Ex vivo* human oral mucosa biopsies were compared to the developed construct. For this purpose, optical microscopy (hematoxylin-eosin), immunohistochemistry (IHC), and immunofluorescence (IF) were employed. The response of both models after exposure to toxic components of dental materials (HEMA, TEGDMA) was also assessed by the same methods.

Results The optimum culture conditions for epithelial barrier formation were the ALI/KGS with the minimum permeation point being at 21-28 days. The tissue-engineered model was successfully assessed via live/dead staining for 50 days. Keratins stained the full-thickness oral epithelium, as well as the salispheres (also positive for AQ5); von Willebrand factor was found in endothelial cells, while HGFs showed strong expression of vimentin. The same expression pattern was demonstrated in the *ex vivo* model.

Conclusions The tissue-engineered oral mucosa provides an excellent simulation of normal oral mucosa in terms of structure and permeability and can be therefore proposed as a biocompatibility tool with reliable *in- vitro-in-vivo*-extrapolation (IVIVE). The comparison with the *ex vivo* model provided useful information regarding the potential of the *in vitro* construct to recapitulate the oral mucosa.



Objectives Among the polymer based additive technologies the stereolithography SLA ensure good opportunities for the formulations of the hydrogels and composites for biomedical application, because of their speed and softer conditions of visible-light polymerization. The aims of this study were to produce SLA printable biopolymer-based hydrogels and composites, and to evaluate the applicability of these systems for bone regeneration.

Methods Methacrylated-poly-γ-glutamic-acid (MPGA), polyethylene glycol dimethacrylate (PEGDMA), 2-hydroxyethyl methacrylate (HEMA) based hydrogel bioink was developed with a lithium phenyl-2,4,6-trimethylbenzoylphosphinate (LAP) and 2-hydroxy-1-[4-(hydroxyethoxy)phenyl]-2-methyl-1-propanone (Irgacure2959) initiator combination. β-tricalcium phosphate (4µm-BTCP) was added to the composite hydrogels as an inorganic component in 1.5, 3, 5, 7 w/w% concentrations. 1.5mm thickness and 1cm diameter hydrogel grid samples were in Ansys SpaceClaim (Ansys Inc, USA) and were printed by a commercially available Form2 (Formlab Inc., USA). The structure of the 3D printed hydrogels and composites and the cell growing on the surfaces were studied by scanning electron microscopy (SEM). The Ca-, and P-ion releases were determined by inductively coupled plasma optical emission spectrometry (ICP-OES). The biocompatibility of the samples was investigated by Alamar blue viability test using dental pulp stem cells (DPSCs). The 3D printed hydrogels and composites effects to the bone regeneration was demonstrated with "critical sized calvaria defect" models with Wistar rats, and were evaluated by SkyScan 1272 micro CT and in vivo PET imaging. **Results** The ICP-OES results showed that the released Ca-, and P ion concentrations increasing continuously for 3days. The Alamar blue test proven the biocompatibility of the 3D printed samples during 3 weeks, and SEM image demonstrate the cell attachment to the composite. The PET and micro-CT images showed faster bone formations processes *in-vivo* for 3 month.

Conclusions The SLA-3D printable hydrogel and composites can be effective and promising tools for bone regeneration aims.



Fabrication of 3D Printed Hollow Microneedles for Oromucosal Applications

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Objectives In this study, 3D printed hollow microneedles (MNs) were fabricated using Digital Light Processing (DLP) for the buccal delivery of actives. Oral mucosa consist a critical site for delivering drugs as it may offers both topical and systemic efficacy. However, its epithelial barrier occasionally may act as a significant inhibit drug permeation, causing low bioavailability and efficacy. The MNs can overcome this barrier without causing significant damage to the epithelium for a successful buccal administration. **Methods** A biocompatible resin was employed to produce these MN devices. The resin is classified as class I and it used for dental applications. The printed devices were evaluated regarding their ability to penetrate the buccal mucosa using porcine buccal epithelium. Moreover, their biocompatibility was assessed by conducting histological studies and cytotoxicity studies using TR146 cell line. *Ex vivo* permeation was also performed using vertical Franz diffusion cells, to evaluate the amount of drugs that are able to bypass the epithelium and reach the acceptor's compartment.

Results The results revealed that the printed objects are safe for applications into the oral mucosa. Histological assessment of porcine buccal samples showed the quick recovery of the epithelium after penetration and no damage to the tissue. Permeability studies confirmed that the needles can penetrate the first barrier of the buccal mucosa and deliver efficiently the drugs to deeper layers. **Conclusions** The produced MN devices are appropriate for buccal applications as they can efficiently deliver actives to the buccal epithelium. They are considered safe for drug deliver and promising for clinical use. They pierce effectively the buccal tissue without causing damage or leaving fragments that may result in toxicity.



Cytocompatibility of Titanium and Poly(Etheretherketone) Surfaces After O2 Non-Thermal Plasma Sterilization

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Objectives The sterilization of medical devices is paramount to achieve an acceptable level of sterility assurance and to prevent hospital-acquired infections. An innovative process based on an oxygen non-thermal plasma (O_2 -NTP) generated on a sealed bag could be used for the sterilization of fragile medical devices. The aim of the present study was to investigate the effect of this new sterilization process on the cytocompatibility of two implantable materials.

Methods MG-63 osteoblast-like cells were seeded on titanium (TA6V) and poly(etheretherketone) (PEEK) disks sterilized by autoclave (AC), gamma-ray irradiation (GI) and O₂-NTP. After 3, 7 and 10 days of culture, the cells' viability and proliferation, and cytotoxicity were determined by water soluble tetrazolium by mitochondrial dehydrogenases (WST-1), DNA quantification and lactate dehydrogenase (LDH), respectively. The cell colonization of the materials' surface was observed by scanning electron microscopy (SEM).

Results The cells' viability and proliferation were enhanced whatever the material types from 3 to 10 days. When seeded on TA6V, MG-63 cells showed a higher viability and proliferation after GI and O₂-NTP treatment compared to AC treatment. When cultured on PEEK, MG-63 cells showed a higher viability after O₂-NTP treatment. No difference of proliferation was observed whatever the sterilization processes. The cell colonization of the materials' surface was confirmed by SEM. LDH assay revealed no cytotoxicity. **Conclusions** O₂-NTP led to similar cell responses to AC and GI and could be a cost-effective alternative process to the usual sterilization methods for fragile medical devices.



Increased Expression of Salivary Gland Chemokines in Primary SjöGren's Syndrome

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Objectives There is a high demand for accurate and non-invasive tools for diagnostics and follow-up of patients with primary Sjögren's syndrome (pSS). We have previously shown significantly upregulated levels of the chemokines CXCL10 and CCL3 in saliva from patients with pSS versus sicca patients (not fulfilling the classification criteria for pSS) and healthy controls. To evaluate if CXCL10 and CCL3 could be used as pSS biomarkers, we examined their mRNA levels and localization within minor salivary glands (MSG). **Methods** MSGs from 34 pSS patients and 22 non-SS sicca controls were included. Labial biopsies were taken at UiO by one oral surgeon, and histopathological evaluations were performed on formalin-fixed paraffin-embedded tissue samples by one oral pathologist at UiB. mRNA expression in MSG was investigated using reverse transcription quantitative real-time polymerase chain reaction (RT-qPCR) and RNAscope® in situ hybridization (ISH).

Results mRNA expression of CXCL10 was higher than CCL3 in all pSS patients. Significantly elevated expression of CXCL10 and CCL3 was detected in patients with a) pSS diagnosis, b) positivity for autoantibodies, or c) positive biopsy. CXCL10 was localized in clusters within focal infiltrates as well as in adjacent acinar and ductal epithelium, while CCL3 was expressed as scattered single mRNA molecules in focal infiltrates and in acinar cells. CXCL10 and CCL3 were not observed in germinal centers or in close proximity to areas with adipose tissue.

Conclusions CXCL10 is suggested as a promising salivary gland disease biomarker due to its upregulated expression in both saliva and MSG in pSS versus sicca patients. While CCL3 also showed an increased expression in pSS, CXCL10 more strongly reflected salivary gland disease due to its tissue localization and should be assessed in saliva and MSG in bigger disease cohorts over time.



Role of EBV and HHV-7 in OLP and Aphthous Stomatitis

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Objectives Herpesviruses infect almost 90% of the population, mostly in childhood. Oral lichen planus (OLP) is the most common non-infectious, chronic inflammatory oral disease affecting 1-2% of the general adult population. Aphthous stomatitis is considered a multifactorial disorder affecting around 25% of the population. This work intends to highlight and explain the possible role of HHV-7 and EBV in the pathogenesis of OLP and aphthous stomatitis.

Methods 69 patients who visited RSU Clinic of Oral and Maxillofacial Surgery and Oral Medicine from dates 17.06.2021- 02.03.2023, ages between 18-75, and signed informed consent were included in the study. 24, 21, 24 patients were enrolled in OLP (reticular and erosive clinical forms), aphthous stomatitis and control group, respectively. Saliva samples were taken on the first visit and stored at - 80° degrees until DNA isolation and subsequent real time PCR analysis. The study is approved by RSU Ethical committee and financed by RSU Doctoral studies grant.

Results Saliva samples positive for both HHV-7 and EBV were detected in 19/24, 15/21 and 14/24 patients, respectively. Positive for single HHV-7 were 3/24, 5/21, 9/24 and for single EBV – none in the OLP group, 1/21 of aphthous stomatitis group, and none of the control group. Median HHV-7 and EBV load (copies per ml saliva) in saliva of OLP patients was 256631.675 (13 patients >10⁵) and 1407 (6 patients >10⁵), respectively; in aphthous stomatitis 106102.995 (9 patients >10⁵) and 18981.96 (6 patients >10⁵) and in the control group 107082.66 (12 patients >10⁵) and 15973.545 (4 patients >10⁵), respectively.

Conclusions The presence of HHV-7 and EBV in saliva could be associated with the aetiology of the lesions and, based on the detected loads, favouring HHV-7 in particular. However, these results are preliminary and larger scale study is required to draw global conclusion on the role of these viruses in the pathogenesis of OLP and aphthous stomatitis.



Erosive OLP Source: RSU Clinic of Oral and Maxillofacial Surgery and Oral Medicine patient archive





Reticular OLP Source: RSU Clinic of Oral and Maxillofacial Surgery and Oral Medicine patient archive



Aphthous ulcer Source: RSU Clinic of Oral and Maxillofacial Surgery and Oral Medicine patient archive



Clinical, Epidemiological and Anatomopathological Features of Oral Lichen Planus

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Objectives To study the clinical, epidemiological and anatomopathological features of oral lichen planus OLP.

Methods The records of patients who visited the department of oral medicine and oral sugery at the Academic Dental Clinic of Monastir, Tunisia between 2018 and 2022 and who have been diagnosed with OLP and/or oral lichenoid lesion OLL and cared by one doctor, were consulted. OLP and/or OLL were diagnosed according to WHO and Van der Waals and Van der meij (2003). Clinical parameters such as medical conditions, clinical forms of OLP, anatomopathologic reports and treatment were analyzed. Statistical analysis was carried out in Excel software from Microsoft.

Results Data of 8 patients were collected. All patients were women except one man. They were aged between 45 and 65 years old. Four patients presented lesions in the lips exclusively. Three patients had lesions in the buccal and lingual mucosa and one patient had lesions in the oral mucosa with labial involvement. The clinical forms were various: white keratotic striaes with erosions and exfoliations in the lips, the dorsal surface of the tongue and the inner side of the cheeks, white swollen patches in the lower lip, atrophic tongue, erythema and reticular aspect. The anatomopathological results confirmed OLP for 7 patients and OLL for one patient. All the patients were treated by local corticosteroid therapy and showed a favorable evolution after one year of follow-up, except the man who developed a micro-invasive squamous cell carcinoma in the lower lip and underwent a surgical excision. **Conclusions** OLP is an inflammatory autoimmune chronic disease that can occur in the oral mucosa with various manifestations. Familiarity with its different clinical presentations is essential for prompt diagnosis and effective treatment. Oral cavity sanitation and follow-up of the patients are mandatory to improve their life quality and prevent malignancy transformation.



Platelet-Rich Fibrin Reduces Zoledronic Acid-Induced Oral Mucosa Toxicity in Vitro

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Objectives Platelet-rich fibrin (PRF) is an autologous fraction of blood without anticoagulants consisting high quantities of platelets. PRF has been investigated to enhance soft tissue regeneration in many applications in dentistry including periodontal surgery, extraction socket healing and more recently in medication-related osteonecrosis of the jaws (MRONJ). MRONJ, caused by zoledronate and other antiresorptive agents, is characterised by the exposure of necrotic bone with a loss of overlying mucosa. Current treatment options for MRONJ are insufficient and while PRF has demonstrated some successful outcomes for MRONJ wounds, evidence on its effectiveness and the mechanism of action is still limited. This study aimed to evaluate the effect of PRF on oral mucosa cell behaviour in combination with zoledronic acid (ZA) in *in vitro* models of wound healing.

Methods Primary human oral keratinocytes and fibroblasts were used in this study. PRF was prepared from the venous blood of healthy volunteers without anticoagulants. The viability, proliferation and migration of oral mucosa cells in the presence of PRF and ZA were evaluated. The metabolic activity and epithelial morphology of tissue-engineered oral mucosa (TEOM) models treated with PRF and ZA were also examined.

Results We demonstrated that ZA alone induced toxicity in 2D and 3D culture while the addition of PRF conditioned media alone increased the metabolic activity of fibroblasts and the migration of keratinocytes. The addition of PRF to ZA treated cells increased cell metabolism, proliferation and migration of both fibroblasts and epithelial cells. TEOM models treated with ZA had complete epithelial loss while the epithelial layer of TEOM treated with ZA and PRF partially remained.

Conclusions Our findings have shown the cellular response of oral mucosa cells to PRF and confirm that PRF can reduce ZA induced toxicity in oral mucosa cells. This data suggests the possible therapeutic benefit of using PRF for the treatment of MRONJ.



Expression of EGFR in Minor Salivary Glands With Sjogren Syndrome

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Objectives Epidermal growth factor receptor (EGFR) tyrosine protein kinase participates in cell differentiation and proliferation. Its expression in tumors can be helpful for diagnosis and as target molecule for therapy but it is also seen in tissue damage and regeneration during inflammation. The aim of this study was to evaluate EGFR expression in minor salivary glands (MSGs) with Sjogren syndrome.

Methods Paraffin embedded samples of 60MSGs biopsies from lower lip taken during Sjogren syndrome investigation were immunohistochemically (IHC) investigated. Among them 20 were positive for Sjogren syndrome, 20 for non-specific chronic sialadenitis and 20 were non-inflammatory MSGs. For IHC the primary antibody EGFR (Santa Cruz Br. U.S, EGFR (A-10) sc-373746, 1/100 dilution) and Envision kit (DAKO) as secondary were used. The statistical analysis was performed with the Chi-square test (p<0.05, significance).

Results Staining for EGFR was detected in 32 out of the 60 (53.33%) samples of all MSGs biopsies. More specifically, 12/20 (60%) diagnosed as chronic sialadenitis, 8/20 (40%) of MSGs with Sjogren syndrome and only 2/20 (10%) from the non-inflammatory MSGs tissuespecimens. Overall, a significant difference occurred between the unified group of chronic sialadenitis and cases with diagnosed Sjogren syndrome in comparison with the group of non-inflammatory MSGs (p=0.002 chi-square test). There was a significant statistical difference in EGFR expression between cases with chronic sialadenitis and non-inflammatory MSGs (p=0.001 chi-square test), and a significant difference between cases with diagnosed autoimmune Sjogren syndrome and non-inflammatory MSGs (p=0.028 chi-square test). Interestingly, in all MSGs with EGFR expression it was found mainly in both acinar and ductal cells of damaged salivary gland parenchyma.

Conclusions EGFR is an important marker expressed in inflammatory diseases of MSGs including immune related Sjogren syndrome and chronic sialadenitis Whether the presence of EGFR indicates tissue damage, or it participates in compensatory effort for tissue regeneration it remains questionable.



0413 The Management of MRONJ: Overview of National and International Guidelines

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Objectives There is a low level of confidence amongst clinicians in the management of Medication-Related Osteonecrosis of the Jaw (MRONJ) though numerous guidelines are available. The aim of this critical review is to appraise current international and national guidelines on MRONJ to evaluate areas of consensus, variability, and to formulate recommendations for future research and clinical care.

Methods

A systematic literature search was performed to identify all national and international guidelines published until May 2022 on the prevention and treatment of MRONJ. Included guidelines were compared and critically appraised.

Results The included sixteen guidelines were published from ten different countries two of which had international collaborations. Though there is agreement to optimise oral health prior to and during therapy, there is disagreement on strategies to reduce risk of osteonecrosis such as the avoidance of invasive dental procedures, suspension of therapy and techniques to reduce the impact of invasive surgery. There is consensus in following a staged approach to treatment however stage 0 is contentious as is the need to stop therapy to aid healing

Conclusions In conclusion there is a need for an international lead in the development of dental guidelines to establish a global standardised management approach aiming for better health equality.



OHQoL in Association With Pain in Head and Neck Cancer Patients

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Objectives Oral Health related Quality of Life (OHQoL) in Head and Neck cancer (HNC) patients deteriorates during radio/chemoradiotherapy (RT/CRT). This study aimed to assess OHQoL changes in HNC patients receiving RT/CRT in association with oral pain (OP).

Methods OHQoL was assessed using the EORTC QoL Questionnaire Core-30 (QLQ-C30, V3.0) and the EORTC Head and Neck-35 Questionnaire (QLQ-H&N35), before (t0) and after the 4th week (t1) of RT/CRT. OP was evaluated using a Numeric Rating Scale (0-10; 0: no pain, 1-4: mild, 5-7: moderate and 8-10: severe) at t1; at t0 NRS=0.

Results Twenty-six male and four female patients (mean age 64.2±13.18) were included in this study. Global QoL scores were statistically significantly decreased (p<0.001), while Function Scales, Symptom Scales and H&N35 scores were significantly increased (p<0.001) at 11 compared to t0 assessment. Seven (23.33%) patients reported severe OP, 10 (30%) moderate, 9 (30%) mild and 4 (13.33%) did not report OP at t1. *QLQ-C30 scores*: Physical, Role and Social Functions scores, and Fatigue and Appetite Loss scores were significantly increased (p<0.04) regardless OP severity. Global QoL and Dyspnoea scores had significant difference (p<0.006 and p<0.004, respectively) at 11 in patients with severe OP; Emotional and Cognitive Functions scores, and Dyspnoea and Constipation scores had significant difference (p<0.03) in patients with moderate OP. *QLQ-H&N35 scores*: Dry mouth, Senses, Social Eating, Sticky Saliva, Social Contact and Weight Loss scores were significantly increased (p<0.007) regardless OP severity at t1; Swallowing, Speech, Sexuality and Felt III scores were significantly increased (p<0.008) in patients with severe and moderate OP. Weight gain, Diarrhoea, Teeth problems, Coughing, Financial problems and Insomnia score differences were statistically insignificant regardless OP severity.

Conclusions OHQoL scores were worsened at 5th-7th week of RT/CRT; OP was related to a significant number of OHQoL scores' changes. Managing OP could ameliorate OHQoL in HNC patients under RT/CRT.



0415 Diode Laser Effect on Osteoblasts Exposed to a Peri-Implantitis Environment <u>E. Zampa</u>, K. Kyriakidou, I. Karoussis NKUA, Athens, Greece

Objectives The goal in the treatment of peri-implantitis is the elimination of inflammation, as well as re-osseointegration. However, existent data do not favor any decontamination approach. Thus, the research question of this in vitro study is: 'In a peri-implantitis scenario, is it possible to obtain cell proliferation and differentiation towards osteocytes of premature osteoblasts (MG-63 cells) irradiated with diode laser (810nm), seeded on SLA titanium discs decontaminated with AirFlow?'.

Methods 200 SLA titanium discs were used decontaminated with AirFlow with erythritol powder and irradiated with LLLT depending on the experimental or control group. The study evaluated cell viability, adhesion and proliferation of osteoblasts in all experimental groups at 24-,48- and 72h, as well as the effect of low-level laser irradiation on the MG-63 cells genetic profile evaluating ALP, OSC, TGF-b1, EGF, Runx-2 and BMP-7 expression at 7-,14- and 21 days.

Results MTT assay showed an increase of cell proliferation in the three given timepoints in all groups which was confirmed by the FDA/PI method. SEM microphotographs at 7 days showed that osteoblasts were actively adhered to all surfaces. Concerning the effect of low-level laser irradiation (810nm) on the MG-63 cells genetic profile, the combination of airflow and LLLT application indicated a more rapid progression and intense rate of osteoblast proliferation and differentiation.

Conclusions Osteoblasts were able to colonize, proliferate and differentiate in all experimental groups, while the effect of airflow application seems to have a more pivotal role, indicating that its use with erythritol powder in order to decontaminate the surface of the implant is efficient and restored biocompatibility.



Oral Bacterial Community Dynamics During Induction of Experimental Gingivitis

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Objectives The human oral cavity constitutes a complex habitat for microbial populations. The dynamics of oral microbial ecosystems and the functions of different microbes in health and disease are not well understood. We aimed to gain understanding in the compositional dynamics of the oral microbiota at the onset of gingivitis.

Methods We performed an experimental gingivitis intervention study, involving 41 healthy volunteers. After a two week wash in period, volunteers refrained from oral hygiene measures for two weeks. After this period, volunteers were allowed to resume oral hygiene. During the experimental gingivitis study, plaque and bleeding scores were monitored. At seven timepoints during the intervention period, samples were collected from six oral niches: saliva, posterior tongue, keratinized gingiva, supra-, sub- and interproximal-dental plaque. Samples were subjected to microbiome analysis by ribosomal sequencing. Multivariate statistical analysis was applied to determine the intra oral microbial dynamics in relation to changes in plaque and bleeding scores.

Results Different oral niches displayed distinct microbial community structures. Tongue and salivary microbiome composition showed no significant changes throughout the experimental gingivitis study. Most prominent changes in composition were observed for supragingival plaque. Dynamic changes in composition were marked by nonlinear behaviour, associated with abrupt changes in composition. We determined significant associations of changes in microbial composition of all oral niches with gingival bleeding and dental plaque.

Conclusions Nonlinear microbial community dynamics of dental plaque, gingival biofilms as well as the tongue coincides with the onset of (experimental) gingivitis, and relate to clinical manifestations of experimental gingivitis.



Novel, Safe, and Microbiome-Friendly Electrolyzed Solutions Prevent Periodontal Dysbiosis.

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Objectives Preventing periodontal diseases often includes using antimicrobial mouthrinses. Despite mechanical and chemical (antimicrobials) interventions involved in periodontal treatments, microbial communities recolonize the oral cavity. Most of antimicrobials are non-selective, targeting the symbiotic oral species as well as the dysbiosis-inducing ones. Guiding the killing and the recolonization processes should be considered. This affects the microbial ecology and metabolic activity, and consequently the host interactions, which can be unfavorable (inflammation-associated) or favorable (health-associated). For such approaches, this study investigated electrolyzed salt solutions as a novel rinse.

Methods Multi-species oral biofilms were grown on hydroxyapatite discs and rinsed daily with the electrolyzed solutions (ES). A corresponding positive and negative controls were included. After 3 rinses, biofilms were analyzed with viability qPCR and visualized using scanning electron microscopy. Supernatants of rinsed biofilms were used for metabolic activity analysis (HPLC). In addition, human oral keratinocytes (HOK) were exposed to the rinsed biofilms to assess their inflammatory response. The HOK were also exposed to ES to test potential cytotoxicity and inflammation induction.

Results Rinsing the biofilms with ES could stop the overgrowth of the periopathogens and prevent biofilms dysbiosis, which altered both biofilm metabolism and interleukin-8 (IL-8) induction in HOK. The qPCR data showed dominance of commensal species and no harmful effects on the homeostatic biofilms. The scanning electron micrographs confirmed the same. Additionally, ES did not have any cytotoxic effects starting from the 1st dilution and did not potentiate IL-8 production in HOK.

Conclusions Electrolyzed solutions showed promising results for preventing dysbiosis in in-vitro rinsed biofilms and controlling key periopathogens, with no potential toxic effects on the human cells or the oral commensal species. This novel approach should be considered for clinical applications.



Oral Microbiota of Mother-Child Pairs: Impact of Maternal Cardiometabolic Health.

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Objectives The influence of maternal cardiometabolic health on the acquisition and maturation of the oral microbiota of children is still not clear. Therefore, the aims of this study were to characterize the oral microbiota of women with and without cardiometabolic risk factors (CRF) during pregnancy and until six months after delivery and to understand the impact of maternal CRF on the oral microbiota of their children.

Methods This study included a total of 59 pregnant women/mother-child pairs (37 healthy mothers and 22 mothers with CRF: arterial hypertension, obesity, and/or gestational diabetes). We collected unstimulated saliva from women during the third trimester of pregnancy, as well as maternal saliva and infant oral swabs one and six months after delivery. The oral microbiota was characterized via sequencing of the 16S rRNA gene (V4 region). Microbial diversity (Shannon; Wilcoxon Rank sum test and signed rank test) and composition (Bray-Curtis distance; PERMANOVA) were compared between mother-child pairs throughout time.

Results Microbial diversity was significantly higher in women with CRF in 1st (p=0.009) and 6th (p=0.029) months after delivery. The oral microbiota composition differed between the study groups in the 1st month after delivery (F=2.62; p=0.0017), with an increased relative abundance of a genus from *Lachnospiraceae* in CRF women. However, no differences were observed regarding the diversity or composition of the oral microbiota of children from different study groups in the 1st and 6th months after delivery. The microbial diversity and composition differed significantly between mother and child at both time points. Six months after delivery, the oral microbiota of children was influenced by suctional habits (F=3.34, p=2e-04), and its diversity was impacted by tooth eruption (p=0.037).

Conclusions Maternal CFR impacts the oral microbiota of the mother, but not the oral microbiota of the child up to the sixth month of life.



Are Atherosclerosis and Periodontal/Peri-Implant Inflammation Correlated? a Prospective Cohort Study

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Objectives To investigate the association between atherosclerosis, evaluated using the surrogate marker carotid intima media thickness (IMT), and periodontal and peri-implant diseases in a sample of patients with primary hypertension.

Methods A prospective cohort study was designed, contacting all patients with primary hypertension and at least one dental implant evaluated two years before in a previous study, with an established diagnosis of periodontitis and peri-implant diseases based on the 2017 EFP/AAP classification. Cumulative Periodontal Screening and Recording (PSR) values were obtained for all patients. They had all baseline records for 24-hours ambulatory blood pressure monitoring, ultrasound assessment of carotid arteries, anthropometric measurements and venous blood samples. New biomarkers and a novel vascular assessment were performed. The comparison between medical parameters collected at baseline and follow-up was assessed by Mann-Whitney U test for continuous variables and by Chi-square test of homogeneity and Fisher's exact test for categorical variables. Then, a multiple regression was performed to ascertain the effects of independent variables on average IMT values.

Results A total of 71 patients were successfully recalled. Among parameters investigated, only IMT values were statistically significant higher (p= 0.015) at follow-up when compared with baseline (mean IMT values of 0.76 ±0.13 mm, 0.88 ± 0.19 mm, respectively). The linear regression model revealed a positive significant association with increased IMT and cumulative PSR values, CRP, Triglycerides and Creatinine, with an $R^2 = 0.863$.

Conclusions Among a cohort of patients untreated for periodontitis and peri-implant diseases, with no differences for hypertensive and lipidic profiles and medications taken, there was a mean progression rate of 0.06 mm/year after two years, consistently higher compared to values reported in large epidemiological studies. When considering all cofounding variables, the linear regression model revealed a positive significant association with increased IMT and cumulative PSR values, CRP and Triglycerides.



The Antibacterial Capacity of Eight Mouthwashes Against Streptococcus Mutans

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Objectives This work aimed to evaluate and compare the antimicrobial actions of eight types of mouthwash against *Streptococcus mutans (ATCC 25175 and clinical strain CH2)*, the microorganism mainly responsible for dental caries. The Ethical Committee of the University of Chieti approved the protocol.

Methods The following products were compared: A (0.12% chlorhexidine-CHX + 0.05% Cetylpyridinium chloride-CPC), B (0.06% CHX + 0.05% CPC), C (0.12% CHX + 0.05% CPC), D (0.05% CHX), E (0.12% CHX + 0.05% CPC), F (0.05% CHX + 0.05% CPC), G (0.10% CHX + 0.50% Chlorobutanol), and H (0.05% CHX + 0.05% CPC).

The minimum inhibitory concentration (MIC), the minimum bactericidal concentration (MBC), and time-kill curves at different contact times (10 s, 30 s, 60 s, 5 min, 15 min, 30 min, and 60 min) were performed against *S. mutans* ATCC 25175 and *S. mutans* CH02. ANOVA with Tukey post hoc were performed for intra-group and inter-group analysis.

Results For each product, the values of MIC and MBC were similar, so all could be considered bactericidal. The bactericidal effect was higher against the clinical strain, *S. mutans* CH02. Product H only showed MIC and MBC values lower than 1% for both strains. A and B showed higher antibacterial activity against *S. mutans* CH02, with MIC and MBC of 0.09 % and 0.39%, respectively; on the contrary, it showed 25% of MIC and MBC against *S. mutans* ATCC 25175. Products C, D, E, F, and G showed a similar trend but with higher MIC values for both strains.

The Time-kill curve against *S. mutans* ATCC 25175 showed that the products A, B, and H were the most effective at 10 s, in which all showed values lower than 500CFU/ml, and less than 100CFU/ml at other time-point. The Time-kill curve against *S. mutans* CH02 showed lower values for products E, F, and G.

Conclusions All products could be considered bactericidal, but the efficacy against the clinical strain *S. mutans* CH2 was higher than the ATCC 25175. A, B, and H showed the higher antibacterial activity against both strains. The results demonstrate significant differences in the antimicrobial actions of the tested mouthwashes, although all contained chlorhexidine, and most also contained cetylpyridinium chloride. These differences could result from other ingredients and additives and their synergic effect on each other.



POSTER PRESENTATIONS abstracts

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Rehardening Effect of Boron-Modified Bioactive Glass on Initial Enamel Caries

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Objectives The aim of this study was to compare the rehardening effect of experimental bioactive glass modified with different concentrations of boron on artificially induced initial enamel caries.

Methods To synthesize the experimental bioactive glass, a rapid alkali-mediated sol-gel method was used. For boron-modified bioactive glass, H3BO3 was added to the mixture. The phase composition and microstructure of the synthesized nano-bioactive glass were characterized by X-ray diffractometer, field emission scanning electron microscopy and Fourier transform infrared spectroscopy. 40 caries-free human molars were used. The teeth were separated from the roots and embedded in acrylic resin with the crowns on top and surface preparation procedures were performed for standardization. In each group, enamel microhardness values were measured at 3 points using a Vickers microhardness tester, before demineralization, after demineralization and after treatment. The teeth were placed in demineralization solution for 15 days to create the initial enamel caries. Than, teeth were randomly divided into 4 groups (n:10). GroupF: Fluoride varnish, GroupBG: Experimental bioactive glass, GroupBG-7: Experimental bioactive glass modified with 7% boron, GroupBG-14: Experimental bioactive glass modified with 14% boron. All treatment agents were applied to the tooth surfaces by rubbing with a microbrush and left for 4 minutes, then washed with distilled water. The data were statistically analyzed by analysis of variance and Bonferroni test (p<0.05).

Results The microhardness of the enamel surfaces decreased in all groups after demineralization (p<0.05), while the microhardness of all groups increased significantly after treatment (p<0.05). When the groups were compared after treatment, GroupBG-7 showed significantly higher microhardness values than GroupF, GroupBG and GroupBG-14 (p<0.05). There was no significant difference between the other groups (p>0.05).

Conclusions Although all treatment groups showed a rehardening effect on initial enamel caries, the highest rehardening effect was determined in bioactive glass modified with 7% Boron.



Picturing Dental Hard Tissue Proteins in Solution Using Mass Spectrometry

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Objectives OBJECTIVE: To identify structural changes in carious tissue proteins, a well-known histochemical label, Rhodamine isothiocyanate (R-ITC), was used to stain the excavated tissues. Proposed bonding to the tissue was analyzed with liquid chromatography mass spectrometry (LC-MS, Scimax).

Methods METHODS: Tissue powder from sound (10 teeth) and carious (5 teeth) of whole teeth were excavated by bur, weighed and rinsed. Powder was stained with R-ICT (ON), rinsed, vortexed and centrifuged (3x) until the supernatant was uncolored. After thoroughly rinsing, stained tissue powder was placed in concentrated anhydrous formic acid (8w), yet if, undissolved transferred into an Guanidyl (6M) protein extraction buffer (8w). The dissolved tissue was analyzed by electron spray ionization in a high-resolution mass analyzing instrument (Scimax).

Results RESULTS: R-ITC was identified by its mass (500 m/z) as non-covalent bonded to the tissues at the retention time (RT) 25 min. Masses representing dissolved carious dentine tissue holding R-ITC fragments were detected at (RT) 35-40 min. The majority of masses from the stained sound dentine tissue (600-700 m/z) were observed at RT 18-25 min. In addition, the largest mass originated from the dentine reference (2700 m/z) at RT 8 min, whereas masses (557, 1420 1603 and 2232 m/z) representing dissolved caries reference were revealed at 16 min

Conclusions CONCLUSION: (R-ITC) were eluted at 25 min with masses corresponding to its molecular weight (500 g/mol), meaning non-covalent bonded to the material. Furthermore, at (RT) 35-40 min masses unique to caries with fragments of (R-ITC) were found. In addition, the LC -Scimax assay revealed the dissolved caries tissue to be less polar in comparison to dentine.



Objectives The aim of this in vivo study was to assess the diagnostic performance of DIAGNOcam (DC) in combination with indocyanin green (ICG) dye to detect cavitated proximal carious lesions in posterior permanent teeth.

Methods Patients diagnosed with at least one proximal carious lesion in enamel or outer half of dentin on permanent posterior teeth assessed by digital bitewing (BW) radiographic examination (CS 7600 Smart Plate, Carestream Health) were included in the study. At the same appointment, an image was captured by DC (DIAGNOcam 2170, KaVo Dental GmbH) in the selected tooth surfaces, and a second one was obtained after application of ICG. Finally, an orthodontic elastic separator was placed to facilitate direct visual-tactile examination in the following appointment (gold standard). Two trained examiners independently classified each surface in sound, outer enamel, inner enamel or outer dentin according to BW, DC and DC with ICG images and the inter-examiner concordance was determined (weighted kappa). Also, the agreement for cavitation between DC together with ICG and the visual-tactile examination was established for both examiners (weighted kappa).

Results A total of 25 patients and 153 proximal surfaces were evaluated, however, 43 surfaces were dismissed due to absence of separation or overlapping structures on BW. According to the visual-tactile examination, 27 lesions were cavitated. The interexaminer agreement was moderate for BW (0.58), and substantial for DC and DC aided by ICG (0.69 and 0.61, respectively). Regarding the decision of whether the lesions were cavitated, using the dye with DC, the agreement between evaluators was moderate (0.46). However, the agreement with the gold standard was fair (0.29) and light (0.19) for each evaluator. DC together with ICG showed a low sensitivity (0%) and a high specificity (100%) for cavity detection.

Conclusions DC aided by ICG dye is not useful to detect cavitation in initial carious proximal lesions.



Comparing NaF and Nicomethanol Hydrofluoride Regarding Enamel Fluoride Uptake

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Objectives Aim of this *in vitro* study was to compare the enamel fluoride uptake (EFU) of toothpastes and solutions containing sodium fluoride (NaF) and the organic fluoride nicomethanol hydrofluoride (NHF, Fluorinol[®]).

Methods Slightly demineralized (15min, 1% citric acid, pH 3.8) human enamel samples were fluoridated in a cyclic procedure including treatment with test products and storing in artificial saliva. Product treatment was conducted by storing the samples in solutions (1min) and toothpaste slurries (1:2 w/w toothpaste:deionized water) of NaF and NHF, respectively (1450ppm F⁻ for all products). The EFU was measured after 1 and 20 treatment cycles by time-of-flight secondary ion mass spectrometry (TOF-SIMS; M6, Iontof). Depth profiling to 4µm was performed by measuring and sputtering in an alternating mode.

Statistical evaluation was conducted by ANOVA and t-tests (p<0.05).

Results For all product groups, a decrease of F⁻ ion intensities with increasing measurement depth was observed. 20 treatments: NHF solution led to significantly ($p < 10^{-6}$) higher EFU (F⁻ ion intensities between 249335±32039 and 14472±5200 counts) than all other test groups over the entire depth. NaF solution (2204±380 – 183±25 counts), NaF toothpaste (1092±168 – 113±20 counts) and NHF toothpaste (1881±314 – 308±36 counts) were in a similar range. NHF toothpaste showed significantly (p<0.007) higher intensities than NaF toothpaste (over entire depth) and NaF solution (from 2000 nm, $p=1.7*10^{-5}$).

1 treatment: NHF solution was significantly ($p < 1.4*10^{-6}$) superior to the other test groups, which were not significantly different from each other here.

Solutions showed higher intensities than the respective toothpastes with considerably greater differences for NHF than for NaF products.

Conclusions NHF performs at least similarly to NaF regarding EFU. Observed significantly higher EFU for NHF products suggests that more fluoride from this source can incorporate into deeper enamel regions. Multiple treatment procedure shows better discriminability between test products and should be used generally to compare the efficacy of different products.

The study was sponsored by Pierre Fabre.



Complex Plaque Control by Robot Testing of Four Different Toothbrushes

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Objectives The best plaque control in elderly/periodontitis patients is still disputed. Therefore, it was the aim of study (i) to compare plaque removal efficacy in a complex clinically validated robot programme including manual, powered and interdental toothbrushes, (ii) to differentiate crown versus root plaque control, and (iii) to summarize clinical conclusions because of validated programmes. **Methods** The robot was programmed simulating 2min brushing, force 3.5N, movement rotating on replicated human teeth in anatomic position. Synthetic plaque simulation was used.

Automated Planimetrical Plaque Assessment was executed at 24 crown and 6 root fields per tooth. The test MTB Inava15/100 (Pierre Fabre, France) was compared to Curaprox1560 (Curadent, Switzerland), and PTB InavaHybrid was compared to PTBInavaHybrid plus gauge-adapted IDBs (Pierre Fabre, France[SM1]).

All four tests were performed 7 times. Kolmogorov-Smirnov-test was applied to test 11 variables for normal distribution, H0 was rejected. Therefore, Wilcoxon-Mann-Whitney-test was used.

Results Brushing programmes were strictly identical. No statistical differences could be detected in plaque control at buccal and lingual smooth surfaces. Mesially and distally, next to gumline and at all root fields Inava was clearly superior to Curaprox, however, inferior to combined brushing with InavaHybrid followed by the IDBs Blue/Yellow. Consequently, this combination was statistically significantly better than Curaprox at all risk fields/areas except next to gumline lingually. Most hidden areas distally of tooth roots showed plaque removal from incisors to second molars of 75.2-99.4% in analysis of single teeth. Range of total brushing efficacy was MTB Inava 71.5% and MTB Curaprox 57.3%, PTB InavaHybrid 66.4% and PTB+IDB 81% Plaque control by soft brushes depends on number of filaments (Inava versus Curaprox).

Conclusions Complex plaque control by powered vibrating/rotating toothbrushing followed by adapted interdental brushing of exposed root areas is highly efficient.

Clinically validated robot testing and planimetrical plaque assessment at 4 sites of all teeth demonstrates standardized biophysical brushing actions.



Lateral NIRT at 1300nm for Caries Detection in Posterior Teeth

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Objectives This study aimed to determine the ability of lateral near-infrared transillumination at 1300nm (NIRT1300) to detect proximal and occlusal caries lesions in permanent posterior human teeth.

Methods Fifty-eight permanent molars and premolars with sound and carious occlusal and proximal surfaces were collected and examined by direct visual inspection using ICDAS, bitewing radiography (BWR) and lateral near-infrared transillumination at 1300nm. For each specimen, one proximal and one occlusal surface were assessed once by two examiners. The surfaces were evaluated according to yes/no decisions regarding the presence of carious lesions. The findings were validated by micro-computed tomography. The statistical analysis concluded cross-tabulation and overall accuracy, sensitivity and specificity calculation. **Results** For proximal caries detection, the overall accuracy was 70.69% for BWR and 76.60% for NIRT1300. Sensitivity was 29.17% for BWR and 61.11% for NIRT1300, while specificity was 100% for BWR and 86.21% for NIRT. NIRT1300 revealed the highest diagnostic results for occlusal caries detection in terms of overall accuracy (71.15%) and sensitivity (75.00%) and specificity (67.86%) values. BWR achieved a specificity value of 100% but paired with a sensitivity of 37.04%.

Conclusions Lateral NIRT1300 achieved higher diagnostic results for the detection of proximal and occlusal caries lesions than BWR. Still, lateral light transmission in transillumination of posterior teeth remains behind occlusal light transmission even at high wavelengths of 1300nm.



Gestational Diabetes and Oral Microbiota. a Systematic Review

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Objectives Gestational diabetes mellitus (GDM) affects nearly 30% of pregnant women and is associated with adverse pregnancy outcomes, such as a high risk of hypertension or cardiovascular disease in mothers and fetal macrosomia and respiratory distress syndrome in infants. Studying the effects of potential dysbiosis of the oral microbiome in women with GDM could be of great interest for tailored preventive interventions. The present systematic review and meta-analysis aimed to evaluate whether the oral microbiome of women with GDM and their offspring had a different composition from that found in unaffected women and their offspring.

Methods A systematic electronic search was performed, after *a priori* registration of the protocol in Prospero (CRD42023406505), in PubMed, Scopus, Embase and Google Scholar. The risk of bias assessment was carried using the Cochrane collaboration's RoB 2 and RoB 1 tools. Stata 17[®] was used for the meta-analysis when at least three articles presented comparable data.

Results There were 2168 records selected, and after the screening process, 8 were included in the qualitative analysis and 3 in the quantitative analysis. The meta-analysis analysed the oral microbiome diversity of salivary samples from children born to mothers with or without GDM (random-effects model, T^2 =0.25, I^2 =76.86%, H^2 =4.32). Women with GDM have a pro-inflammatory environment with high levels of periodontal bacteria such as *Treponema*, *Prevotella* and anaerobic species. Almost 85% of the studies were at moderate risk of bias.

Conclusions Although with limitations caused by the limited number of included studies, women with GDM and their offspring appear to have a distinctive oral microbiome associated with periodontitis; however, the long-term effects on general and oral health of these changes are still uncertain. More well-designed studies with larger samples differentiating pregnant women for oral health and general health outcomes are needed.



Objectives Dentigerous cysts are the most prevalent odontogenic developing cyst of the jaws. Dentigerous cysts are mostly associated with a developing tooth bud or an unerupted permanent tooth. As a conservative treatment, marsupialization lowers intracystic pressure and promotes centripetal bone formation from the surrounding bone walls, by continuously draining the cystic fluid.

The aim of this study is to present the treatment of dentigerous cyst with marsupialization method in two different cases. **Methods** 9 and 10-year-old 2 boys were admitted to our faculty with mild swelling on their mandibular region. clinical and radiographic examinations showed that a large radiolucent lesion extending from the apex of the tooth 85 was determined in a 9year-old boy. In a 10-year-old boy, a large radiolucent lesion that was surrounding his left second premolar was detected. Both patients were in good general health with no significant medical history or associated syndromes.

In both cases, impressions were taken from the lower jaws for a custom-made appliance before surgical extraction. After the extraction of the lesion-related primary teeth under local anesthesia, acrylic removable appliances with a metal-tube for draining the cyst were placed immediately on both patients. Parents were notified to irrigate the cyst cavity with isotonic solution 3 times a day via the tubes.

Results Patients were scheduled for regular visits every three weeks after the first check.

After 3 months the lesion had started to heal the permanent premolars had begun to erupt in both cases. Afterward, the drain was removed and the appliance was used as a space maintainer.

After 2 years of follow-up, it was seen that bone lesions were healed, premolars were erupted and reached the occlusion. **Conclusions** Marsupialization is a successful conservative therapeutic option for treating large dentigerous cysts, particularly in pediatric patients.



Objectives The aim of this case report is to present the management and follow-up of a necrotic and immature premolar tooth with a regenerative endodontic procedure.

Methods A healthy 11-year-old boy patient was admitted to our clinic with a complaint of pain on the left side of the mandibular region. Clinical examination showed deep dentin caries lesion on the mandibular left second premolar and sensitive to percussion. The periapical radiograph was obtained and observed that the tooth has an open apex and radiolucent lesion. A diagnosis of pulp necrosis with symptomatic apical periodontitis was made, and a regenerative endodontic procedure was decided for management. The carious lesion was removed, and the pulp chamber was accessed. Firstly gentle instrumentation is done with #15 K-file. The canal root system irrigates with 1.5% NaOCI (20 mL/5 minute) and then with saline was realized by paying attention to positioned irrigating needle above 1mm from the root end. Calcium hydroxide was placed in the dried root canal system by lentulo, and the cavity was sealed temporarily. After three weeks, mandibular anesthesia was performed with 3% mepivacaine (Safecaine, Vem Ilaç, Turkey) without vasoconstrictor, and the tooth was isolated with a rubber dam. Then, medicaments in the root canal were removed and irrigated with 17% EDTA(20 mL). With a sterile #35 K-file root canal file, apical bleeding was obtained by 2mm over-instrumenting. Bleeding was stopped in the enamel-cement junction, and MTA was placed and covered with glass ionomer cement after hardening. Due to excessive crown destruction, the tooth was restored with a stainless steel crown.

Results The regenerative endodontic procedure achieves the primary goal of eliminating symptoms and healing bone. After four years, as a secondary goal: thickening of the dentin walls, ongoing root development, and apical closure were observed in long-term follow-up.

Conclusions With regenerative endodontic procedures, thickening of dentin walls, root lengthening, and apical closure are reported in the symptomatic immature necrotic tooth.



Dental Management of a Patient With Osteogenesis Imperfecta.

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Objectives Osteogenesis imperfecta (OI) refers to a group of connective tissue disorders that affect about 1/13,500-15,000 births worldwide. It is caused by quantitative and qualitative defects of type 1 collagen and non-collagenous matrix proteins and is characterized by bone fragility. It has distinct oral manifestations including microdontia, hypodontia, crown and root defects, delayed eruption, Class III malocclusion and dentinogenesis imperfecta. The aim of this case report is to describe the oral manifestations and dental management of a patient diagnosed with osteogenesis imperfecta.

Methods A 4-year-old girl with medical history of OI was referred by a general practitioner to the Department of Paediatric Dentistry (NKUA), with "broken and gray teeth". Initial clinical examination revealed dentinogenesis imperfecta with gray opalescent discoloration of anterior and posterior primary teeth and post-eruptive breakdown, caries, attrition and fusion of teeth # 72-73 and #82-83. Radiographic examination showed thin and narrowed roots, cervical constriction and agenesis of two lower incisors. Results Management of the case involved an individualized preventive program for high caries risk patients every 4 months, and restorative treatment of anterior teeth with composite resin and posterior teeth with stainless steel crowns. One year post-treatment oral hygiene was improved and there were no new caries or fractures detected.

Conclusions The goals of treatment for these patients are removal of infection, restoration of aesthetics and protection of posterior teeth from attrition. Individualized treatment varies according to the age of the patient and the severity of the defects and close monitoring with long-term follow-up is necessary.



Delayed Replantation of Avulsed Tooth: a 4-Year Follow-Up

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Objectives The aim of this case report is to address a delayed replantation and apexification of an avulsed immature permanent incisor with calcium hydroxide.

Methods A 9-year-old boy was referred to our pediatric dental clinic after dental trauma 2 hours ago while the child was playing in the water park. Intraoral examination revealed that maxillary right central incisor was avulsed and buccal alveolar plate was fractured. Parents were advised to find avulsed tooth immediately. After another 2 hours, tooth was brought to our clinic stored in buttermilk and standard treatment guidelines for avulsed immature permanent teeth were followed. Endodontic treatment was started placing calcium hydroxide extraorally. Tooth was replanted, buccal bone fragment was replaced, sutured and stabilized using a flexible splint for 4 weeks. After apical closure, root canal treatment was completed and the tooth was restored with composite resin 22 months after trauma.

Results The radiographic and clinical evaluations a period of 4 years demonstrated periodontal bone healed without root resorption and mobility. Endodontic treatment was performed on the patient's maxillary right central incisor using calcium hydroxide as an intracanal medicament in apexification procedure. Although tooth was left with calcium hydroxide dressing during pandemic period over 12 months, apex was closed successfully. After obturation, tooth was permanently restored with composite resin. Endodontic success with a closed apex was demonstrated by clinical and radiographic imaging 4-year follow-up. However, ankylosis caused significant infraposition of the maxillary right central incisor. Ankylosed tooth was esthetically restored with composite resin using mock-up technique.

Conclusions Although delayed replantation with prolonged extra-alveolar dry time, tooth remained stable and functional after four years. Using replanted tooth to maintain the surrounding bone until the patient is a viable implant candidate can be considered as an option for pediatric patients.









3-year



Initial

1-month 20-month

After endodontic treatment

Radiographs





a) Avulsion of the right upper incisor



b) Replantation and splinting 4 hours after trauma



c) Sutures in gingival tissue



d) 6 months after trauma

Replantation of Avulsed Tooth



Esthetic Management of Ankylosed Tooth with Composite

b) Esthetic rehabilitation of infrapositioned tooth



Objectives The aim of this study is to analyze the whitening toothpaste's roughness effects on enamel surface characteristics in young permanent teeth using the mechanical profilometer.

Methods One hundred enamel samples were used in our study. Samples randomized into ten groups (n=10).

Group 1(G1):Colgate Optic White Expert, Group 2(G2):Opalescence Whitening Toothpaste, Group 3(G3): Ipana 3D White Luxe, Group 4(G4): Splat Biocalcium, Group 5(G5): ROCS Sensation Whitening, Group 6(G6): Dentiste Plus White, Group 7(G7): Colgate Total 12, Group 8(G8): Signal White Now, Group 9(G9): Curaprox Black is White, Group 10(G10): Distelled water. Each group was subjected to a brushing cycle with toothbrushing simulator. The samples were vertically brushed at a speed of 40 mm/sec, 3600 cycles under 200 gr/cm2 force. It was performed to simulate a 12-week treatment period of two daily brushings. A mechanical profilometer was employed to assess and make a comparative analysis of the surface roughness among the various samples subjected to brushing. A contact type profilometer was used to measure the Ra of the specimens' baseline and after brushing. For each specimen, three Ra measurements were taken and averaged.

Results After brushing, G2, G5, G6, G8 toothpastes group's Ra values exhibited greater surface change (p<0.05). Surface roughness decreased in these groups.

Conclusions In conclusion, mechanical profilometer analyses showed that under in vitro conditions, whitening toothpastes with different contents have different effects about enamel roughness. Clinicians could benefit from this study when recommending toothpaste to their young adult patients. Further research is required to obtain additional confirmation regarding the clinical application of these findings.



Co-Occurrence of Dental Caries and Periodontitis: Multilevel Modelling Approach

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Objectives To assess co-occurrence of dental caries and periodontal inflammation indicators on the same teeth. **Methods** A stratified random sample of 1405 34-78-year-olds was recruited during the Lithuanian National Oral Health Survey (response rate 52 %). Information about sociodemographic (age, sex, education, residence), behavioral (sugar-containing diet, tooth brushing frequency, use of interdental care products, last dental visit, smoking) and biological (systemic disease, use of medication, xerostomia) determinants was collected using the World Health Organization (WHO) Oral Health Questionnaire for Adults supplemented with additional questions. Clinical data was collected by one trained and calibrated examiner using the WHO criteria. Dental caries status was measured as decayed, filled teeth (DFT) and included proximal, buccal and oral surfaces. Bleeding on probing (BOP) and probing pocket depth (PPD) were assessed at six tooth sites. The highest PPD measurement per tooth was selected and dichotomized into absence or presence of 4+ mm PPD. BOP was recorded as presence or absence of the condition at a tooth level. Multilevel binary logistic regression analyses were employed using BOP and PPD as outcomes, adjusted for determinants and included interaction terms.

Results Associations between DFT and BOP (OR 1.97, 95% CI 1.84-2.19) and DFT and PPD (OR 2.13, 95% CI 1.90-2.40) were found. The effect of DFT on the probability of BOP was stronger in older age and if participant had no systemic disease. The effect of DFT on the probability of PPD was stronger if an individual did not use interdental care products.

Conclusions The results of this study support evidence of co-occurrence of dental caries and periodontal inflammation indicators on the same teeth. Longitudinal studies to validate our results on a tooth surface level are warranted.


0068 Comparison of Efficacy of 3D Electric and Manual Toothbrushes. C. Rahiotis, K. Charalambus, E. Pepelassi, A. Kakaboura

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Objectives This study compared the ability to remove plaque and cause gingival abrasion between an electric and a manual toothbrush over three months.

Methods This study is a randomized, double-blind, parallel-assignment clinical study. Forty (40) dental students from the National and Kapodistrian University of Athens were included, equally divided into two groups. Each group received a manual (Indicator 35 Medium, Oral B) or an electric toothbrush (Pro 600, Oral B). Quigley & Hein plaque index and gingival abrasions were recorded using the revealing solution (Mira-2-Ton, Hager & Werken) at baseline (T0), after 7 days (T1), and after 3 months (T2). ICDAS clinical caries criteria and the wear of the used toothbrushes were also recorded.

Results The gingival abrasion index was higher for the manual toothbrush group than the corresponding electric one (p<0.01). On the contrary, the plaque index was statistically significantly higher for the electric than for the manual toothbrush (p=0.028). A correlation was also found between gender and gingival abrasions (p<0.05). No difference was observed between right- and left-handed participants in the dependent variables.

Conclusions The manual toothbrush of moderate hardness was more effective in controlling the local agent than the corresponding electric one for 3 months. However, the electric toothbrush led to less gum abrasion. Men also tend to injure the soft periodontal tissues more when brushing



0069 Efficacy of Ventilation to Improve Air Quality in Treatment Room <u>Y. CHESTSUTTAYANGKUL¹</u>, A. OPASAWATCHAI² ¹Dental, Rajavithi Hospital, Bangkok, Thailand, ²Oral Microbiology, Mahidol University, Bangkok, Thailand

Objectives To determine bioaerosol dispersion during ultrasonic scaling under different ventilation.

Methods The procedure was performed in a single dental unit treatment room under 0ACH (ventilation is off) and 12ACH (ventilation is on). Agar plates were placed in 6 positions: at the table (1), on the patient's chest (2), on the operator's tray (3), on the assistant's tray (4), at the left side of the dental chair (5), and near the exhaust chamber (6), at distances ranging from 20-200cm from the oral cavity and were exposed to the room air for 60min while two patients were scaled by using a magnetostrictive ultrasonic scaler. Then plates were incubated $(37\pm0.5^{\circ}C, 1d)$ and colonies were counted (CFU). The experiment was repeated (n=12) and data were analyzed (Mann-Whitney U, p<0.01).

Results Total number of CFUs under 12ACH (93.25) compared to 0ACH (99.98) was significantly lower at the table (1) and on the left side of the dental chair (5). The highest number of CFUs were found on the patient's chest (2) under both conditions. Followed by near the exhaust chamber (6).

Conclusions Adding fresh air and removing contaminated air creates airflow from operator to patient. Reducing the total number of CFUs shows improvement in air quality and less risk of infection. The highest number of CFUs on the patient's chest was from splatters which were unable to improve by ventilation.



Figure shows agar plates in 6 positions; table behind the operator (1), on the patient's chest (2), on the operator's tray (3), on the assistant's tray (4), on the left side of the dental chair (5), and near the exhaust chamber (6)



Factors Influencing Tooth Loss in Adolescents in Belgrade, Serbia

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Objectives The purpose of this study was to assess the prevalence of tooth loss, as well as to evaluate the factors that can influence both oral health and the reasons for tooth extraction in the examined adolescent population in an urban area. **Methods** This cross-sectional study was conducted in Belgrade in January 2023. The sample included 273 participants aged 15-17 (181 females and 92 males respectively). The research was conducted in two high schools, after obtaining all signed consents. The study consisted of filling out an anonymous questionnaire, which comprised 9 groups of questions. Questions referred to the socioeconomic status of participants, oral, and general health habits, self-esteem as well as the impact of oral health on daily performance. The clinical examination followed the methodology proposed by WHO.

Results Almost one-fifth of participants (21% girls and 16.3% boys respectively) had at least one tooth extracted and only 13.6% of them were already in orthodontic therapy during the examination. The most common reason for tooth extraction was planned orthodontic therapy (51.9%), followed by untreated decay and its complications (44.4%). Further data analyses using nonparametric correlations showed that socio-demographic factors could influence dental status. The economic status of the family can affect the number of participants with extracted teeth, as well as the mother's education level.

Conclusions Despite living in an urban area with available dental care, the percentage of adolescents with extracted permanent teeth is very high. Sociodemographic factors can influence dental status, positively or negatively.



Endodontic Referrals of Children and Adolescents: a Complex Matter

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Objectives Quality assurance studies in the dental services provide valuable information both to the service and to health authorities. This study investigated the reasons for referrals to endodontists of young patients (6 -20 years old) at the Public Dental Services (PDS) in Western Norway.

Methods All referrals to endodontists at the Oral Health Center of Expertise in Bergen, Western Norway (TkV/H) during the years 2015-2018 had been evaluated (N=1379). Demographic data of the referred patients showed that children and adolescents constituted the largest group of endodontic referrals (44%) for this public specialist clinic . The reasons for referrals were mapped into three categories (pure-endodontic reasons, patient-related reasons, other reasons) with subcategories. The probability of each referral reason was evaluated using binary logistic regression models where tooth position, age, and gender were set as predictors. **Results** The most common number of referral reasons per child/adolescent was two (min=1, max=7). Incisors and molars were the most common tooth groups among referrals (51.2 and 39% respectively). The incisors were mostly associated with dental trauma, need for interdisciplinary collaboration and technically difficult cases. The molars were mostly associated with technically difficult cases and re-treatment. The most age-dependent referral reasons were trauma, interdisciplinary collaboration, re-treatment, and technically difficult cases. The first two decreased with age, and the latter two increased (p<0.001) for all four referral reasons). For dental trauma, the overall probability of referral was higher for males than females (p<0.001). Retreatment increased more with age for females than for males (p<0.01).

Conclusions Endodontic referrals of children and adolescents are complex. Not only pure endodontic reasons but also patient-related and/or other reasons play a role for decision to refer. Age, gender, and tooth position influence the composition of endodontic referrals in the PDS.



0072 Treatment Effects of Tongue Crib Appliance in Growing Patient

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Objectives The aim of this study was to investigate treatment effects of tongue crib appliance on anterior open bite in growing patients.

Methods

The study sample consisted of 19 growing patients with anterior open bite, who were successfully treated using tongue crib appliance. Tongue crib appliance contained palatal cribs at the level of the maxillary canine, which extends vertically lingual to the level of the mandibular incisor. Twenty-eight growing patients without history of orthodontic treatment were selected as the control group.

Cephalometric variables associated with dentoskeletal pattern, tongue position, and hyoid bone were measured at pretreatment (T0) and at least six months after treatment (T1) using lateral cephalometric radiographs. Differences in cephalometric changes between T0 and T1 were analyzed between the two groups using the Mann-Whitney U test.

Results There were no significant differences in sex and age distribution, and skeletal pattern between the two groups at T0. Significant differences in inclination of the maxillary and mandibular incisors were found between the two groups. The treatment group showed more retroclination of the maxillary (maxillary incisor to FH plane angle and maxillary incisor to SN plane angle) and mandibular incisors (mandibular incisor to mandibular plane angle and mandibular incisor to NB angle) than the control group. Interestingly, there were no significant differences in skeletal, tongue position, and hyoid bone position changes between the two groups.

Conclusions Considering that changes in the maxillary and mandibular incisors without significant skeletal, tongue, and hyoid bone changes during wearing of the tongue crib appliance, this study suggests that the treatment effects of the tongue crib appliance may mainly be associated with dental changes. More long-term evaluation should be investigated in the further studies.



Prefabricated Myofunctional Appliances Effects and Use for Dental Trauma Prevention

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Objectives The prevalence of Traumatic Dental Injuries (TDI-s) varies from 6-49%. TDI are the second disease of the oral cavity after tooth decay. Many studies have concluded that, among other risk factors for dental trauma, some dental factors may be considered as such. The correction of these dental risk factors as orthodontic ones, with different tools during the orthodontic treatment may be considered a preventive measure regarding dental trauma.

Methods This investigation has been performed to evaluate the effectiveness of 1-year active treatment time with Prefabricated Myofunctional Appliance (PMA) in 8- to 9-year-old children by improving occlusal relationships and follow-up for two years. **Results** During the orthodontic treatment large overjet, deep bite and lip incompetence, considered frequent risk factors for dental trauma, were improved. A reduced ANB angle (7° to 4°) showed that skeletal Class II division 1 was improved, with little change of facial angle (78° to 79°) and FMA angle (23° to 25°), improvement of overjet (6 mm to 3 mm), deep bite (4 mm to 2.5 mm) and inclination of the maxillary incisor (114° to 109°). The study showed orthodontic improvement in the parameters and consequently a lower risk of trauma.

Conclusions PMA can be considered an efficient tool in the prevention of dental traumas by improving the situation of dental trauma risk factors. The study showed that through improved occlusion, as of deep bite, there can be a decrease in risk factors.



Objectives To assess whether the effect of Coca-Cola on enamel staining is different in teeth with and without prior orthodontic bracket bonding.

Methods An in vitro study was conducted on extracted teeth. On 4 teeth orthodontic brackets were bonded with Transbond XT with enamel surface preparation by G-Bond (1 st group), on another 4 teeth orthodontic brackets were bonded with Fuji Ortho LC (2 nd group), and 4 teeth were used as they were, as control (3 rd group). Afterwards brackets were debonded, and all teeth were immersed in Coca-Cola for 5 weeks. Color measurements were done initially and in the end, always after teeth were professionally cleaned, using VITA Easyshade spectrophotometer, color parameters L, C, h, a*, b* being recorded. SPSS Statistics was used for data analysis.

Results Initially, the 3 groups were not statistically significant different in regard to all color parameters mentioned (p>0.05 for all). Immersion in Coca-Cola associated similar susceptibility to tooth color change (Δ L, Δ C, Δ h, Δ a, Δ b, and color difference Δ E were not statistically significant between the 3 groups of teeth, p>0.05 for all). Immersion in Coca-Cola associated a tendency of color change similar in all 3 groups, in regard to decreasing the value of L, h, and increasing the values of a*. Parameters C and b* exhibit least changes, the pattern being different in teeth with and without previous orthodontic brackets. **Conclusions** Based on this research, considering its limitations, it can be concluded that orthodontic bracket bonding itself does not associate a higher staining susceptibility of the teeth after exposure to Coca-Cola.





Streptococcus Mutans Adherence to Orthodontic Brackets: an in-Vitro Study

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Objectives Organic acids produced by *Streptococcus mutans* (*S. mutans*) lead to demineralization of the enamel and causes dental caries. The placement of fixed orthodontic brackets increases the number and volume of these bacteria.

This study aimed at evaluating *S. mutans* adherence on various orthodontic brackets made of different materials and ligature types, through the conduction of an in-vitro experimental design and microbiological analyses.

Methods Two groups of five systems (1cm wire + maxillary premolar brackets + ligature (ORMCO®)) which varied according to the type of ligature and bracket model (metal + metallic ligature, metal + elastomeric ligature, metal self-ligating, ceramic + elastomeric and ceramic self-ligating) were tested. The brackets were previously sterilized. In group 1, they were initially immersed in saliva for one hour, and subsequently washed and added in a bacterial suspension, maintained in aerobiosis for 24 hours. In group 2, the brackets were directly put in a bacterial suspension. Initially, after incubation the less adherent cells were removed from the brackets by submerging in water two to three times, followed by staining with 250µL of 0.1% crystal violet and the absorbance was measured at 600nm using a spectrophotometer. The same experiment was done thrice, and absorbance means were calculated. The retention of bacteria was observed under scanning electron microscopy (SEM).

Results Saliva provided anti-adherent properties. Self-ligating ceramic brackets obtained the best results (see table).

Conclusions Self-ligating ceramic brackets possessed antibacterial properties and therefore could help in preventing dental caries and plaque accumulation indirectly.

Absorbance values (600nm)

	Conventional bracket and elastomeric ligature	Conventional bracket and metallic ligature	Self-ligating metal bracket	Ceramic bracket and elastomeric ligature	Self-ligating ceramic bracket
With saliva	1.04 ± 0.008	1.16 ± 0.02	0.61 ± 0.01	0.93 ± 0.03	0.49 ± 0.07
Without saliva	0.64 ± 0.003	0.66 ± 0.007	0.84 ± 0.05	0.94 ± 0.16	0.47 ± 0.07



Objectives To evaluate the effects of various finishing and polishing (F/P) systems regarding the surface roughness (R_a) value of a ceramic nanohybrid composite and a hybrid ceramic composite cadcam block.

Methods A total of 72 disc samples (2mm thickness) were prepared from a nano-hybrid ceramic resin composites (IPS Empress Direct)(n=32) and a hybrid ceramic cadcam block(3M ESPE Ultimate Lava)(n=32). After being immersed and stored for 24 hours in 37°C distilled water, basaline measurements of surface roughness (Ra, μ m) were recorded. Each composite group was divided into three F/P disk groups: Aluminium oxide discs-SHOFU Super Snap Rainbow, Opti1step(Kerr) ,Clearfil Twist Dia(n=12). The same operator polished all samples. Another blinded-operator conducted postoperative measurements. Statistical analysis of this in vitro study was performed with a SPSS 22.0 software system (SPSS Inc., Chicago, USA). Two-way analysis of variance (ANOVA) test was used to compare the mean surface roughness data obtained from the groups. (p > 0.05).

Results The results of this study showed that different polishing systems produced different numeric roughness values. IPS Empress Direct resin composites which polished with opti1step , had the highest Ra(1,1342) value, while 3M ESPE Ultimate CAD/CAM blocks which polished with the disk ,had the lowest Ra(0,4650) roughness. The groups polished with the disk showed the least roughness value.

Conclusions There was no statistically significant difference found between all groups. However, the disc with cadcam block provided a higher gloss.



Fatigue Resistance of Chairside CAD-CAM Materials

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Objectives

Continuous development in manufacturing methods has provided a wide range of possibilities to the dental practitioner. Using computer-assisted design and manufacturing techniques (CAD/CAM), a restoration can be milled and delivered to the patient in the same appointment. This technique also came with a new set of material options that can be used for various indications. The aim of this study was to evaluate the fatigue resistance of these materials intended for chairside processing using CAD/CAM. **Methods** Rectangular beams (2x2x12 mm) were sectioned using a water-cooled diamond saw. Milling blocks intended to be used in a CEREC(Dentsply) system were used: Cerasmart (GC Dental), Enamic (Vita), Grandio Blocs (Voco), Lava Ultimate (3M), IPS e.max CAD (Ivoclar). Filtek Supreme XTE(3M) served as direct restorative resin control. After determining the flexural strength (n=10/group), the beams were loaded in cyclic 4-point flexure to failure using load control with 0.1 stress ratio and 5 Hz frequency in fully hydrated conditions (n=20). The stress range versus the number of cycles to failure was evaluated up to 1.2E6 cycles. Apparent endurance limit estimation was done for a fatigue limit defined at 1E7 cycles. Data were analyzed with One-way ANOVA and Wilcoxon rank sum test (α =0.05).

Results

The flexural strength and fatigue life distribution of lithium disilicate (IPS e.max CAD) material was significantly higher than the resin composite or hybrid materials. (p<0,001) The apparent endurance limits were: 31,4 MPa for Enamic (Vita), 31,8 MPa for Filtek Supreme XTE, 44 MPa for Cerasmart, 51,3 MPa for Grandio, 63,4 MPa for Lava Ultimate, and 108 MPa for IPS e.max CAD. **Conclusions** The lithium disilicate reinforced glass ceramic material IPS e.max CAD has better mechanical properties and fatigue resistance compared to hybrid ceramic or composite materials which increases the likelihood of success in a clinical setting.



Three-Dimensionally Printable Antimicrobial Dental Material by Microencapsulation of Phytochemicals

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Objectives Poly(methyl methacrylate)-based dental resin is susceptible to oral biofilm or plaque formation. The aim of this study was to develop 3D printable dental resin-based biomaterial with antimicrobial activity against oral microorganism by using microencapsulation of phytochemicals and to test antimicrobial activity and cytotoxicity.

Methods Phytochemical (phytoncide extract) was included into microcapsules and tested for antimicrobial effect against oral microorganism (*Streptococcus oralis (S.oralis), Streptococcus gordonii (S.gordonii), Candida albicans (C.albicans)*) by transmission electron microscope for morphological analysis. Phytochemical-filled microcapsule extract was evaluated with high performance liquid chromatography to detect components of phytochemicals. Microcapsules were mixed with 3D printable dental resin using dispersing agents, and disc specimens were printed using digital light processing. After cleansing and post-polymerization, microcapsule-containing 3D-printed discs were tested for antimicrobial and antifungal activity (Live/Dead staining, colony counting, crystal violet staining). Extracts from microcapsule-containing discs were seeded into human gingival fibroblast and evaluated after incubation using MTT assay to test cytotoxicity.

Results Phytoncide-filled microcapsule inhibited growth of microorganism and induced morphological changes of *S.oralis*, *S.gordonii*, and *C.albicans*. Microcapsule extract contained (-)- α -pinene, which is one of major components of phytoncide. During 3D printing, microcapsules were dispersed homogeneously in the printable resin as well as in specimens. The number of colonies of oral microorganism in microcapsule-containing 3D-printed resin discs decreased compared with no microcapsules, which was also confirmed by live/dead staining assay. Cellular viability was more than 70% compared with negative control, which is observed with non-cytotoxic substances according to ISO-10993.

Conclusions Phytochemical-filled microcapsule can be directly applied into 3D printable dental resin to obtain a biomaterial with promising antimicrobial and antifungal properties. Developed biomaterial can be used to 3D print dental prostheses to prevent/minimize oral biofilm or plaque formation sourced by oral microorganism, with no significant risk of cell cytotoxicity.



Preheating of LC-Composite Restoratives Does Not Improve Conversion Under Overlays

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Objectives To evaluate the degree of conversion (DC%) of four LC resin composite restoratives used for luting indirect composite overlays after different preheating procedures.

Methods The composites tested were Majesty ES 2 Universal (MJ), Filtek Universal (FU), Tetric Evoceram (TE) and Viscalor (VC). The composites were placed on zirconia bases and pressed by composite overlays (12X8x4 mm, A2 shade) to create a standardized film thickness of 100 microns and exposed for 60s (3x20 s from top, buccal and lingual sites) using a LED curing unit (1.5W/cm²) before and after preheating (50°C for MJ, FU, TE employing a universal heater and 65°C for VC by the proprietary gun dispenser). Specimens polymerized without the overlays (60s, top) were used as controls. After demolding the DC% of the specimens was measured at central, middle and site length locations by micro ATR-FTIR spectroscopy. Statistical analysis was performed by 3-way ANOVA (material, location and heating status the independent variables) plus Holm-Sidak multiple comparisons test (α =0.05). **Results** Statistically significant differences were found for the levels of material (FU>MJ, TE, VC p<0.001), location (all locations vs the control, p<0.001)) and heating status (in favor of preheated, p=0.047), with insignificant interactions between them (p>0.05). **Conclusions** Although some DC% differences were encountered between composites, the values recorded under the overlays were significantly lower from the controls, with a marginal improvement after preheating. The clinical use of LC composites as luting agents under indirect overlay restorations should be avoided.



Objectives The purpose of this study was to compare Vickers Hardnesses of two different resin composites measured from both top and bottom surfaces.

Methods A bulk-fill and a conventional resin composite were selected for this study. Five composite discs were prepared 10 mm in diameter and 4 mm in thickness for each group. Samples were cured for 20 or 40 seconds on the top surface. Thicknesses of composite resins were 2 or 4 mm. 8 groups were included totally. For each specimen 3 measurements were performed at both bottom and top surfaces of the composite. Micro-hardness test was conducted with Vickers microhardness (VH) tester under under 300 grams (2.94N) load and a 15 s dwell time. Data were statistically analyzed with Kruskall Wallis test and Bonferoni correction. **Results** Significant differences were observed between the top and bottom measurements in all groups (p<0.05), except for the conventional composite group that was light-cured for 40 seconds at 2 mm thickness (VH_{top}=98.1, VH_{bottom}=94.4, p>0.05). In both the top and bottom measurements of tested resin composites, the microhardness values increased statistically when the time was doubled (p<0.05). The thickness of the composite did not affect the microhardness values at the top surface (p>0.05), but decreased the measurement values at the bottom surface (p<0.05).

Conclusions The thickness of the restoration is a factor influencing the microhardness of the bottom surface in the bulk-fill and conventional composite tested. The increase in time is a factor that increases the microhardness of the tested composites on both the top and bottom surfaces.



Temperature Rise During Polymerization of Bulk-Fill Composites Using Blue Laser

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Objectives The aim was to investigate the effects of the source of light (high-power LED curing unit and diode laser), and curing method on the temperature rise during polymerization of bulk composite materials bonded to dentin using universal adhesive **Methods** To create flat bonding substrates; coronal sections of teeth were embedded in an acrylic resin. Composite cylinder studs of SDR Plus (Dentsply Sirona) and Ever X Flow (GC, Japan) were bonded to dentin substrates using Adhese Universal (Ivoclar Vivadent) both for curing and co-curing method with Power Cure (PC) (Ivoclar Vivadent) and blue diode laser (BL) (449 nm, 1.6 W, Jinjiang Co., China) for: 5 s (2000mW/cm²) and 10 s (1000 mW/cm²). Temperature rise was measured using thermal vision camera in real time mode

Results For SDR, the highest temperature increase was measured in the experimental group BL10 (1000mw/cm² 10 s BL) and BL5 (2000mw/cm² 5 s BL), where the medial temperature increase was 7,3 and 7,2 °C respectively. The lowest increase (0.8 °C) was recorded in group PC5 (2000mw/cm² 5 s). When using Ever X Flow, the highest temperature increase was recorded in experimental group BL5 (2000mw/cm² 5 sec BL), with medial temperature increase of 13.0°C. The lowest increase (0.7°C) was recorded in group PC5 (2000mw/cm² 5 sec BL), with medial temperature increase of 13.0°C. The lowest increase (0.7°C) was recorded in group PC5 (2000mw/cm² 5 sec).

Conclusions Blue laser produces more heat during polymerization of bulk fill composite materials in comparison to high-power LED unit, while co-curing technique with simultaneous polymerization of composite and adhesive results in lower temperature rise



0082 **Functional Mechano-Biology and Morphology After Conditioned Dentin Cleaning** <u>M. Toledano¹</u>, E. Osorio¹, J. Espigares², R. Osorio¹, M. Toledano-Osorio¹ ¹University of Granada, Granada, Spain, ²Kuraray Noritake Dental Inc., Tokyo, Japan

Objectives Saliva may contaminate the conditioned dentin resulting in inferior polymerization of adhesive resin monomers, interfacial microleakage, coronal discoloration and bond deterioration. A subsequent conditioning may produce dentin over-etching. The objective of the present study is to analyze the effect of *Katana Cleaner* (KC) in nanomechanical properties and nano-roughness of dentin surfaces conditioned with *Clearfil SE Bond* 2 primer, and then contaminated with saliva and treated with KC. **Methods** Dentin disks from human third molars were prepared. Four subgroups were done within each group: *i*), untreated dentin,

just polished (UD), *ii*) conditioned dentin with Clearfil SE Bond 2 primer (CSEB), *iii*) conditioned dentin contaminated with saliva (CSEB+S), and *iv*) conditioned and contaminated dentin treated with KC (CSEB+S+KC). Nanohardness, Young modulus, nanoroughness measurements and atomic force microscopy (AFM) analyses were performed. ANOVA and Student-Newman-Keuls (p<0.05) were used for comparisons.

Results CSEB primer did not produce a decrease in dentin nanohardness, neither after KC application (mean±SD -GPa-: UD:1.09±0.46; CSEB:0.97±0.24; CSEB+S:0.90±0.03; CSEB+S+KC:0.96±0.03). CSEB+S+KC attained higher Modulus of Young (*Ei*) (mean±SD 24.34±0.76GPa) than UD and CSEB+S groups (21.26±0.95 and 22.94±0.67GPa, respectively). Young modulus of CSEB group was not different to any of the other experimental groups (26.00±4.40 GPa). All subgroups performed similar in nanoroughness, except for CSEB+S that attained the highest values (66.52±11.85nm).

Conclusions KC does not alter nanomechanical properties of dentin surfaces after CSEB application. Grant PID2020-114694RB-I00 funded by MCIN/AEI 10.13039/501100011033.M.T-O is Fellow FPU of Ministry of Universities (Grant FPU20/00450)



Material's Type Influences the Surface Properties of Resin-Based Printed Restorations.

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Objectives To compare the surface roughness (Ra), Vickers hardness number (VHN), and Volumetric wear (VW) of printed and milled resin-based (RB) materials.

Methods Standardized RB blocks were either printed from VarseoSmile Crown plus, Bego (B), C&B MFH, NextDent (N), or milled from HC blocks, SHOFU (S). Surface topography was examined under a scanning electron microscope (SEM) then the samples' surfaces were polished with a series of sandpaper discs. Ra and VHN were measured using Mitutoyo suftest-211 surface roughness tester and FM-800 Vickers microhardness tester, respectively. The average of three sequential measurements was taken for each sample (n=8). Another eight samples from each group were subjected to thermomechanical cyclic loading (TMC) (500,000 chewing cycles and 10,000 thermal cycles between 5°C and 55°C) and then inspected under a stereomicroscope. Wear measurement was conducted by three-dimensional scanning of the specimens before and after TMC, and the difference in the sample's volume was recorded as the volumetric material loss due to wear.

Results SEM revealed linear discontinuity in B and large particles in S, while N surfaces were more homogeneous. One-way ANOVA and Tukey's post-hoc test revealed no statistically significant difference between Ra of the three tested materials (p > 0.05) and VHN of B and N (p=0.62). VHN of S was significantly higher than B and N (p<0.001). S exhibited significantly higher VW than B and N (p=0.002 and p<0.001 respectively) and showed deeper wear facets with no cracks after TMC. Meanwhile, the minimum VW was detected in N and it was significantly lower than B (p=0.001). Cracks were detected in 75% of N samples and 50% of B samples after TMC.

Conclusions N yielded superior wear-resistant than B and S and comparable Ra and VHN to B. Yet, the cracks developed after TMC may limit their clinical durability.

	Surface Roughness (µm)	Surface hardness (VHN)	Wear (mm3)
VarseoSmile Crown plus, Bego (B)	0. 31 (0.18)	16 (1.5)a	5.6 (1.5)a
C&B MFH, NextDent (N)	0.29 (0.12)	14.9 (1.6)a	1.9 (0.8)b
HC blocks, SHOFU (S)	0. 35 (0.16)	46.3 (6.3)b	9.0 (1.2)c

Mean (SD) of the Surface Roughness (µm), Surface Hardness (VHN) and Wear (mm3) of the Tested Materials

*Within each column, mean values with different letters indicate a statistically significant difference (p < 0.05).



Dexamethasone and Zinc-Loaded Nanoparticles Improve Dentin Mechanical and Chemical Behaviour

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Objectives

To evaluate the effect of polymeric nanoparticles (NPs) doped with dexamethasone (Dex) and zinc+dexamethasone (Zn-Dex) on both mechanical and chemical behavior of demineralized dentin infiltrated with these novel polymeric nanoparticles. **Methods**

Coronal dentin conditioned surfaces were infiltrated with undoped NPs, Dex-NPs or Dex-Zn-NPs and stored for 24h or 21d. A control group without NPs was included. Then treated surfaces were analyzed by Raman analysis, Nanohardness, and Young's modulus. ANOVA and Student-Newman-Keuls (p<0.05) were used for comparisons.

Results Dentin treated with undoped-NPs attained the lowest nanohardness and Young's modulus (mean±SD; 0.44±0.025 and 14.31±0.37GPa, respectively), at 21d of storage. After same aging time, Dex-NPs and Zn-Dex-NPs increased dentin nanohardness obtaining almost twice the value of undoped-NPs. Additionally, after 21d of storage Dex-NPs and Zn-Dex-NPs achieving higher Young's modulus with 20.16±0.035 and 19.15±0.66GPa, respectively. When functionalized Dex-NPs were applied on the dentin interface Raman analysis showed high remineralization, crystallinity (FWHM_P=19.08), crosslinking and better structure of collagen. **Conclusions** Dexamethasone in dentin improved crystallographic maturity, crystallinity and facilitated maturity and secondary structure of dentin collagen. Nanomechanical evaluation analyses (nanohardness and modulus of Young testing) evidenced that these NPs produce reinforcement of the dentin structure. Therefore, using dexamethasone-functionalized NPs before resin infiltration is a clear option to obtain dentin remineralization.

Acknowledgements: Grant PID2020-114694RB-I00 funded by MCIN/AEI 10.13039/501100011033.



Effect of Vital Pulp Therapy Antiseptic Agents on Dentin Bonding

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Objectives To evaluate the effect of antiseptic agents used for haemorrhage control and pulp lavage in vital pulp therapy on immediate microtensile bond strength (µTBS) and nanoleakage (NL) to dentin, 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% NaOCI for 5 minutes [NaOCI_5], 2.5% NaOCI for 10 minutes [NaOCI_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 μ TBS and failure mode (FM) were determined. Data were analyzed by two-way ANOVA and Tukey's test (p<0.05) without considering pre-test failures (PF). The morphological pattern of NL of selected beams was analyzed under SEM.

Results Table shows μ TBS mean values in MPa (sd), PF percentages and FM. No relevant effect of the antiseptic solutions on μ TBS was detected as values were only influenced by the adhesive strategy (P<0,001). Higher μ TBS values were yielded with ER strategy after NaOCI_5 (P=0,004) and CHX_5 (P=0,026) application. A higher percentage of PF were detected for specimens bonded with SE strategy, especially after NaOCI_10 protocol. In SE samples a linear thin silver accumulation at the base of the hybrid layer with areas of no silver deposits was observed. In contrast, a continuous pattern and wider silver layer observed in specimens treated with ER strategy.

Conclusions The solutions evaluated for pulpal lavage seem not to negatively affect µTBS values. However, lower values were obtained when 2.5% NaOCI and 2% CHX were used for 5 min and the universal adhesive was applied with SE strategy. In contrast, NL was more evident when ER strategy was selected.

Anticontic agont	MPa (sd)		PF (%)		FM (% - A/CC/CD/M)	
Antiseptic agent	SE	ER	SE	ER	SE	ER
Control	53,94 (9,13) a1	57,89 (9,27) a1	7,4	0	6,1/36,4/3/54,5	35,7/28,6/3,6/32,1
NaOCI_5	44,64 (5,92) a2	59,37 (5,48) a1	9,3	2	21,4/21,4/0/57,1	50/26,7/3,3/20
NaOCI_10	43,84 (12,91) a1	61,65 (12,83) a1	17	0	13,2/21,1/0/65,8	10/50/0/40
CHX_5	45,02 (6,51) a2	61,10 (11,42) a1	11,9	0	5,6/38,9/0/55,6	30,8/53,8/2,6/26,3

Different letters in the same column indicate statistically significant differences among different antiseptic agent protocols. Different numbers in the same row indicate statistically significant differences between SE and ER for each antiseptic agent protocol. Glossary: A (Adhesive), CC (Cohesive in composite), CD (Cohesive in dentin) and M (Mixed).



Adhesive Potential of Different Luting Systems to Bovine Dentin

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Objectives This study aimed to compare the bonding potential of different adhesive luting systems to bovine dentin using the x-bar tensile bond strength test.

Methods The adhesives luting systems under investigation were a universal self-adhesive luting resin with corresponding universal adhesive (Panavia SA Cement Universal, PSCU, and Clearfil Universal Bond Quick, CUBQ, Kuraray Noritake), a dual-curing luting composite with self-etch adhesive (Multilink Automix, MLA and Multilink Primer, PAB, Ivoclar Vivadent), and a dual-curing luting composite with universal adhesive (RelyX Ultimate, RXU and Scotchbond Universal, SBU, 3M).

Bovine incisors were embedded in resin, and rectangular dentin rods with a width of 3 mm were prepared (n=180) and then divided into 3 groups (n=60). Two dentin rods were bonded with the materials under investigation at a 90° angle to each other, resulting in 30 x-bar specimens per group. One-half of the specimens per group were stored in 37 ° C distilled water for 24 hours, and the other half was subjected to thermal cycling (TC) with 10000 cycles (5/55°C, 30s dwell time). Tensile bond strength (TBS) was measured by pulling the samples apart using a universal testing machine (Z2.5, Zwick-Roell). Statistical evaluation was carried out using a one-factor ANOVA with a Tukey post-hoc test with a significance level of 0.05.

Results Statistical analysis showed that after 24h RXU+SBU reached the highest TBS of 5.8±3.5 MPa and was significantly higher than PSCU+CUBQ (3.1±2.5 MPa; p=.044). MLA+PBA (3.7±2.8 MPa) did not have a significant difference in TBS compared to RXU+SBU and PSCU+CUBQ (p>.05). After TC, there were no significant differences (p>.05) between RXU+SBU (3.4±2.8 MPa), PSCU+CUBQ (3.1±2.2 MPa) and MLA+PAB (2.6±2.9 MPa).

Conclusions After in-vitro hydrothermal loading no significant differences could be found between the different adhesive luting systems.



Separate Silanization of HF-Etched Glass-Ceramic Improves Bonding of Silane-Containing Adhesive

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Objectives To evaluate the shelf-life effect of a silane-containing universal adhesive (UA) on its shear bond strength (SBS) to lithiumdisilicate glass-ceramic (LiSi₂).

Methods Initial LiSi (GC) block parts were either ground or mirror-polished (MP). SBS to MP and hydrofluoric-acid etched ground glass-ceramic (HF), with/without prior application of ceramic primer (G-Multi Primer, GC: G-MP) was measured. Scotchbond Universal Plus (SBUp) (3M Oral Care) was used 33 ('fresh') and 6 ('aged') months before the expiration date. SBS specimens were prepared using Ultradent jigs: MP: (1) G-MP applied (or not) and air-dried, (2) SBUp rubbed for 20 sec and air-dried, (3) 1-mm composite (Clearfil AP-X, Kuraray Noritake) increment placed within mold, (4) both adhesive and composite light-cured for 20 sec (SmartLite Pro; Dentsply Sirona); HF: (1) Porcelain Etch (Ultradent) applied for 20 sec, rinsed and air-dried, (2) post-etched by scrubbing 35% phosphoric acid (K-Etchant, Kuraray Noritake) for 15 sec, rinsed and air-dried, (3-4) same as for MP. Upon light-curing, all specimens were kept at 100% humidity for 1 hour prior to being immersed into pre-warmed water (37°C) for either 1 week ('immediate') or 3 months ('aged'). SBS was measured using a universal testing machine, upon which all fractured SBS pairs were examined using stereomicroscopy to determine the failure mode ('cohesive failure in ceramic', 'adhesive interfacial failure', 'mixed failure'). Data were analyzed using 2-way ANOVA and Tukey (α =0.05).

Results Statistics revealed no significant difference in SBS depending on SBUp's freshness (figure). No significant decrease in SBS was recorded upon aging. The significantly highest/durable bonding effectiveness was measured when LiSi₂ was HF-etched followed by separate G-MP silanization.

Conclusions Despite the UA contains silane, the most effective and durable bonding to LiSi₂ was achieved upon HF-etching followed by separate silanization, irrespective of the UA's shelf life.



0088 10-MDP Containing Cleaning Agent Restores Bond Strength to Contaminated Resin

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Objectives The aim of the present study was to investigate the efficacy of recently introduced 10-MDP containing cleaning agent in restoring the bond strength after blood and saliva contamination.

Methods KATANA Avencia (Kuraray) and Tetric CAD (Ivoclar) blocks were used as substrates. The blocks were wet-polished with 600 grit sandpaper, sandblasted, and ultrasonically cleaned. After blood and saliva contamination, the specimens were divided into subgroups: control-no contamination, water rinsing, acid etching, Ivoclean (Ivoclar) or KATANA Cleaner application. Multilink Automix (Ivoclar) resin cement was then applied in increments of 2 mm and light cured. After 24 hours of water storage at 37°C, the blocks were sectioned to obtain bars of approximately 0,5 mm². Half of the specimens were tested immediately for μ TBS and the other half was thermocycled (between 5-55°C with a dwell time of 30 seconds) for 5000 cycles and tested. Block surfaces were inspected with a scanning electron microscope (SEM). Three-way ANOVA was performed for μ TBS values (α =0.05).

Results In the KATANA Avencia group, the positive control subgroup obtained the highest value (56,01 MPa, SD:6,96) followed by Katana Cleaner and Ivoclean when immediately tested, with significant differences respect to the water rinsing (p<0.041) and acid etching (p<0.048) groups. After thermocycling, higher values were found in the KATANA cleaner (47,57 MPa, SD:8,15), but differences were not significant. In the Tetric CAD group, KATANA cleaner subgroup showed highest bond strengths (64,46 MPa SD: 10,92) at the initial test. After thermocycling, KATANA cleaner (58,66 MPa, SD: 9,93) gave the highest µTBS value. Significant differences between water rinsing group and the rest of subgroups (p<0.001), and between KATANA cleaner and the positive control group (p<0.006) were observed.

Conclusions KATANA cleaner was able to restore the initial bond strength after contamination and maintained µTBS values better than the positive control subgroups after thermocycling.



0089 Effect of Solvents on the Cytotoxicity of Surface pre-Reacted Glass

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Objectives To evaluate whether dentin pretreatments with dimethyl sulfoxide and/or ethanol affects the transdentinal cytotoxicity of a surface pre-reacted glass ionomer cement (S-PRG).

Methods Dentin discs (300 µm in thickness) from deep dentin, were prepared, cleaned with 50% citric acid (30 s) and permeability of each disc was measured, followed by sterilization at 121 degrees celsius for 25 min). Discs were distributed into 6 groups (n=8 discs/group). Groups consisted of dentin pretreatments with 100% ethanol, 100%DMSO, 50% DMSO dissolved in water (DMSO/H₂O) or ethanol (DMSO/EtOH), and an aqueous 50% ethanolic solution (EtOH/H₂O). No pretreatment groups served as control. 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 cytotoxicity test. After applying 1.5 µL of dentin pretreatments, S-PRG (S-PRG, Shofu) was applied in a 1 mm-thick increment. As negative control (100% cell viability), a polyvinylsiloxane impression material was used. Cell viability (%) was analyzed spectrometrically and assessed by MTT essay. Data were analyzed by Kruskal-Wallis test (α =0.05). **Results** Cell viability produced by the untreated S-PRG (97.8%) was not significantly affected by the additional DMSO/H₂O (83.32%). Dentin pretreatment with EtOH/H₂O (72.49%), 100% DMSO (72.69%), 100% EtOH (71.34%) and DMSO/EtOH (54.8%), produced significantly lower cell viabilities compared to the group with no pretreatment (*p*<0.05).

Conclusions The use of solvents as dentin pretreatments increase the cytotoxicity of Surface pre-reacted glass materials, 50% dilution of DMSO in water seems to be a safe threshold for the tested solvents. However, the use of ethanol or DMSO to improve the performance of surface pre-reacted glass material must be performed with caution, strictly avoiding their combined use in deep clinical cavities.



0090 Propolis and Hypericum Perforatum as a Cavity Disinfectant

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Objectives It is aimed to prevent the development of caries and stop the initial lesions in children and adolescents with pit and fissure sealants commonly used within the scope of preventive therapies. Before applying the fissure sealant, the plaque should be removed from the tooth surface. For this purpose, some different surface cleaning techniques are applied. It is appropriate to use a cavity disinfectant to eliminate bacteria remaining after mechanical cleaning in pits and fissures. This study aims to compare the effects of the use of propolis and Hypericum perforatum extract as cavity disinfectant on the physical properties of the fissure sealant material prior to the application of the fissure sealant material.

Methods The method of dye penetration has been chosen to evaluate the microleakage and the method of shear test method has been chosen to evaluate bond strength. Negative control group samples were not disinfected. Disinfection with chlorhexidine was applied to the positive control group, disinfection with propolis and disinfection with Hypericum perforatum were applied to the experimental group samples before fissure sealant.

Results One-way ANOVA revealed that the difference between bond strength values was not statistically significant (p>0.05).. Fracture types are grouped as adhesive, cohesive and mixed. There was no significant relationship between fracture type and groups (p>0.05).

Microleakage scores were evaluated as 0,1,2,3. There was no significant relationship between the groups in terms of score distribution.

Conclusions The use of propolis and Hypericum perforatum extract for disinfection did not affect the physical properties of resin based fissure sealant. It has been concluded that these natural substances with antimicrobial properties can be used as cavity disinfectants.



Objectives Nanoporous, bioactive TiO₂-coating has been shown to enhance cell attachment to titanium implant surface in vitro. The aim of this study was to evaluate if saliva exposure changes surface hydrophilicity and protein adsorption on TiO₂-coated and non-coated titanium.

Methods Grade V titanium discs (n=36) were prepared and polished. Half of the discs were provided with TiO₂-coating using in sol polycondensation method. Half of the TiO₂-coated and noncoated discs were further soaked in pasteurized whole saliva for 30 min, followed by washing with PBS three times. After exposure to saliva, the total protein amounts on surfaces were measured. The adhered proteins were collected with brushing with warmed SDS buffer, boiled and measured with Micro BCA[™] Protein Assay Kit. The hydrophilicity of noncoated, TiO₂-coated and saliva treated discs were detected with water contact angle (WCA) measurements using sessile drop method.

Results In sol coated TiO₂-surface had significantly lower WCA values when compared to noncoated titanium indicating more hydrophilic surface. In addition, both non-coated and TiO₂-coated surfaces showed significant decrease in contact angle values after saliva exposure. After the exposure the difference between coated and noncoated was not significant. No significant difference was found in protein adsorption. The amounts of adhered salivary proteins were equal on TiO₂-coated and non-coated surfaces. **Conclusions** To conclude, the TiO₂-coating increases hydrophilicity of titanium, and exposure to saliva enhances hydrophilicity even more. There are no differences in salivary protein adsorption on TiO₂-coated and noncoated titanium surfaces.



Novel Hesperitin Nanofibers for Application in Bone Tissue Engineering

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Objectives The current study aimed to develop a novel hesperitin nanofibers in order to find a drug delivery system with improved properties on the differentiation, metabolic activity and inflammatory response in osteoblasts.

Methods Hesperitin nanofibers were developed by an electrospinning technique and fiber diameters were evaluated by scanning electron microscopy (SEM) analysis. To evaluate cell proliferation and osteoblastic differentiation, osteoblasts were seeded on hesperitin nanofibers using an osteogenic medium and infected or not with *Phorphyromonas gingivalis*; the cell viability, mineralization and alkaline phosphatase (ALP) activity were assessed. Additionally, the expression of proinflammatory cytokines IL-6 and IL-8 were determined by enzyme-linked immunosorbent assay (ELISA).

Results SEM images of hesperitin nanofibers appeared randomly oriented and thick with small interfibrillar spaces. Osteoblasts seeded on hesperitin nanofibers showed a significant increase in cell viability, proliferation, mineralization nodules formation and ALP activity after infection or not with *P. gingivalis*. Furthermore, hesperitin nanofibers significantly inhibited the expression of IL-6 and IL-8 cytokines.

Conclusions This study showed the therapeutic potential of hesperitin nanofibers on cell proliferation, differentiation, matrix mineralization, and its anti-inflammatory property in osteoblast cells. Thus, the novel hesperitin nanofibers may be a promisor drug delivery strategy for bone regeneration of periodontal disease in scenarios with or without inflammation.



Bioactivity of Calcium Silicate-Based Endodontic Sealers

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Objectives To evaluate the bioactivity of four calcium silicate-based endodontic sealers after 30 d storage in distilled water and simulated body fluid (SBF).

Methods Four calcium silicate-based sealers (BioRoot RCS/BRT, TotalFill BC Sealer/TFL, AH Bioceramic Sealer/AHB and CeraSeal /CSL) were studied with an epoxy resin-based sealer (AH Plus /AHP), serving as a control. One week set disk-shaped specimens, were randomly divided into two groups (n=5/material, group) and immersed for 30 d in distilled water (G1) or SBF (G2) at 37°C. Then, they were rinsed with water, air dried and examined by micro-ATR FTIR and HV-SEM/EDS.

Results In G2 characteristic IR peaks of Ca-P (1150-950 cm⁻¹) were found in all sealers, except for the epoxy control. No such peaks were probed in G1. HV-SEM/EDS revealed the presence of crystalline deposits on G2 bioceramic sealer surfaces not traceable in G1. Elemental mapping showed that the crystalline structures mainly consisted of Ca and Ca-P, with a complementary distribution to sealer Si core element.

Conclusions The calcium silicate-based sealers studied have been found to induce the formation of apatite-like structures on their surface when stored in SBF.



Hard-Tissue Cell Response to Zirconia Implant Surfaces Coated With MTA

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Objectives The aim of this study is to evaluate the biological response of human osteoblasts in contact with zirconia implant surfaces coated with Mineral Trioxide Aggregate (MTA).

Methods Zirconia discs stabilized with Yttria (Y-PSZ) and Titanium discs were produced using cold pressing technique. 4 groups were considered: Nd:YAG laser textured Zirconia (Zr-Textured); coated group (Zr-MTA), in which MTA was applied in Zirconia-textured surfaces; Y-PSZ and Ti discs without texture (Zr and Ti-Untextured). Surface roughness (Ra) was evaluated by contact profilometry. Human osteoblasts (hFOB) were cultured on discs for 14 days. Cell adhesion and morphology (1 day) were analysed by SEM. Cell viability was evaluated at 1, 3, 7 and 14 days using a resazurin-based method. Interleukin 8 and osteocalcin were evaluated at 1- and 3-days using ELISA. Results were presented as mean \pm standard deviation (SD). Group comparisons were tested using ANOVA (Tukey's post-hoc) using appropriate statistical software (p < 0.05).

Results Zr-Textured Ra values were significantly higher than all other groups (p<0.05). SEM images revealed cell adhesion on all test materials at 1day. Cell viability decreased from 1 to 3 days of culture and then increased over time for all groups. MTA samples showed significantly lower viability (p<0.05) unlike Ti-Untextured group showed significantly higher viability values compared to Zr-MTA (1 day), to Zr-MTA, Zr-Textured and Zr-Untextured (3 days) and to Zr-Untextured (14days) (p<0.05). Zr-MTA group showed higher IL-8 secretion (1 day) compared to Ti-Untextured, and at 3 days Zr-MTA, Zr-Textured and Zr-Untextured groups were higher than Ti-Untextured (p<0.05). An increase in osteocalcin secretion (3 days) was observed in Zr-MTA group compared with the remaining groups (p<0.05).

Conclusions Despite the potential beneficial properties of MTA regarding biocompatibility and antibacterial capacity, the proposed strategy of incorporating MTA into implant surfaces does not seem beneficial for the cellular response.









Sample Roughness

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Effectiveness of Various Therapies Against Dentin Hypersensitivity

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Objectives Dentin hypersensitivity is the clinical condition that can be defined as a sharp, short pain arising from exposed dentin in response to thermal, chemical, or mechanical stimuli, and affects 4%-73% of the population. The purpose of this study was to evaluate and compare the effects of five desensitizing techniques as a treatment of dentin hypersensitivity on the exposed dentine, after in-office tooth whitening procedure.

Methods A total of 30 extracted intact human molars were stored in a chloramine-T solution at 6°C. The specimens were obtained by transversely cutting 2.5 mm of the crowns leading to exposure of the dentin. The specimens were cleaned in an ultrasound bath and treated initially with EDTA gel 15% for 4 min and then with Opalescence Boost bleaching gel (40% H_2O_2) for 20 min. Then the specimens were randomly divided into six groups (n=5) and received one of the following treatments: Group A (No treatment - control group), Group B (air-abrasion with ProSylc – Bioglass 45S5), Group C (BioMinF toothpaste), Group D (Emofluor gel - SnF₂), Group E (Laser Er,Cr:YSGG), and Group F (MI Paste – CPP-ACPF). Then, the specimens were observed using scanning electron microscopy (SEM), in order to evaluate the occlusion ratio and rate of dentinal tubule occlusion.

Results The analysis of the SEM images revealed no occlusion of the dentinal tubules in Group A, >95% tubule occlusion in Group B, almost 100% tubule occlusion in Group C, >50% tubule occlusion in Group D, almost no occlusion in Group E, and 50% tubule occlusion in Group F.

Conclusions It was concluded that all the tested groups presented higher percentage of occlusion of the dentinal tubules compared to the control group, there were differences in their effectiveness among them. The most effective treatments were the use of BioMinF toothpaste followed by air-abrasion with ProSylc.



Objectives Apical root resorption due to different reasons can cause significant destruction of the tooth. It is expected that the treatment applied to these teeth will prevent resorption, induce the formation of hard tissue by stimulating the cells in the surrounding tissues, and enable the tooth to remain healthy in the oral environment. Mineral trioxide aggregate (MTA), which has become popular recently, can also be used for filling the entire root canal. The aim of this case report is to report the treatment of persistent primary tooth #53 with irreversible pulpitis with mta and its 1-year results.

Methods A 23-year-old female patient applied to our clinic with the complaint of pain. She reported that the pain was continuous. In the clinical examinations, it was determined that a persistent primary tooth #53 showed spontaneous pain and percussion sensitivity, its mobility levels were in the same range as a healthy tooth, it had a large carious lesion and was vital. When examined

radiographically, it was observed that more than half of the root was resorbed. Treatment alternatives were presented to the patient. Root canal treatment with MTA (Wellroot PT, Vericom, United Kingdom) was recommended as an alternative treatment for the permanent primary tooth to remain in the mouth. After the root canal pulp was removed, irrigation solutions were activated by sonic activation (Endoactivator, Dentsply, USA), a cellulose sponge was placed in the apical region and the root canal system was filled with MTA and then restored with composite.

Results As a result of 1-year follow-up, it was determined that the related tooth was maintained in the mouth in a healthy way, and the symptoms of pain and percussion sensitivity were relieved.

Conclusions If persistent primary teeth with root resorption are desired to be kept in the mouth, MTA treatment may be an appropriate treatment option.



Can Energy Drinks Affect the Appearance of Bioactive Restorative Materials?

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Objectives To compare the effect of different energy drinks on surface roughness, weight loss, and color change of different bioactive restoratives.

Methods 40 specimens of each material (Charisma Diamond One, Activa Bioactive Restorative, Activa Presto, Equia Forte; n= 160) were prepared using a plastic mold (8x2mm). Each specimen, except Equia Forte, was photo-polymerized for 20 sec using a visible light-curing unit (ZenoLite, President Dental, Germany). After Sof-Lex discs polishing (3M ESPE, St. Paul, MN, USA), specimens were immersed in different energy drinks: distilled water (control), Powerade (Coca-Cola, Atlanta GA, USA), Burn (Coca-Cola, Atlanta GA, USA) and Monster (Monster Energy Ltd, California, USA) for 7 days. The color measurements were performed with a spectrophotometer (Vita Easyshade, Vident, Brea, USA) and evaluated according to CIEDE2000 system. The surface roughness measurements were obtained with a profilometer (SurfTest SJ-301, Mitutoyo, Japan). An electronic balance (Pioneer PA64, Ohaus, Pine Brook, USA) was used to evaluate the specimen's weight at baseline and after 7 days. Statistical analyses were performed by Wilcoxon signed-rank test and Mann-Whitney U tests (p< 0.05).

Results All energy drinks significantly roughened the surfaces of Equia Forte (p<.05). Powerade and Monster increased the Ra of all bioactive materials compared to baseline (p<.05). Burn affected all the groups except Activa (p>.05). Significant weight loss was observed in Equia Forte groups after immersion in all drinks while no loss was noticed in the other groups. Burn and Monster lead to more discoloration in all the bioactive materials (p<.05). Repolishing procedures lighten the color of the materials but not to a comparable level to baseline (p<.05). The less affected bioactive material from the process was Activa.

Conclusions Energy drinks affected in different degrees the surface roughness, weight loss, and color change of bioactive restorative materials. The most affected material was Equia Forte while the less was Activa.



Perceptibility and Acceptability of Lightness Differences of a Single Maxillary Central Incisor

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Objectives The aim of this study was to assess the lightness difference perceptibility and acceptability thresholds, for a single maxillary central incisor, and to investigate possible differences in these thresholds regarding the direction ($+\Delta L^* vs -\Delta L^*$), the group (dentists vs laypersons), the gender and the age of the observers.

Methods A series of images with varying lightness (L*), were created by altering the right maxillary central incisor of a male Caucasian, on a frontal view full-portrait image. Digital modification of one central incisor by 1 Δ L* unit resulted in 15 different images: one control, 7 with increased and 7 with decreased lightness. The images were presented in random order, on a digital calibrated monitor, to 158 participants (79 dentists, 79 laypersons), who were asked to evaluate every image and answer whether they perceive a difference and if yes, whether they accept this difference.

Results Each factor (magnitude of ΔL^* , direction of ΔL^* , group, gender, age) was statistically significant. 50:50% perceptibility thresholds ranged from 2.3 to 4.5. Dentists perceived lightness differences at lower values than laypersons. Female participants perceived and accepted lightness differences at lower values compared to males. Difference of lightness was perceived and accepted at lower values when the tooth become lighter instead of darker. As age increased, differences of lightness were perceived and accepted at higher values.

Conclusions Perceptibility and acceptability of lightness differences of a single maxillary central incisor are affected by the magnitude and the direction of lightness change, as well as the gender, the age, and the type of the observers.



0099 Fluorescence and Color Changes of Several Universal Composites After Aging

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Objectives To determine the fluorescence and color change of several universal resin composites after aging. **Methods**

Ten circular specimens (10 mm diameter and 1.5 mm thick) of three universal composites (Omnichroma, Tokuyama; Essentia Universal, GC; G-aenial A'Chord A2, GC) and of Filtek Supreme XTE Enamel A2 (3M Oral Care) were prepared. Surfaces were polished using Soflex discs and randomly distributed into two groups according to the water aging method: 55° C or UV irradiation (n=5). A fluorescence emission spectrum was recorded at an excitation wavelength of 380 nm, using a fluorescence spectrophotometer (Cary Eclipse). L*a*b* coordinates were determined by a spectrophotometer (VITA Easyshade) under a gray background. Both fluorescence intensities and color parameters were recorded initially (T1), at 4 days (T2) and after 1 month (T3) of aging. Color change Δ E00 (CIEDE2000) was calculated between T0-T1 and T0-T2. Data were analyzed by two-way ANOVA, Tukey's test and paired t-tests (p<0.05).

Results

At 5 days and 1 month, the fluorescence intensity was influenced by the composite (p<0.001) and the aging method (p=0.045). Essentia exhibited the highest fluorescence intensity for all evaluation times. A reduction of the initial fluorescence intensity was observed for Essentia (18.5% at T1 and 35.3% at T2) and Omnichroma (12.1% at T1, and 23.8% at T2).

The color change was influenced by the composite (p>0.001), the aging method (p=0.044) and the interaction between both factors (p>0.01) after 4 days, but not by the composite after a month (p>0.05). Color change was not acceptable (threshold =1.8) and similar for all composites after 1 month of UV aging. In contrast, A'Chord exhibited a higher color change, without any difference with Omnichroma, after aging at 55°C.

Conclusions A decreased in fluorescence was detected for Essentia and Omnichroma after aging. Color changes were not acceptable after 1 month water aging for all composites.



Objectives Fiber-reinforced composite (FRC) resin bridges are a conservative alternative to traditional fixed dental prostheses or implants. Replacing missing teeth, especially in the anterior region, is an important part of dental practice. This technique is a minimally invasive and reversible application and can be completed in a single visit. In this case report, a conservative treatment option of a root-fractured anterior tooth is presented using a glass fiber post to bond the crown and root fragments. **Methods** A 60-year-old man visited the Department of Restorative Dentistry because of mobility of the left maxillary central incisor (tooth #21) after it was endodontically treated. The tooth showed Miller Class 3 mobility and slight tenderness on percussion. Clinical and radiographic examinations revealed that the tooth has oblique root-fractured at the coronal cervical third. The tooth extraction needed, the conventional treatment options (or implant) and the conservative treatment options (FRC, without tooth extraction) were explained to the patient. The patient preferred FRC treatment without tooth extraction, which is a more conservative treatment option. After that the coronal part of tooth #21 was adhered to the root using a glass fiber (AAA Fiber Post, China) with a full-thickness periodontal flap elevation . Then, polyethylene fiber (Ribbond-THM 2 mm,Optident,UK) was placed into the prepared cavity on the palatal surfaces of teeth between #23-#12 and the tooth was splinted.

Results At two years' recall examination, the crown and root strengthened with glass fiber post were in sound and good condition. No specific discomfort was reported. Periapical radiography was taken and bone filling was observed in the surrounding hard tissue of the crown and root junction area.

Conclusions FRC restorations can be considered as an alternative method for the treatment of root-fractured anterior teeth without tooth extraction. FRC restorations may delay more expensive implant and prosthetic treatment options for years to come.



Removal of Broken Instruments From Root Canal: Two Case Reports

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Objectives Root canal materials made of commonly used metal alloys in endodontics can break due to various factors such as fatigue, torsional forces, and prolonged use beyond the recommended duration, which can negatively affect the success of the treatment. This case series presents the removal of fractured root canal instruments extending through the apical region and root canal system in two different patients using a dental operating microscope and ultrasonic methods, and their three-month follow-up. **Methods** In patients referred to the Endodontics Clinic of Selcuk University Faculty of Dentistry with complaints of pain, radiographic examination revealed a fractured instrument in the apical region of the distal canal of the left mandibular molar in the second case and along the root of the left maxillary lateral tooth in the first case. After isolating the teeth with a rubber dam, the broken instruments were removed under the dental operating microscope using K-file, H-file, (Acteon Satelec Ultrasonic-ED4, ED5D, E14, ED14) ultrasonic tips, and irrigated with sodium hypochlorite, distilled water, and chlorhexidine, by loosening them with counterclockwise rotational contacts. Following the removal of the broken instruments, the root canal treatment was completed with the restoration process.

Results After the removal of broken instruments in two different patients, spontaneous pain, and vertical percussion sensitivity decreased, and it was observed that these symptoms completely disappeared after the renewal of root canal treatment. At the three-month follow-up, there were no symptoms in these teeth, and radiographically, healing was observed in the periapical tissues. **Conclusions** The use of modern technologies such as dental operating microscopes and ultrasonic instruments in removing broken instruments from the root canal system positively affects the treatment outcome. Using the operating microscope allows for better visualization of the broken instruments, which can be removed more precisely and with minimal tissue damage using ultrasonic tips.



0102 Retaining Vitality of a Crown-and-Root-Fractured-Tooth Using Partial Pulpotomy

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Objectives The prognosis of teeth with horizontal root fractures (HRFs) depends on a multitude of factors, like concomitant injuries. The following case report describes how pulp vitality was preserved in a case of combined HRF and crown fracture. **Methods** Intraoral inspection revealed a crown fracture with pulp exposure of tooth 11, which reacted sensitive to cold test and percussion (Fig. 1). Periodontal probing depths were within physiological limits and the tooth showed minimal mobility (grade I). Radiographically, a translucent bold line at the mid-level of the root (Fig. 2) was detected. The diagnosis was HRF with minimal dislocation (< 1mm) of the coronal fragment.

After removing 2-3 mm of the coronal pulp under rubberdam isolation, hemostasis was achieved using the application of 1% NaOCI via a foam pellet for 3 min. The pulp was capped using a hydraulic calcium silicate cement (Biodentine, Septodont, Saint-Maur-des-Fossés, France). After 12 minutes curing time and sandblasting, a temporary resin-based composite restoration was placed. Teeth 12-22 were splinted for two weeks using a semi-flexible splint (Titan-Trauma-Splint, Medartis, Basel, Switzerland).

Three months postoperatively, the radiograph revealed a thin opacity right below the pulp capping material which could be interpreted as a "dentin bridge" (Fig. 3). After two years, tooth 11 reacted normal to cold testing and showed no signs of mobility (Fig. 4).

Results Tooth retention and pulp vitality preservation were achieved in this case. Contributing factors were a short pulp exposure time (<1h) and minimal dislocation of the coronal fragment. The latter allowed for a shortened splinting time, which benefitted or al hygiene and reduced the risk of periodontal complications.

Conclusions Partial pulpotomy and subsequent splinting were effective for preserving pulp vitality in a combination of HRF and crown fracture with pulp exposure.



Fig. 1: Clinical situation one hour after the accident. The bright color of the exposed pulp indicates its vitality. Palatal gingival bleeding suggests a localized rupture of periodontal ligament.




Fig. 2: Radiograph taken one day after dental trauma: Tooth 11 revealed an obvious fracture line in the middle part of the root.



Fig. 4: Two years after the accident. The last recall showed no sign of apical or periodontal inflammation. The dentin bridge remained clearly visible.



0103 Direct Pulp Capping Techniques and Material Choices: Perspective of South African Dentists <u>R. Adam</u>

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Objectives The purpose of the study was to determine the treatment decisions for different pulp capping cases by a group of South African dentists

Methods

A cross sectional descriptive study design was used. Links to an online survey using the Google platform was distributed to a group of general dentists in South Africa registered for postgraduate education at a dental school via social media groups. The study received ethics approval (BM22/2/10). A poor response rate was recorded (n=51). Information regarding vital pulp therapy (materials for direct pulp capping and treatment strategies) were collected using case studies. Data was submitted for descriptive analysis using SPSS programme.

Results

Calcium Hydroxide was the preferred material of choice (72%) for direct pulp capping. Fisher's exact test was used to determine if there was a significant association between years of experience as a dentist and dental material choice for direct pulp capping. There was not a statistically significant association between the two variables (two-tailed p = .365). The preferred technique for direct pulp capping was total caries removal and the placement of a permanent restoration (45%) and total caries removal and a temporary restoration was the second best. Similarly, there was no relationship between the direct pulp capping technique and years of experience as a dentist (two-tailed p = .738).

Conclusions In conclusion, preliminary evidence suggests that the number of years of experience as a dentist did not influence direct pulp capping technique (choice of partial or total caries removal) or direct pulp capping material choice. In addition, newer materials such as Biodentine and calcium silicate cements are not routinely used by South African dentists despite sufficient evidence advocating for its use.



Objectives Vital pulp therapy (VPT) has been recently suggested as an alternative clinical procedure to treat symptomatic mature permanent teeth presenting deep caries lesions, in order to maintain the pulp vitality over time and to avoid or post-pone root canal therapy (RCT). Therefore, the aim of the present study was to assess the success rate of mature permanent teeth underwent full pulpotomy.

Methods Five systemically-healthy subjects presenting deep caries lesions approximating/involving the pulp of mature permanent teeth and with signs and symptoms of reversible pulpitis, underwent full pulpotomy using hydraulic calcium-silicate based cements. One week after treatment, presence of pain or signs and symptoms of pulp sufferance were evaluated and final restorations in composite resins were carried out. Dental elements were clinically and radiographically followed-up to assess the success rates over time. All treatments were performed at the Dental Clinic of University of Naples Federico II.

Results The clinical cases were followed for different time intervals (3 to 12 months) and a 100% of clinical and radiographical success rate was reported. Some patients reported slight pain within 24 hours after treatment, treated by ibuprofen administration; none additional complications were observed.

Conclusions Within the limitation of the present study, it could be concluded that VPT, especially full pulpotomy, should be considered as a valid non-invasive treatment in mature permanent teeth with signs and symptoms of reversible pulpitis. However, a larger sample size and a longer follow-up period are needed to confirm the preliminary obtained results.



Cigarrete Increases Apical Periodontitis Bone Resorption in Rats

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Objectives Evaluate effects of cigarette smoke inhalation(CSI) associated with apical periodontitis(AP) induced in rats using markers of bone turnover and histometric, immunohistochemical, and microtomographic analysis.

Methods 32 three-month-old male Wistar rats were divided into four experimental groups (n=8): C-Control; CSI-rats with CSI; APrats with AP; and CSI+AP - rats with CSI and AP. The rats of the CSI and CSI+AP groups inhaled cigarette smoke while remaining inside a smoke chamber for 8min, 3times per day, for 50days. After 20days of smoke inhalation, rats of the AP and CSI+AP groups had first right lower molar pulps exposed to the oral cavity for 30 days to induce AP. In these subsequent 30days, CSI and CSI+AP rats groups continued with CSI. On day 50, they were euthanized. Blood was collected to evaluate serum alkaline phosphatase, calcium, phosphorus, nicotine, and cotinine levels, and the mandibles were removed for histological processing to evaluate bone resorption via histometric, immunohistochemical (RANKL/OPG), and microtomographic analysis. The Mann-Whitney test was applied for nonparametric data and Student's t-test was applied for parametric data, with significance level of P<0.05.

Results Serum calcium concentration was lower in the CSI + AP group compared to the AP group (P=0.036). Bone resorption occurred in the AP and CSI + AP groups. The histometric analysis showed a larger area of bone resorption for the CSI + AP group (P=0.004) and the microtomographic analysis showed greater volume of resorption (P<0.001) compared to the AP group. The CSI + AP group had a high immunostaining pattern for RANKL compared to the AP group (P<0.001), which had a higher immunostaining pattern for OPG (P=0.015) compared to the CSI + AP group.

Conclusions AP associated with CSI resulted in a larger area of alveolar bone resorption and higher immunostaining for RANKL, predominating osteoclastic activity.





Figure 1. Histological sections (H&E) of the periapical region. C group: a1-a2: preserved periodontal ligament space and alveolar bone; CSI group: b1-b2: preserved periodontal ligament space and alveolar bone; AP group: c1-c2: destruction of the periodontal ligament and alveolar bone space. CSI + AP group: c1-d2: extensive area of bone resorption. (a1-d1: SO; a2-d2: 100x).



Figure 2. Representative images of the immunohistochemical analysis of the periapical region of groups C: (a1, a2); CSt: (b1, b2); AP: (c1, c2); CSI + AP: (d1, c2). Immunostaining for OPG (a1, b1, c1, d1) and RANKL (a2, b2, c2, d2) cytokines. (H&E staining, 1000k).



Figure 3. Images representing micro-CT, by sagittal view, of the first right lower molar of the a: Control group: preserved periodontal ligament space, lamina dura, and alveolar bone; b: CSI group: preserved periodontal ligament space, lamina dura, and alveolar bone; b: AP group: hypodense image (yellow dotted line) characteristic of bone resorption; d: CSI + AP group: hypodense image (yellow dotted line) characteristic of bone resorption; d: CSI + AP group: hypodense image (yellow dotted line) between the mesial and distal roots of the first molar characterizing the volume of bone resorption.

. Mean and standard deviation of biochemical concentration of markers of bone turnover, nicotine, and cotinine

Analyses Biochemical	C Group	CSI Group	P value	AP Group	CSI + AP Group	p Values
Alkaline phosphatase (UL-1)	72.64 ± 14.85a	60.64 ± 13.14a	0.213	73.40 ± 16.34a	81.18 ± 13.39a	0.434
Calcium (mg dL–1)	10.52 ± 0.29a	10.74 ± 0.64a	0.508	10.30 ± 0.14a	10.02 ± 0.20b	0.036
Phosphorus (mg dL-1)	8.22 ± 1.82a	11.53 ± 4.02a	0.132	10.63 ± 3.25a	8.58 ± 1.65a	0.244
Nicotine (ng/ml)	Undetectable	26.24 ± 9.58	< 0.001	Undetectable	28.97 ± 7.04	< 0.001
Cotinine (ng/ml)	Undetectable	294.06 ± 64.86	< 0.001	Undetectable	332.71 ± 35.34	< 0.001

Different superscript letters represent statistically significant differences P<0.05.

Median values, standard deviation, and mean histometric, immunohistochemical, and microtomographic findings.

	C Group	CSI Group	AP Group	CSI + AP Group	P-value
Histometric	3.42 ± 0.20	3.43 ± 0.23	6.18 ± 0.81a	7.32 ± 0.45b	t-test P=0.004
OPG Imuno	1 (1-1)	1 (1-1)	4 (3-4)a	3 (3-2)b	P=0.015
RANK L	1 (1-1)	1 (1-1)	3 (3-4)a	4 (4-5)b	P=<0.001
Micro-CT volume	1.20 ± 0.40	1.72 ± 0.46	4.60 ± 1.38a	8.68 ± 0.70b	t-test P=<0.001

Different superscript letters represent statistically significant differences (AP vs. SAP), P<0.05.



0106 **Management of Extraoral Sinus Tract With Non-Surgical Endodontic Treatment** <u>S. Kara</u>, O. Tavsan Endodontics, Usak University, Usak, Turkey

Objectives This case report aims to describe the treatment process and 1-year follow-up of an extraoral fistula. **Methods** A 37-year-old female patient without any systemic disease was admitted to Usak University Faculty of Dentistry Endodontic Clinic with a complaint of swelling in the left mandibular region.Upon radiographic examination, it was determined that the left mandibular second molar tooth had an old restoration and a periapical lesion.The tooth was asymptomatic, did not respond to vitality tests, and root canal treatment was started.The root canal was prepared using VDW.GOLD®RECIPROC® Endo motor (VDW, Germany) and Reciproc (VDW, Munich, Germany) files. Irrigation with 2 ml of 2.5% NaOCI was performed between each filing. For the final irrigation, 2.5% NaOCI, 17% EDTA, and 2.5% NaOCI were used, respectively. The irrigation solution was activated by passive ultrasonic irrigation. Calcium hydroxide was used as an intracanal medicament. After 1 week, the patient did not have any symptoms, and the extraoral fistula had reduced in size. The calcium hydroxide was removed by passive ultrasonic irrigation, and the final irrigation procedure was repeated. Root canal filling with gutta-percha was completed using the cold lateral compaction method. The permanent restoration was completed with direct composite resin. The patient was referred to the dermatology department for treatment of scar tissue in the region of the extraoral fistula.

Results At the 1-, 3-, 6-, and 12-month follow-ups, it was observed that the apical lesion of the left mandibular second molar tooth had shrunken radiographically and that the extraoral fistula had healed with scar tissue formation.

Conclusions When the correct diagnosis is made, the elimination of the source of infection by or root canal treatment is simple and effective. Therefore, the correct diagnosis and an effective treatment planning of the disease is vital.



A Collagen Scaffold Encapsulating Complement C5a Enhances Pulp Cell Colonization

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Objectives In vital pulp therapy, a pulp capping material is used to replace the underlying destroyed tissue. The subsequent tertiary dentin production occurs at the expense of the pulp volume. An innovative scaffold made of collagen sponges loaded with microspheres containing Complement C5a, have been developed to induce the dentin-pulp regeneration without pulp volume loss. This work was designed to investigate C5a release from the collagen sponges and its effects on human pulp cell proliferation and sponge colonization.

Methods Collagen sponges loaded with Complement C5a encapsulated into microspheres were incubated in MEM medium and C5a release over 52 days was quantified by ELISA. Human pulp cells, prepared from extracted third molars, were incubated with the collagen sponges to evaluate its biocompatibility and cell proliferation using the MTT test. A 3D printed device was specifically developed and adapted to investigate the sponge colonization with pulp cells. The sponge (6mm high and 3 mm Ø) was maintained in a vertical position over the cell monolayer. After culture for 14 days the sponge colonization was evaluated with DAPI staining of the cell nuclei.

Results C5a was gradually released from the collagen sponges until day 52. The sponges didn't have any toxicity and significantly increased pulp cell proliferation. After 14 days of culture of the sponges in the home-made device, the cell nuclei were observed in the sponges containing C5a at different heights, but no colonization was observed with the controls (without C5a).

Conclusions This work demonstrates that the collagen sponges containing C5a induced pulp cell proliferation. These sponges were colonized with pulp cells at different heights. This suggests that the newly developed material with the encapsulated C5a may be promising for recruiting pulp cells in future dentin and pulp regeneration studies aiming at avoiding pulp volume loss.



Characterization of Reduced Enamel Epithelial Cell Culture Cells

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Objectives

Our goal is to isolate and characterize epithelial cellular culture from reduced enamel epithelium in dental follicle of retained third molars.

Methods

Dental follicle cell cultures were isolated from retained third molars. collected after routine extractions in Dental faculty (Medical university – Sofia) after informed consent was obtained from the patients. Follicle tissue was dissected with scalpel and minced, after which it was digested with 3 mg/ml Collagenase I / 4 mg/ml Dispase solution in PBS for 30 min. After routine passaging, mesenchymal cells were removed from the culture. Further epithelial cells were grown in KBM-Gold medium (Lonza,Basel, Switzerland) supplemented according to the manufacturer's instructions.Epithelial and mesenchymal cell cultures were characterised for expression of variety of dental specific and epithelial markers with immunofluorescence.

Results

After enzymatic digestion the follicle tissues were allowed to attach to the bottom of 6 cm. dishes and after 3-7 days we observed cells migrating and proliferating. We recognised two types of cells: spindle like mesenchymal cells and oval, tightly lined next to each other epithelial cells. Trypsin disattached quickly the mesenchymal cells and the epithelial colonies remained attached longer. Morphological and immunofluorescent observations confirmed we managed to isolate epithelial cell culture, expressing ACE2, CK19, CK14, P63, Amelogenin, Ameloblastin, Tuftelin, etc.

Conclusions

Dental follicles of retained third molars have viable epithelial cells, relative to the enamel epithelium and rests of Malassaez, which can be isolated and studied further.



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Objectives To observe the biocompatibility of different human cells on various 3D plant derived scaffolds

Methods 5 mm thick sheets were obtained from apple, leek, green onion, green garlic and they were carved into circles with a diameter of 16mm. The samples were treated with 0.1% SDS solution and spun at low speed for 72h. Following the decellularization protocol, the scaffolds were incubated in 100mM CaCl₂, spun for another 24h to remove any surfactant residue and sterilized in 70% ethanol overnight. Then they were incubated for 24h with a solution of DMEM and 10% FBS. Meanwhile, PerioDontal Ligament Stem Cells (PDLSC), Stem Cells from Apical Papilla (SCAP), Hertwig's Epithelial Root Sheath (HERS), Follicular Stem Cells(FSC), Dental Pulp Stem Cells(DPSC), Bone Marrow Stem Cells(BMC), Stem cells from Human Exfolliated Deciduous teeth (SHED) were isolated from routinely extracted human third molars, using laboratory routine methods (1,2). Cells between 3rd and 5th passage were seeded in the scaffolds and cultivated for 4 weeks. After that the samples were fixed and treated with DAPI for InCell observation. **Results** The 3D plant derived scaffolds are similar to the structure and the size of human cells. All the decellularized scaffolds were found to be supportive for the survival and proliferation of PDLSC, SCAP, HERS, FSC, DPSC, BMC. Fluorescent staining revealed clusters of cell nuclei forming 3D structures on the surface and inside the scaffolds. The plant derived scaffolds did not show any significant toxicity.

Conclusions Natural 3D scaffolds are a great cellular microenvironment for human culture growth. The decellularized plant tissues supported the cell adhesion, proliferation and functionality of PDLSC, SCAP, HERS, FSC, DPSC, BMC, SHED. Additionally, there was no cytotoxicity exhibited, therefore proving they are a promising substitute of synthetic scaffolds and can be used for many in vivo and in vitro tissue engineering purposes.



Decrease of the Geriatric Masticatory Coefficient in the Elderly Suffering From Malnutrition

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0110

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Objectives The aim of this study was to measure in Malnourished elderly people identified by the Mini Nutritional Assessment (MNA) (MNA scoring is: 12-14 : normal nutritional status, 8-11 at risk of malnutrition, 0-7: malnourished) a Geriatric Masticatory Coefficient(GMC): a number of points was attributed for each natural tooth with or without antagonist as follows: 2 points for the upper central incisors, 1 point for the other incisors, 4 points for the canines, 3 points for the premolars, 2 points for the upper third molars, 3 points for the lower third molars and 5 points for the other molars. The total was 100 when all teeth were present. **Methods** 60 elderly people (75-95 years) with or without removable prosthesis were examined in a day geriatric hospital (CHU Bordeaux France), the patients were divided into two groups of 30 people, the first (control group) has a normal MNA (mean: 12.8<u>+</u> 0.94SD), the second (experimental group) has a low MNA (mean: 4.86<u>+</u>1.9SD). GMC was measured in both groups. Patients at risk of malnutrition were not included in this work.

Results in experimental group the GMC was significantly lower (mean: 49,03+32,51SD) than in control group(mean: 64,76+21,99SD) p<0,02847 Friedman ANOVA.

Conclusions In our study, elderly people suffering from malnutrition have a significantly lower GMC than elderly patients with normal nutritional status.



Digital Impression for Implant-Treated Edentulism: a Clinical Scenario-Based in-Vitro Study

0112

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Objectives Data concerning accuracy of intraoral scanners (IOS) are still lacking, and general dentists are in dilemma when choosing the appropriate device. Moreover, regarding completely edentulous arches where multiple implants are inserted, no consensus has been reached. Aim of the study was to evaluate the accuracy of digital impressions for maxillary full-arch (all-on-six) implant restorations simulating two different clinical scenarios and to compare the accuracy in terms of implant angulation and splinting of the scanbodies with a new IOS device.

Methods Two models of the edentulous maxilla, with six implants at positions #12,14,16,22,24,26 were reverse engineered in ANSA (by Beta CAE Systems), while the sockets for the scanbodies were digitally predefined. The models were then 3D printed in resin. In the first scenario, all implants were parallelized – in the second, implants #12, #22 had a 20-degree angulation buccally, while implants #16, #26 a 20-degree angulation distally. The models were scanned with a new IOS device (Trios 3, 3Shape) using either non-splinted or splinted scanbodies. The scans were exported to a Standard Tessellation Language (.stl) file and imported into inspection software (Autodesk Meshmixer, Geomagic Control X; 3D systems) for accuracy assessment.

Results Both clinical scenarios provided scans with accuracy within clinically acceptable limits. Implant angulation and splinting of the scanbodies facilitated and made faster the scanning process. Splinting of the scanbodies provided scans with greater accuracy, especially in the first clinical scenario.

Conclusions The present IOS tested provides adequate accuracy of fit for implant scanning. Implant angulations may complicate the accuracy of fit after digital impressions due to a lack of bone tissue. Splinting of scanbodies with an extensional structure may minimize the accumulative errors generated from the stitching process and optimize marginal discrepancy problems. Other IOS available in the dental market should be tested to provide evidence-based information for dentists.



Chin Volume Asymmetry Score Changes After Class III Orthognathic Surgery

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Objectives The objective of this study was to investigate the asymmetric changes in chin volume over 12 months after orthognathic surgery using three- dimensional stereophotogrammetry. The analysis of soft tissues over time was conducted using 101 healthy Caucasian patients with a skeletal Class III malocclusion (age range 19–53 years, mean age 28.6 years).

Methods Three-dimensional facial images were acquired using the 3dMDtrio (3dMD, Atlanta, GA) stereophotogrammetric system and recorded: before surgery (T0), 6 months (T1) and 12 months (T2) after surgery. The 21 anthropometric landmarks were digitally marked on each 3-D facial surface and evaluated at 3 time points. The chin area asymmetry was assessed and classified as: 0-2 mm (mild); 2-5 mm (moderate); > 5 mm (severe). The Chin Volume Asymmetry score (CVAS) was used. All patients were divided in two groups depending on the type of surgery: single jaw (LeFort I-21 (20.8%)) and both jaw (bimaxillary- 79 (78.2%)) surgery group. **Results** The Chin Volume Asymmetry score showed statistically significant difference between T0 (median 1.11 mm; IQR (1.04; 1.19)) and T1 and T2 (median 1.08 mm for both; IQR (1.04; 1.13); P < 0.001), but not difference between T1 and T2 (P > 0.05). No differences in the CVAS was found between both surgical groups at any time point (p > 0.05). With the CVAS, the right side of the face was larger before surgery (51.48% of cases); while in 19.8% of cases, the sides changed after surgery, but the right side remained dominant. A statistically significant difference was observed in moderate asymmetry group between T0 (median: 1.16) and T1 (median: 1.07) (p < 0.01).

Conclusions It is concluded that with the CVAS the most statistically significant changes were found in the first 6 months after the surgery. Furthermore, there was no statistically significant change in chin asymmetry 12 months after surgery.



Imaging Findings of Bisphosphonate-Related Osteonecrosis of the Jaw With Emphasis on Late Magnetic Resonance Imaging Findings A. O. Gerçek, S. Adiloğlu, A. Aktas

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Objectives Medical-related osteonecrosis of the jaws (MRONJ) is a well-described clinical condition with consistent radiographic evaluation to describe the MRONJ, emphasising late magnetic resonance imaging findings. MRI could demonstrate the bone marrow changes associated with edema or inflammation resulting from increased water content, replacing normal fatty marrow. This study investigated whether this condition could be diagnosed with magnetic resonance imaging in the late stages of MRONJ. **Methods** Ten patients with a clinical history of pain, suppuration, and swelling in the mandible or maxilla were referred to the Department of Oral and Maxillofacial Surgery, Hacettepe University. All patients had the usage of antiangiogenic or antiresorptive agents. All patients had clinical and pathological confirmation of osteonecrosis with stage 2 or 3. MRI images of 6 female and 4 male patients diagnosed with MRONJ were retrospectively reviewed, and temporal changes in imaging features were noted.

Results The latest MRI finding was the loss of the standard T1 hyperintensity or loss of the standard T2 hypointensity of fatty marrow in the mandible and maxilla. The MRI findings of more advanced MRONJ included bone destruction, soft tissue edema and enhancement, inferior alveolar nerve thickening, lymphadenopathy enhancement and bone marrow involvement.

Conclusions Osteonecrosis of the mandible and maxilla is a complication of medication treatment of bone metastasis and osteoporosis and typically manifests after a dental procedure. Magnetic resonance imaging findings may precede clinical symptoms. MRI features readily recognise and determine the disease's extent; however, they are not specific.



Frequency of Human Papilloma Virus in Patients With Dry Mouth

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Objectives Aim of this study was to determine the frequency of Human Papilloma Virus (HPV) infection in patients with dry mouth and in autoimmune diseases (Sjögren's syndrome- SS and Bechterew disease-BD).

Methods 74 patients with xerostomia and 32 healthy controls were examined in the frame of Xerostomia Clinic working group. After a 16-question-containing 4-grade (0-1-2-3) survey about the grade of intra- and extraoral sicca symptoms, participants underwent sialometry to assess hyposalivation. Xerostomic patients were then referred to further immunoserological and histopathological examinations towards autoimmune diseases. The 74 patients were divided into 4 groups: 1: xerostomia (n=28), 2: hyposalivation (n=30), 3: Sjögren's syndrome (n=10), 4: Bechterew disease (n=6). To detect oral HPV infection oral mucosal exfoliated cell sample was collected with a cytobrush. Sample processing and detection of HPV-specific sequences was performed at the Institute of Metagenomics, University of Debrecen by HPV16-specific as well as MY/GP consensus nested PCR test. All data were statistically analysed by Spearson's Chi-square test at a significance level of p<0.05.

Results Among the healthy control group 1 individual had HPV16 positivity and 2 patients showed MY/GP positivity among patients who suffered from hyposalivation. In the xerostomia group 3 patients had HPV positivity in GP PCR (identification of HPV genotype in MY/GP and GP positive samples requires further examination by the sequencing of the PCR amplicons), 1 of them carried HPV16. None of the patients suffered from SS and BD showed HPV positivity. No significant difference was found in either group compared to the controls.

Conclusions HPV infection was slightly but not significantly elevated among patients with decreased salivation, but not in patients with SS or BD. There was no evidence of any significant correlation between HPV and dry mouth or SS or BD.



DAPK1 and DCC Hypermeyjylation in Oral Lichen Planus

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Objectives The aim of this study was to investigate the expression of hypermethylated DAPK1 and DCC genes and DAPK/DCC proteins in OLP, comparing them with OL and OSCC in order to evaluate their potential use as predictive biomarkers. Methods DAPK1 and DCC hypermethylation was evaluated in tissue samples from the Department of Oral Medicine/Pathology, School of Dentistry, Aristotle University of Thessaloniki, Greece, including 21 OLPs (Reticular and Erosive forms), 62 OLs (Hyperkeratosis Mild, Moderated/Severe dysplasia), 39 OSCCs (well-differentiated, moderately-differentiated and poorly-differentiated) and 12 normal oral tissues. DNA-hypermethylation was evaluated using bisulfate conversion and Methylation specific PCR-MSP techniques whereas DAPK1/DCC molecules' expression was detected via paraffin immunohistochemical analysis (IHC). Results DAPK1 and DCC hypermethylation was found in 30% and 55% of OLP respectively. All OLP expressed DAPK1 whereas 78% of them expressed DCC molecule.

Significant difference in DAPK1-hypemethylation was found between OLP forms (higher in erosive) (p=0,007) and between OLP and OSCC (higher in OSCC) (p<0,001). The DAPK1 IHC expression was significantly higher in OLP than compared to OSCC and OL with moderated-severe dysplasia (p<0,001, p=0,002 respectively). Regarding DCC-hypermethylation, statistically significant difference was found between OLP and OSCC (p<0,001) (higher in OSCC).

Conclusions DAPK1 and DCC genes are epigenetically inactivated by hypermethylation in most cases of OSCC but not in OL or OLP suggesting a non-premalignant background. Whether this OLP-hypermethylation in specific cases is related with precancerous or cancerous progression needs further investigation. DAPK1 protein is mainly expressed in OLP and less in OSCC or moderated-severe dysplasia OL supporting its tumor suppressive activity in OLP.



An Unusual Form of Epidermolysis Bullosa With Recurrent Oral SCCs

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Objectives This report describes a 61 year old male who presents with recurrent oral squamous cell carcinomas (SCCs) at various sites over five years. The patient has an unique form of autosomal recessive dystrophic epidermolysis bullosa (RDEB) with a rare variant in COL7A1 gene. Cutaneous SCCs in RDEB is well reported however Oral SCCs are less common. The World Health Organisation Collaborating Centre for Oral Cancer regarded Epidermolysis Bullosa (EB) to have limited evidence as an Oral Potentially Malignant Disorder (OPMD). The objective of this study is to highlight the manifestations and challenges in this uniusual form of RDEB in which future development of pathology is uncertain and assess current evidence regarding EB as a OPMD.

Methods This case report evaluates the presentation and management of recurrent Oral SCCs in the patient. A literature review is undertaken to investigate current evidence base of Oral SCCs in patients with EB.

Results The persistent nature of mucosal changes and development of malignancy along with their management is difficult and a challenge to maintain a good oral function and quality of life. Areas exposed to high trauma such as the buccal mucosa and lateral border of the tongue are higher risk areas for development of Oral SCCs. Other case reports of Oral SCCs are limited and most commonly associated with Kindler EB.

Conclusions Cutaneous SCCs are more commonly reported than Oral SCCs in patients with RDEB. Reports of Oral SCC development in patients with EB are small thus the evidence base is still limited in relation to EB as an OPMD. Reporting to a centralised database of Oral SCC cases in patients with EB is required to identify a potential subtype at risk. Also a well designed observational study will ascertain if there is an overall increased risk of Oral SCC compared to the general population. Our case has a unique form of autosomal RDEB where current knowledge regarding its manifestations are limited. The recurrent nature of Oral SCCs potentially indicate an increased risk associated with this particular form however further cases need to be observed to confirm this risk.



Periodontal Bone Loss Detection on Periapical Radiographs by Transformer Networks

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Objectives Neural networks have become commonly applied deep learning-models in dentistry for diagnostic tasks, including the assessment of periodontal bone loss (PBL). Following the emerging breakthrough of transformer networks in computer vision, we aimed to evaluate five models for automatized PBL detection on periapical radiographs. It was hypothesized that an overall diagnostic accuracy of 90% would be achievable with similar diagnostic performances for all transformer networks. **Methods** A set of anonymized periapical radiographs (N=21,819/ training set N=18,819/ test set N=3,000) from upper/lower and anterior/posterior teeth was assessed by calibrated dentists. The applied diagnostic criteria followed the classification of periodontal and peri-implant diseases differentiating between periapical X-rays with healthy periodontium and PBL (mild: <15% PBL of the coronal third, severe: PBL up to and beyond the mid-third of the root). Five (vision) transformer networks (VIT-base/VIT-large from Google, BEIT-base/BEIT-large from Microsoft, DeiT-base from Facebook/Meta) were trained over 5 epochs and evaluated. Accuracy (ACC), sensitivity (SE), specificity (SP), positive/negative predictive value (PPV/NPV) and area under the ROC curve (AUC) were statistically determined. **Results** The overall diagnostic ACC and AUC values ranged from 83,4-85,2% and 0,899-0,918 for all evaluated (vision) transformer

Results The overall diagnostic ACC and AUC values ranged from 83.4-85.2% and 0.899-0.918 for all evaluated (vision) transformer networks, respectively. Differences in diagnostic performance were evident for lower (ACC 94.1-96.7%; AUC 0.944-0.970) and upper anterior (86.7-90.2%; 0.948-0.958) and lower (85.6-87.2%; 0.913-0.937) and upper posterior teeth (78.1-81.0%; 0.851-0.875). **Conclusions** In this study, only minor differences among the tested vision transformer networks were detected. Furthermore, better diagnostic performance was achieved for lower anterior teeth compared to other tooth-groups. To increase the diagnostic performance and to support the clinical use of transformer networks further optimizations are needed.



Objectives The aim of this study was to determine the effect of the root surface air-polishing with erythritol powder on initial adhesion of microorganisms in comparison with hand or ultrasonic instrumentation.

Methods Permanent extracted premolars or molars were divided in 4 groups (n=12): Control (no treatment), Curette (scaling and root planing with hand curettes), Air-polishing (previous calculus removal with ultrasound followed by 15 seconds of root surface air polishing with erythritol) and Ultrasound (30 seconds scaling and root planning using ultrasonic instrument). Treatments were performed by 2 calibrated operators. Teeth were washed twice with saline solution and incubated in a nutrient broth containing a six-species bacterial suspension of periodontal pathogens. After 2 hours, initial biofilm formation was quantified through counting Colony Forming Units (CFU) at a defined surface. In addition, scanning electron microscopy (SEM) was performed. **Results** No differences in CFU counts vs. control were observed for the Curette and Ultrasound groups (p>0.05). Air-polishing group showed less bacterial adhesion (p<0.05) than the untreated control. Findings were confirmed by SEM images.

Conclusions Results indicate that air-polishing with erythritol powder might decrease the reformation of biofilm on the root surface.



STING Activation in Human Gingival Keratinocytes by Bacterial Cyclic Dinucleotides

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Objectives Cyclic dinucleotides mediate the immune responses through the Stimulator of Interferon Genes (STING) pathway. The STING pathway is an essential innate immune signaling that stimulates the TANK-binding kinase 1 (TBK1) and interferon regulatory factors (IRF3). In turn, it stimulates the expression of proinflammatory cytokines by stimulating the transcription of type I interferons and the nuclear factor- κ B. This study aims to demonstrate if the STING pathway is the only stimulated pathway by cyclic dinucleotides to activate TBK1 and IRF3 in human gingival keratinocytes (HMK).

Methods HMK were incubated overnight with 100uM or 10uM of cyclic dinucleotides (C-di-AMP and C-di-GMP) alone or with STING inhibitor H-151 (0.5uM or 5uM). The expression of STING, TBK1, and IRF-3 was detected by western blotting.

Results STING and TBK1 pathway expression markedly decreased when HMK incubated with c-di-AMP or c-di-GMP alone or together with 5 μ M of 151. The level of IRF3 did not show any significant changes when HMK cultured with cyclic dinucleotides or with cyclic dinucleotides and H 151

Conclusions Cyclic dinucleotides activated TBK 1 in HMK depending on STING. On the other hand, IRF3 activation by CDN is regulated by pathways other than STING.



0123 **The Prevalence of β-Lactamase Production by Oral Capnocytophaga Species** <u>A. Algahawi</u>, V. Härkönen, E. Könönen, M. Gursoy Department of Periodontology, Institute of Dentistry, University of Turku, Turku, Finland

Objectives Human *Capnocytophaga* spp. constitute part of the oral microbiota and are considered to be among the key contributors of β-lactamase enzyme production. However, the majority of existing data are obtained from immunocompromised or immunocompetent patients with severe infections and/or periodontitis. Thereby, this study aimed to examine the prevalence of beta-lactamase production by oral *Capnocytophaga* species in a systemically healthy and periodontitis-free population. **Methods** Human oral *Capnocytophaga* isolates (n=691), recovered from plaque and saliva samples obtained from 30 healthy, non-smoking and periodontitis-free Caucasian women, were tested for β-lactamase production using the Nitrocefin disk test (Sigma-

Aldrich, USA) according to the manufacturer's recommendations.

Results Out of 691 *Capnocytophaga* isolates, only 37 (5%) were β-lactamase positive. Of all β-lactamase-producing isolates, *C. ochracea* was the most prominent species (72%), followed by *C. haemolytica* (16%), and *C. sputigena* (10%). At the species level, β-lactamase production was detected in 22% of *C. haemolytica* isolates, 5% of *C. sputigena* isolates, and 4% of *C. ochracea* isolates. **Conclusions** The overall prevalence of β-lactamase production by human oral *Capnocytophaga* spp. seems to be rather low in a systemically healthy and periodontitis-free population. The clinical relevance of species-specific variations and the presence of high β-lactamase activity of *C. haemolytica* remained unclear. Thus, further analyses to determine their role in healthy and diseased periodontium are still warranted.



Gene Expression Profiles in Smokers and non-Smokers With Stage III-IV Periodontitis

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Objectives To profile differential gene expression in heavy smokers and non-smokers with stage III-IV periodontitis. Methods Thirty heavy smokers and 30 non-smokers with stage III or IV periodontitis were, following a full mouth clinical examination and verification of smoking status by serum cotinine levels, included in this cohort study. Blood samples were collected in PAXgene® Blood RNA tubes. Total RNA was isolated by PAXgene® Blood RNA Kits and sample quality verified with spectrophotometry. Sequencing libraries were generated using NEBNext® Ultra[™] RNA Library Prep kit from Illumina®. Following cluster generation, the library preparations were sequenced on an Illumina platform and paired-end reads were generated. FeatureCounts was used to count the read numbers mapped of each gene and reads per kilobase of transcript per million reads mapped (RPKM) was calculated. Differential expression analysis was performed using DESeq2 R package. Genes with an adjusted pvalue less than 0.05 and log2 Fold Change 0.8 were assigned as significant. A network of protein-protein interactions (PPIs) was constructed using STRING Database. Cytocide was used to visualize hub genes and critical modules on the PPI network. **Results** Compared to non-smokers, smokers showed a significant different fold change in 198 regulated genes, 163 up- and 35 downregulated. Genes with greatest transcriptional difference were found to be LINC00599, SEMA6B, GPR15, NXF3, AHRR, GSDMA, LRRN3, AK8, SOX5, ESPNL. These genes are primarily associated with smoking and the regulation of inflammatory processes. Hub genes were mainly genes encoding ribosomal subunits through PPI.

Conclusions Differential gene expressions in heavy smokers and non-smokers demonstrate a modulating effect of smoking on gene expression profiles in patients with severe periodontitis.



0125 Evaluating the Effects of Different Air-Polishing Powders on Different Tooth Surfaces s. yadipour

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Objectives The aim of this study is to evaluate the capability of different air-polishing powders on enamel, enamel-memento junction and root surface of teeth with scanning electron microscopy.

Methods In this study 17 single-rooted human teeth extracted due to advanced periodontal tissue loss was included. The samples were randomly divided into 4 groups, 4 teeth in each three experimental groups and 4 teeth in the control group. Erythritol was applied to the first experimental group, glycine was applied the second, and trehalose powder was applied to the third experimental group. No powder was used in the control group.

In the scanning electron microscope, images of each sample were taken at different magnifications (250x, 500x, 1000x) from 3 different areas, namely the enamel surface, the cementum junction and the root surface. On the SEM the images surface structure, surface roughness and powder accumulation of the tooth surfaces were evaluated with predefined indexes.

The data distribution was evaluated using Kolmogorov-Smirnov test. Normally distributed data were evaluated with one-way ANOVA, and the data not showing normal distribution were

evaluated using the Kruskal-Wallis test. The significance level was accepted as p<0.05.

Results No statistically significant differences were found between the three experimental groups and the control group regarding powder accumulation on the surface. No significant difference was found comparing each of the three experimental groups with the control group, regarding surface roughness. A significant difference was found only comparing glycine and control group on the enamel surface, regarding the hard-soft attachments on the surface,. There was no significant difference between the erythritol and trehalose experimental groups and the control group.

Conclusions The results illustrate that powder accumulation occurred at different rates on different tooth surfaces. Likewise, different powder accumulation rates and surface attachment were observed in different experimental groups, indicating that different powders used in clinical settings have different effects on the tooth surface.



Flavonoids: Broad Spectrum Agents on Resolution of Inflammation and Repair

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Objectives Resolution is typically defined as a regulated process that restores tissue homeostasis and prevents the development of chronic disease. This process is driven by a complex set of mediators that regulate cellular events required to clear inflammatory cells from sites of infection or injury to restore tissue function. There is further immunological activity occurring after the resolution cascade is complete that alters the immune physiology of tissues, redefining what was once termed restorative homeostasis as adapted homeostasis. Fruits contain high levels of phytochemicals that show anti-inflammatory/pro-resolutive effects, but their mechanisms of action have not been completely identified. This work aimed to test the anti-inflammatory/pro-resolutive activities of the citrus flavonoids eriocitrin, eriodyctiol and tangeritin.

Methods It was evaluated the effects of these compounds on the migration and collagen synthesis of murine fibroblasts L929, as well as their ability to promote polarization towards an M2-anti-inflammatory/pro-resolutive phenotype in M1-pro-inflammatory monocyte-derived macrophages. In vivo, mice were supplemented with eriocitrin or tangeritin and subjected to an LPS-induced periodontal disease model to assess the anti-inflammatory, anti-oxidative and pro-resolutive activity of these compounds. Results Eriocitrin decreased the expression of surface markers on M1-macrophage suggesting polarization to the M2 profile. Low concentrations of these compounds improved fibroblast migration in scratch assay and increased collagen synthesis. Moreover, the compounds showed anti-inflammatory and anti-oxidative properties by regulating pro-inflammatory cytokines, leukotriene-B4 production, improving endogenous anti-oxidative defences, and clearing free radicals in gingival tissue of mice subjected to periodontal inflammation.

Conclusions In conclusion, flavonoids showed the ability to regulate oxidative status, inhibit the synthesis of pro-inflammatory mediators, drive macrophages towards a pro-resolutive profile, improve fibroblast migration, and increase collagen synthesis. This indicates that these compounds have the potential to promote the resolution of inflammation and subsequent wound healing.



The Use and Ethics of Dental Photography in South Africa

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Objectives The aim is to determine the use and ethical practice and sharing of dental photography on social media amongst qualified and undergraduate oral health practitioners at a dental school in South Africa.

Methods Data collection and analysis

After capturing the data on REDcap©, the information was downloaded as an excel spreadsheet, anonymized and imported into the STATA software for statistical analysis. Descriptive Statistics (i.e. frequencies, percentages, means, standard deviations) and first-order analysis (i.e., chi-square tests and Fisher's exact test) were performed.

Ethical clearance was sort from the Biomedical Research Council at the University of the Western Cape (UWC), BM22/4/8 and BM22/6/1.

Results There were 126 participants in this study. There were 80 undergraduate students and 46 qualified oral healthcare practitioners. Majority of the participants were aware that photography could be used in dentistry, and 87.3% (n=110) took photographs of the dental treatments performed on their patients. 94.4% (n=119) had a social media account, and there was no difference in qualification status and the creation of a social media account (p=0.72). Almost 98% (97.6%, n=122) of participants were aware that they needed informed consent when taking dental photographs, and there was no difference between graduation status and the awareness of needing this informed consent.

Conclusions Clinical assessment, research, monitoring treatment, patient education and treatment planning were the main reasons why participants took dental photographs. Easy access to social media via your mobile phone can result in mindless and unethical practices in sharing patient data. Care should be taken to ensure that patients' identities are always masked. On a positive note, the majority of our participants reported that they needed informed consent for dental photography, and either get verbal or written consent from their patients before sharing their patients' photographs. Undergraduate training needs to include an ethical course on dental photography and the sharing of dental images on social media.

			Undergraduate	Qualified	p-value
Are you aware that you need informed consent for dental photography?	No	3 (2.4)	1 (33.3)	2 (66.6)	0.5545
	Yes	122 (97.6)	78 (63.9)	44 (36.1)	
Do you need informed consent from	No	1 (0.8)	1 (100.0)	0 (0)	1.000
patients when using their photographs on social media?	Yes	124 (99.2)	78 (62.9)	46 (37.1)	
	Verbal	22 (17.6)	19 (86.4)	3 (13.6)	-
	Written	101 (80.8)	59 (58.4)	42 (41.6)	
What type of consent is needed?	Other	2 (1.6)	1 (50.0)	1 (50.0)	0.045*
Do you maintain patient confidentiality when presenting patient photographs?	Yes	121 (96.0)	76 (62.8)	45 (37.2)	0.434
	No	5 (4.0)	4 (80.0)	1 (20.0)	
Do you think that your method of maintaining confidentiality is sufficient?	No	14 (11.1)	11 (78.6)	3 (21.4)	
	Yes	112 (88.9)	69 (61.6)	43 (38.4)	0.254
Have you heard of the POPI act?	No	8 (6.4)	4 (50.0)	4 (50.0)	
	Yes	117 (93.6)	76 (64.9)	41 (35.1)	0.457
When obtaining consent, do you have to mention all forms of SM that you are going to use?	No	26 (20.6)	17 (65.4)	9 (34.6)	0.822
	Yes	100 (79.4)	63 (63.0)	37 (37.0)	
Do you state that the patient consented to posting their picture on SM?	No	29 (23.0)	18 (62.1)	11 (37.9)	0.856
	Yes	97 (77.0)	62 (63.9)	35 (36.1)	
Have you shared a patient photograph/gray, on SM platform?	No	65 (51.6)	39 (60.0)	26 (40.0)	0.401
	Yes	61 (48.4)	41 (67.2)	20 (32.8)	
	TikTok	3 (2.38)	3 (100.0)	0(0)	
	Instagra m	40 (31.8)	33 (82.5)	7 (17.5)	
	Twitter	2 (1.6)	2 (100.0)	0(0)	
	Faceboo k	8 (6.4)	2 (25.0)	6 (75.0)	
Which platform did you use to share the photograph/crav?	Whatsap	59 (46.8)	40 (67.8)	19 (32.2)	
	Snapchat	3 (2.4)	3 (100.0)	0(0)	
	Other	40 (31.8)	22 (55.0)	18 (45.0)	

Table 4: Ethical characteristics of the study sample +

Ethical characteristics of the study sample



Socio-Ethical Parameters in Denta School Students

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Objectives The present social research aimed to describe parameters regarding the choice of Dentistry, the principles of the dentistpatient relationship (chair-side manners) and the health profession ethics (deontology) **o**f students at Dental School, Aristotle University of Thessaloniki, Greece.

Methods The study was consisted of questionnaire submitted by Google Form link. Nonparametric Mann-Whitney U test was applied for statistics.

Results The students decided Dentistry aiming to obtain feelings of peace, internal balance, and satisfaction. This was more obvious in students declared as unrelated to religion (p=0.022). The second most frequent choice was based on the concept of altruism as seen mainly in students declared as having religious beliefs (p=0.01). Regarding to doctor-patient relationship the students considered as most important the feelings of respect, dignity, and sense of responsibility, not-related to personal characteristics of patients (social-economic-religious). This was more common in students with religious beliefs (p=0.028). Overall, the religious influence in the chair-side manners was not significantly important as supported mainly by male students (p=0.018). In regard to the health profession ethics (deontology) the students considered as most important the respect to the rules as well as the sense of care towards patients. **Conclusions** Current social-economic and ethical needs suggest a role of additional studies in human-centered management of the physician-patient relationship, for the improvement of the dental praxis. Beyond scientific (hard) skills in dentistry, the training of students in the quality of their relationship with patients (bed-side manners) (soft skills) is missing link for professional success.



Objectives The determination of research trends in the academic field is important to define and follow the existing situation and to create new research strategies. The aim of this study is to evaluate the research trends in the field of dentistry through scientific databases regarding the 'general dentistry' and 'dental hygiene' topics.

Methods The searches and analyses were performed using SciVal (Elsevier) and InCites (Web of Science Core Collection) databases in the period of 2017-2021 including subject title, sub-topic, scientific journals, the classes of journals, the impact values, the number of publications and citations in general world.

Results The most studied subjects in general world were determined as; tooth-bone-dentin (53.568), oral health-periodontitis-dental caries (24.808), orthodontics-malocclusion-temporamandibular joint (16.130), cleft lip/palate-craniocytosis (7.761) and mandibular fractures-orbital fracture-injuries (3.577). The most used keywords in the general dentistry were obtained as respectively; teeth (19.616), dental caries (6.062) and oral health (5.561). The most active resources in the field of general dentistry were; British Dental Journal (3.647), Clinical Oral Investigations (2.229), BMC Oral Health (1.695), Journal of the American Dental Association (1.539) and Journal of Endodontics (1.388). The most used keywords for dental hygiene were obtained as respectively; teeth (196), dental caries (154) and mouth (135). The most active resources in the field of dental hygiene were; Oral Health & Preventive Dentistry (443), Journal of Preventive and Treatment for Stomatological Diseases (141), European Endodontic Journal (12).

Conclusions It is noteworthy that dental caries is still one of the most studied specific areas as a result of the analyzes performed for both the world and the selected topics. The active sources also vary in accordance with the topics.



Objectives Malocclusions, along with caries and periodontitis, are among the most common oral health impairments. Epidemiological studies have drawn attention to the association of malocclusions and dental caries, which was also confirmed in a meta-analysis. What is unclear is the direction of this association. Therefore, the aim of this study was to systematically generate hypotheses for both causal directions and test them tentatively with cross-sectional data.

Methods For this question, data from an oral epidemiological study, the 6th German Oral Health Study (DMS 6), were analyzed. 1,892 individuals from the 2011 and 2012 birth cohorts were invited to participate in the study. A disproportionally stratified probability sample yielded 705 study participants with their respective data on malocclusions and oral health. For the most prevalent malocclusions hypotheses were generated for both causal directions of the malocclusion-caries link. Each hypothesis was then tested with adequate associational statistical methods.

Results Clinically relevant malocclusions with a prevalence of at least 10% were investigated: Mandibular recession, deep bite, crowding, and lack of space. These are related to approximal caries of the supporting zones (canines, both deciduous molars, and six-year molars) with different associational strength.

Conclusions Etiopathogenetically, both directions are conceivable: malocclusions can act as a risk factor for the development of caries and vice versa. The results of this study are hypothesis-generating because they were cross-sectional. The hypotheses can serve as a basis for longitudinal epidemiological follow-up studies and thus have preventive potential in translational research.



0234 **The MoBaTooth Biobank: a Resource for Investigating Early-Life Exposures** S. S. Jensen, <u>M. Bratteberg</u>, K. S. Klock Department of Clinical Dentistry, University of Bergen, Bergen, Norway

Objectives The Norwegian Mother, Father and Child Cohort Study (MoBa) is a longitudinal, population-based cohort study that has enrolled over 100.000 pregnancies and continues to monitor the children as they grow, using questionnaires and biological sample collection. The cohort includes approximately 114.500 children, 95.200 mothers and 75.200 fathers. MoBa's primary goal is to explore specific etiological hypotheses by quantifying the relationships between exposures and diseases, ultimately contributing to preventive strategies. The MoBaTooth Biobank, a repository for exfoliated primary teeth, has emerged as a powerful tool for gaining insights into toxic and essential element exposures during fetal life and early infancy. The overall goal with the MoBa-study is to determine specific etiological hypotheses by investigating the correlation between exposure and disease, with the aim of prevention.

Methods In fetal-and early life there are critical windows of susceptibility, periods when exposures to specific toxicants have a greater effect on a health outcome compared to other periods of development. Toxic and essential trace elements from the child's environment and nutrition are built into the dental tissue as the teeth are formed. Deciduous teeth present an opportunity to assess retrospective early-life exposures to toxicants in a highly temporally resolved manner in a noninvasive sample during sensitive developmental windows. Analyzing the primary teeth using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) can reveal the presence and amount of these trace elements as well as time of exposure, which is valuable for investigating the correlation between exposure and disease.

Results By integrating tooth analysis results with corresponding questionnaire data and other biological samples, the MoBaTooth Biobank offers an unparalleled opportunity to delve into the role of trace elements during critical developmental periods. The biobank stores 35.830 primary teeth which make it the world's largest biobank consisting of primary teeth connected to mother, father and child data.

Conclusions As a comprehensive and continually growing resource, the MoBaTooth Biobank represents a pivotal asset for future research aimed at uncovering the causal factors that influence health and disease.



Enamel Remineralization - a Comparative in Situ and in Vitro Study

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Objectives Aim was to evaluate the comparability of *in situ* (iS) and *in vitro* (iV) study protocols regarding remineralization of artificial enamel lesions.

Methods The study was approved by the corresponding ethics committee.

The differentiability for remineralization of the lesions (60-80µm) between two toothpastes (placebo 0ppm F-, 1450ppm F- of sodium fluoride, blinded during study conduct) was investigated iV and iS.

iV, a pH-cycling model was applied for 10d with daily 5x15min demineralization (pH4.8) and 2x6min toothpaste slurry treatment (1:2 toothpaste:remineralization solution (RS) w/w). In between demineralization and toothpaste treatment, samples were stored in RS (pH7).

iS remineralization was realized by subjects wearing dental appliances with embedded enamel samples for 21d. Samples were brushed with the toothpastes 2x2min daily. After 10d, selected samples were measured to obtain results from this time point. Samples were scanned with an X-ray computed tomography (μ CT) system (Nanomex 180NF, Phoenix). Grayscale value line profiles corresponding to mineral density were taken from de- and remineralized regions. The area between the profiles and the maximum grayscale value of the respective sound enamel was determined to quantify the remineralization effect (relative difference of the areas (rel. Δ Z)). Statistical analyses were done by t-tests (p<0.05).

Results Rel. ΔZ (mean+sd) of fluoride treated samples was comparable (p=0.50) iV after 10d (40.2%±18.3) to iS after 21d (46.1%±13.6). Placebo toothpaste led iS (10d: 25.2%±16.9; 21d 22.7%±10.3) to a significantly (p<0.05) higher remineralization than iV (-6.2%±19). The remineralization capability of both toothpastes could be differentiated significantly for both procedures (iS: p=0.009; iV: p=0.001). iS, higher rel. ΔZ was observed for fluoride toothpaste after 21d compared to 10d (11.5%±18.8) but not for the placebo.

Conclusions Although there are different study protocols, μ CT results revealed a reasonable correlation between iS and iV remineralization, possibly suggesting that selected iS studies can be replaced by iV studies.



Enamel Surface Remineralisation Enhancement With Peptide Gels

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Objectives The aim of this study is to investigate the remineralisation effect of gels on human enamel samples affected by micro abrasions and acid erosion's.

Methods 40 extracted teeth were divided in four groups, one as control (C) and three treated with three remineralisations gels, one commercial GC Tooth Mousse (TM) and two experimentals based on peptides (P1 with K3014 - Anticorp anti-kalikreină L1, peptide; P2 with ABT260 - Anti-Amelogenin, X isoform, peptide). The gels were applied on the enamel surfaces for 20 days, 30 min/day and then immersed in artificial saliva at 37°C. The general morphologic aspect was investigated by SEM microscopy and the specific details such as fine microstructure and nanostructure was investigated by AFM monitoring the surface roughness. The samples were also investigated by FTIR-ATR to evidence the remineralisation effect on the enamel surface.

Results Results show that all initial samples have an altered state with micro-abrasions and erosion with mineral loss. Remineralisation treatment with GC Tooth Mousse partially restores the enamel by significant decreasing of the surface roughness and local remineralization but do not get the parameters of the healthy enamel. Good results were obtained for the surfaces treated with P1 and P2. Peptides have the potential to promote remineralization of enamel lesions in depth, not just on the surface. Fact is sustained by the presence of new formed fluorides in the FTIR-ATR spectra. The P1 and P2 restore the enamel in an enhanced manner by a roughness decreasing to values comparable. This is due to an extended re-mineralization abundant in fluoride crystals as observed by AFM and FTIR.

Conclusions The use of peptides as an effective strategy in restoring the dental structure of the damaged enamel is a very promising approach.



Incorporation of Zinc Element in Suspended Collagen and Whole Dentin

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Objectives To investigate incorporation of the zinc element in collagen by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and zinc test (Spectroquant, Merck). In addition, the release of zinc after different filling therapies on extracted teeth by ICP-MS was analysed.

Methods Suspended collagen type I (10 mg/mL) was exposed to different concentrations of zinc chloride solutions (3, 6 and 9 mM) and mixed with sterile saliva and Caredyne (control, 24 hrs, 8°C). Samples were washed, vortexed and centrifuged (3x), supernatants spectrophotometrically determined by zinc test (Spectroquant, Merck). Once zinc elements were undetectable, the remaining pellets were sent to ICP-MS for additional zinc analysis. Protein determination (BCA Protein Assay Kit, Thermo Scientific) was performed on all supernatants verifying any protein lost. Twelve carious teeth were cleaved, restored (Caredyne, Fuji, Centi-Forte, Ketac) and investigated with ICP-MS.

Results After final washing, the amount of protein was similar in all supernatants (0.1 mg/mL). Dissolved zinc increased in saliva (0.5 - $0.9 \pm 0.2 \text{ mg/L}$) and in combination with Caredyne (1.8 $\pm 0.2 \text{ mg/L}$), apart from ZnCl₂. Collagen (ref) in Millie Q water (0 mg/L). ICP-MS analysis of zinc in centrifuged material increased with exposed concentrations of ZnCl₂ (3-9 mM; mean 1.3 $\pm 0.3 \mu$ g/g protein). Adding saliva increased the amount of zinc (2500 $\pm 600 \mu$ g/g protein). Whereas collagen in Caredyne and the Caredyne product itself resulted in 5670 ± 800 and 44,600 $\pm 600 \mu$ g/g protein.

From the restored tooth samples by ICP-MS, the zinc content, after normalisation to 50% of all elements, resulted in 45,000 ppm for Caredyne; 25 ppm for Ketac; 15 ppm for Centiforte and 10 ppm for Fuji.

Conclusions Suspended collagen is a poor absorbent of zinc. However, it increases in suspension with saliva and Caredyne. It is mainly released from the material in comparison with other tested restoratives.



Effect of Bioactive Materials on Enamel Susceptibility to Erosion

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Objectives The purpose of the study was to investigate the protective effect of three in-office preventive treatments with bioactive materials against enamel erosion induced by artificial gastric juice similar to that found in gastroesophageal reflux disease (GERD) patients. The treatments included air-abrasion of enamel with a fluoride-containing bioactive glass (BioMinF®), Bioglass 4555 (ProSylc) and nano-hydroxyapatite (MI Pearls) to test enamel susceptibility following an erosive challenge.

Methods Enamel surface loss was evaluated using confocal microscopy, while changes in enamel surface roughness and morphology were also investigated after the treatments. SEM and EDS were used to observe formation of apatite crystals on enamel and to detect alterations in mineral composition. In Group 1 (negative control) the specimens did not receive any treatment; Group 2 specimens (positive control) treated with 0.4% SnF₂, while in Groups 3-5 enamel was air-abraded with BioMinF®, ProSylc and MI Pearls, respectively.

Results All the experimental groups reduced significantly enamel surface loss compared to the negative control group (p<0.05), except for the MI Pearls treatment (p>0.05). The most protective behavior against erosion presented the treatment with SnF₂. BioMinF induced the larger amount of apatite crystals on the enamel surface, followed by ProSylc.

Conclusions BioMinF and ProSylc treatments may be beneficial against dental erosion induced by gastric juice in GERD patients, while MI Pearls treatment may not suitable for this indication. Both materials promote formation of apatite crystals on enamel in acidic conditions protecting the surface from the erosion. The tested treatments may be useful in GERD patients who cannot comply with at-home therapies with SnF₂.



Effects of Bioactive Materials on Dentin Protease Activity

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Objectives To investigate whether different bioactive and calcium silicate-based materials would affect the integrity of coronal dentin. **Methods** Dentin beams (0.3×3×7mm) were demineralized in 0.5 M ethylenediaminetetraacetic acid (EDTA) for 2 h at 4°C using a rotator and rinsed in distilled water at 4 °C for 2 h. Dentin beams were dehydrated for 72 hours. After baseline measurements of dry mass, beams were divided into 5 groups (n=10/group). The material blocks (1×3×7mm) were prepared from four bioactive materials; (1)Bio-C Repair, (2)S-PRG-sealer (3)Orbis MTA, (4)Theracal, and were put in contact with the occlusal surface of the dentin beams with a "sandwich technique". The untreated beams served as control. Specimens were placed in 0.5 ml artificial saliva and incubated in a water-shaking bath at 37°C with 60 rpm speed for 24h, 1 week and 3 weeks. After each time point, dry mass of beams were measured and aliquots of incubation media were analyzed for the peptide fragment degraded by cathepsin K (CTX) and hydroxyproline (HYP) to assess the amount of collagen degradation. Data were analyzed by repeated measures ANOVA (α =0.05). **Results** The loss of dry mass was significantly different among test groups (p<0.05). Bio-C Repair showed the highest dry mass loss at 37.86% after 3 weeks. HYP release followed same trend and showed highest HYP at Bio-C Repair compared to all other groups. The amount of CTX telopeptides release decreased significantly for all treatment groups after 3 weeks (0.11 – 18.11 pg/ml) while continued to increase in untreated control group (23.60 – 57.40 pg/ml) (p<0.05).

Conclusions The results of this study indicate that most of the bioactive and calcium silicate-based materials tested in this study are good inhibitors of cathepsin K activity in dentin, therefore preventing enzymatic dentin degradation.



Structural Pathobiology of Cervical Wear by Robot-Simulated 3-Year Toothbrushing

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Objectives Occlusal wear is a natural phenomenon, the lifetime cervical wear is, in contrast, a risk for dentin hypersensitivity and hard tissue loss. An ex-vivo study was aimed at (i) identifying enamel/dentin loss from regular toothbrushing, (ii) improvement of cervical conditions contributing to oral health by (iii) comparing manual toothbrush with flexible ball joint versus conventional toothbrush. **Methods** Following ethical approval of using human bio-materials EC-UWH-SR-67-2021 random toothbrushing (44 strokes/tooth horizontally, rotating, vertically. 2x/d) with MTBs Rapid Relief Soft with flexible ball joint neck versus regular Jubilee Soft and dentifrice Sensodyne Extra-fresh (Haleon, Weybridge, UK) was performed in Artificial Oral Cavity with robot force 3.5 N on 2x7 human extracted teeth (2 incisors, canine, 2 premolars, 2 molars: juvenile, adult, senior teeth in anatomic position).

Morphological features of enamel, dentin, cementum were examined by SEM using replication technique (*LEO-1450, Zeiss*). 3D-SEM analyses were carried out with a 4Q-BSE detector (*SEM-515, Philips; Point Electronic, Halle*). Wilcoxon-Mann-Whitney-test was used for statistical analyses of morphological feature coding.

Results Morphological feature coding 0 - 3 revealed four enamel patterns (abrasion marks, perikymata, prismless/prismatic, infractions), one dentin (open tubules) and three cervical patterns (calculus, overlapping cementum or enamel, gaps, enamel islands) in 3-year random toothbrushing. Masked isolated enamel islands on root dentin were first time documented. Adverse impacts: Removal of superficial prismless enamel, further enamel/dentin loss. Positive impact: Removing hidden calculus, smoothing [KW1] traumatic, iatrogenic damages.

On average, 53.5nl less tooth structure was removed by Rapid-Relief-MTB (24-50nl) versus Jubilee-MTB (41-188nl). Adolescent teeth – no/negligible wear, young adult teeth – cementum wear undermining enamel, adult teeth – wear extending apically 100 – 1500 micrometers.

Conclusions SEM and 3D-SEM elucidate negative as well as beneficial oral health-contributing micromorphology patterns of simulated 3-year random toothbrushing.

Ball joint neck flexibility of toothbrushes contributes to less damaging cervical wear compared to rigid toothbrushes in this ex-vivo model.



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Objectives The treatment options of dental fluorosis varied which can be bleaching, microabrasion, macroabrasion, resin infiltration, veneer or crown depending on the depth and size of the lesion. The purpose of this study was to report the treatment option and outcome of a 23-year-old Thai women who came to the Special Dental Clinic of Khon Kaen University with white opaque diffused lesion on labial surface of upper and lower teeth. Classification of this dental fluorosis is mild according to Dean's index.

Methods The patient had regularly received a professional fluoride application since she was young. After she had completed the orthodontic treatment, she had been treated dental fluorosis with long-term applying casein phosphopeptide-amorphous calcium phosphate paste but the result was not satisfied. Therefore, resin infiltration combination with macroabrasion was selected to correct the lesion on anterior and premolar area. First, the lesion was applied with 15% hydrochloric acid gel for 2 minutes. After the gel was washed away for 30s, the lesion was desiccated by application of ethanol for 30s. The white opaque lesion was polished with fined diamond disc. Finally, application of resin infiltrant was performed for 3 minutes followed by the second coat of the same material for 1-minute with light polymerization in each layer.

Results After all the treatment, patient's teeth showed better harmonized tooth color without tooth hypersensitivity. The opaque area was removed almost undetectably, which satisfied the patient.

Conclusions The treatment of dental fluorosis should start with the most conservative option if it cannot be correct the lesion, another option will be considered. Thus, communication between dentist and patient plays the most significant part in the treatment selection. Nevertheless, long-term follow-up after treatment is also necessary.



The teeth showed white opaque diffused lesion on labial surface.





After the treatment, the white opaque lesion was removed.


Detection of Proximal Caries Using NIRR From 1050 to 1550nm

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Objectives This in vitro study aimed to evaluate the diagnostic potential of near-infrared reflection at 1050 (NIRR₁₀₅₀), 1200 (NIRR₁₂₀₀), 1300 (NIRR₁₃₀₀) and 1550nm (NIRR₁₅₅₀) for proximal caries detection in permanent posterior teeth. The findings were validated by micro-computed tomography.

Methods A total of 250 healthy and decayed permanent human teeth were arranged in pairs, examined with bitewing radiography (BWR) and using NIRR with wavelengths of 1050 to 1550nm. Findings in the NIRR images were evaluated using a yes/no decision depending on the presence of caries lesions. Two examiners evaluated all findings twice. Reliability assessments included kappa statistics and revealed a high agreement level for all methods. Statistical analysis included cross-tabulation and calculation of sensitivity, specificity and AUC values.

Results Overestimation of proximal caries was 2.00% for NIRR₁₀₅₀, 7.60% for NIRR₁₂₀₀, 8.00% for NIRR₁₃₀₀, 20.00% for NIRR₁₅₅₀ and 0.40% for BWR. Whereas an underestimation was 18.80% for NIRR₁₀₅₀, 16.40%, for NIRR₁₂₀₀, 14.40%, for NIRR₁₃₀₀, 8.80% for NIRR₁₅₅₀ and 25.81% for BWR. Overall accuracy was 79.20% for NIRR₁₀₅₀, 76.00% for NIRR₁₂₀₀, 77.60% for NIRR₁₃₀₀, 71.20 % for NIRR₁₅₅₀ and 73.79% for BWR.

Sensitivity values for proximal caries detection were 48.91% for NIRR₁₀₅₀, 55.43% for NIRR₁₂₀₀, 60.87% for NIRR₁₃₀₀ and 76.09% for NIRR₁₅₅₀. Specificity values were 96.84% for NIRR₁₀₅₀, 87.97% for NIRR₁₂₀₀, 87.34% for NIRR₁₃₀₀ and 68.35% for NIRR₁₅₅₀. BWR exhibited 29.67% sensitivity, but 99.36% specificity.

Conclusions For proximal caries detection by NIRR, wavelengths above 1000nm showed significantly higher sensitivity values than near-infrared wavelengths below 1000nm. With increasing wavelength, sensitivity values increased while specificity values decreased.



Caries Detection in Anterior Teeth Using Lateral NIRT at 1300nm

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Objectives The aim of this in vitro study was to assess lateral near-infrared transillumination at 1300 nm (NIRT1300) for proximal caries detection in permanent anterior human teeth and to compare it with direct proximal visual inspection using ICDAS and digital bitewing radiography (BWR).

Methods Eighteen extracted permanent anterior teeth with sound or carious proximal surfaces were visually assembled and assessed using ICDAS in direct view, BWR and NIRT1300. The NIRT1300 was passed through the samples in a horizontal direction. Corresponding proximal surfaces were assessed from the lingual and buccal sides one time by two examiners. Two examiners each assessed the surfaces in one session based on yes/no decisions regarding the presence of carious lesions for BWR and NIRT1300. Micro-computed tomography served as reference standard. Statistical analysis included cross-tabulation and calculation of overall accuracy, sensitivity and specificity.

Results A total of 32 filling-free proximal surfaces in 18 anterior teeth were assessed. These surfaces were 15.63% sound (code 0), 53.13% had signs of initial or established lesions (codes 1 and 2) and 31.25% had cavitations according to ICDAS. The overall accuracy was 65.63% for BWR, 71.88% for ICDAS and 84.38 % for NIRT1300. Underestimation of caries was 34.38% for BWR and 9.38% for NIRT1300. There was no overestimation of caries according to BWR, while NIRT1300 exhibited 6.25%. Sensitivity values were 38.89% for BWR and 83.33% for NIRT1300. Both methods revealed high specificity, with 100% for BWR and 85.71% for NIRT1300.

Conclusions Lateral NIRT1300 revealed comparable or higher diagnostic results than ICDAS and BWR for proximal caries detection. Lateral transillumination of the anterior dentition seems to be a promising new methodology to complement visual inspection and BWR as diagnostic instrument.



Three-Dimensional (3D) Morphological Properties of Local Cementocellular Networks

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Objectives Our workgroup developed a custom made true 3D light microscopic investigating system, including the so called "stereoconverter", that is able to increase the magnification of the traditional microscope by 5-fold without decreasing its depth of field. It opens up completely new horizons towards transparent, true 3D qualitative and quantitative microscopic study of the cementum.

Methods Extracted human teeth were prepared to produce native or decalcified, 0.5-2 mm thick, axial and horizontal sections and were cleared in triethanolamine solution. The cementum was investigated by our spatial examination system. The stereophoto pairs were investigated in our 3D stereophotogrammetrical measuring system and documented with anaglyph 3D pictures. **Results** Locally connected cellular networks, especially wreath-like systems are frequently found in the cementum. Some of the networks from near the surface pass through the whole thickness of the cementum. The cementocyte processes are predominantly centrifugally directed toward the cementum surface rather than toward the dentin. Adjacent cellular bodies are apparently connected to each other by 1-3 continuous common bridge-like plasma processes. On the free end of most of the processes button-like thickenings can be observed. Some of the cementocytes are surprisingly similar to glial cells, others to pyramidal cells of the central nervous system.

Conclusions The spatial investigation of cementocyte complexes by true 3D topographic light microscopy leads to a new approach to spatial cognition of network architectures. The widespread communication networks of cementocytes can provide the functional basis of their supposed mechanosensing, homeostasis and mineral metabolism regulator functions. What could be the reason for the morphological similarity between many dental root cementum cells and neuronal cells? One possibility is their common developmental ectodermal origin. However, "no shape in nature exists by chance" the common functional background of this morphological similarity still remains to be deciphered.



Objectives To evaluate the instant optical whitening effect of a chewing-gum containing E132 (Indigotine) vs. a chewing-gum placebo after 2'30"

Methods This was a single-center double-blind randomized parallel trial. To enter the trial, participants were required to have all their superior incisor teeth without restorations, no oral or systemic diseases, and no removable dentures. The 212 eligible participants, after a dental impression procedure, received a silicone mask with a calibrated hole at one upper incisor to apply a colorimeter (Vita[®] Easyshade). They had to avoid oral hygiene for two hours before the appointment. The test chewing-gum (1.5g/piece) was added with 200ppm of E132, the placebo one was identical without pigments. The color of the teeth was detected before and after the mastication of one piece of chewing-gum for 2'30" with the colorimeter and the Δ WIO and Δ WI_D whiteness indexes were calculated as differences pre-post treatment. Statistical analysis was performed intragroup with the paired T-Test and between the groups with ANOVA. This trial was approved by the Ethical Committee (U.S.IRB2022PVM/01)

Results All the participants completed the study, 119 females and 93 males (mean age 31.3 ± 10.8). In the test group, the WIO and WI_D differences pre-post treatment (Δ WIO=1.85±3.49; Δ WI_D=1.13±1.58) were statistically significant (p≤0.001), instead in the placebo group they were not (p=NS). Both the Δ WIO and Δ WI_D after 2'30" were statistically different between the two chewing gums (p≤0.001). The acceptance was high, and none reported problems or side effects

Conclusions This study suggests that the mastication of a chewing-gum containing solely E132 results in a perceptible whitening optical effect



Caries Experience in Subjects With dry Mouth-Related Conditions

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Objectives To assess whether having Sicca syndrome and Sjogren's syndrome in addition to xerostomia is associated with higher caries experience.

Methods The sample included data from two datasets: 328 subjects were identified during Lithuanian National survey, and 127 participants were included from 5 hospitals in Vilnius, Lithuania. The same methodology was used to collect data for both datasets, and the inclusion criterion was self-reported dry mouth. Data were collected via the World Health Organization (WHO) Questionnaire for Adults supplemented with questions asking frequency of dry mouth, dry eye-related questions, and systemic diseases. Participants were through clinical examination, which included caries status assessment. The Whole unstimulated sialometry and Schirmer's test were performed for participants with dry eyes to confirm the Sicca syndrome. For statistical analyses, participants with xerostomia were divided into three frequency groups: experiencing dry mouth 'sometimes', 'often', and 'always'. Sicca syndrome group consisted of participants with salivary flow \leq 1.5 ml/15 min together with tear flow \leq 5mm/5min, and Sjogren's syndrome group was comprised of those who had self-reported Sjogren's syndrome. Independent Samples Kruskal Wallis Test and Mann Whitney Test were used for statistical analysis.

Results Out of 455 participants, 76% (348) were females. More than half of participants (258, 57%) experienced xerostomia sometimes, 27% (123) often, and 16% (74) had it always. The Sicca syndrome was diagnosed for 8% (35), and 6% (29) had Sjogren's syndrome. The median DMFS score in those who had xerostomia 'sometimes' was 66 (IQR13), often 74 (IQR19), and always 84 (IQR19), p=0.001. The DMFS score differed significantly between those with additional Sicca syndrome and not, with median scores 97 (IQR28), and 70 (IQR10), respectively, p=0.001.

Conclusions Participants with a higher frequency of xerostomia had higher caries experience. Having Sicca syndrome in addition to xerostomia associated with higher DMFS scores, although additional Sjogren's syndrome was not associated with it.



Objectives This case series aimed to present different clinical applications of Mineral-Trioxide-Aggregate (MTA) in four children aged 6-12.

Methods Case-1 was an 11-year-old boy who applied to our clinic one day after the trauma with a complicated-crown fracture in tooth #11. The dentine has been sealed with glass-ionomer-cement (GIC). After removal of GIC, the color of the pulp could be seen. The coronal pulp was removed. The cavity was rinsed with sterile-saline and 2.5%-sodium-hypochlorite (NaOCI). MTA, GIC, and composite-resin-restoration were placed for the coronal pulpotomy procedure.

Case-2 was a 12-year-old boy who applied to our clinic with spontaneous pain in tooth #21. #21 had been treated with regenerative endodontic treatment (RET) after extrusive luxation 4-years ago. After the removal of MTA, the canal was irrigated with 2.5%-NaOCl, sterile-saline, and 17%-ethylenediaminetetraacetic-acid solution (EDTA). Calcium-hydroxide (CaOH₂) was used for intracanal medicament. When the tooth is symptom free root-canal was obturated with MTA. Then GIC and composite-resin-restoration used for restoration.

Case-3 was an 11-year-old boy with deep dentin caries in immature tooth #46 with sensitivity to vertical percussion. Caries and coronal pulp was removed, the cavity was rinsed with sterile-saline and 2.5%-NaOCI. MTA, GIC, and composite-resin-restoration were placed for the pulpotomy procedure.

Case-4 was a 6-year-old girl with an abscess in immature tooth #36. The root-canal was irrigated with 2.5%-NaOCI, sterile-saline, and %17-EDTA. Ca(OH)₂ was applied for dressing. After 3-weeks, the root-canal was irrigated with %17-EDTA. The apical bleeding was achieved over-instrumentation with a sterile file. After filling the entire canal with blood to the level of cement-enamel-junction, MTA, GIC, and composite-resin-restoration were placed.

Results Recalls were made at 1st, 3rd, 6th, and 12th months. No signs or symptoms of the pulpal disease were observed in all cases. **Conclusions** MTA could be a successful alternative material for pulpotomy, apexification, and RET in children.



Intraosseous Anesthesia in Pediatric Dentistry: Split-Mouth Randomized Clinical Trial.

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Objectives To compare the efficacy, acceptance and preference of an intraosseous anesthesia method, delivered by an electronic controlled delivery system, to conventional local anesthesia for pediatric dental patients.

Methods 45 healthy children aged 5-9 years old requiring similar treatment in both sides of the upper or the lower jaw were recruited in the Pediatric Dentistry Department of Dental School of Aristotle University of Thessaloniki, Greece, and randomized with splitmouth design to intraosseous anesthesia with Quicksleeper 5[®] (Dental HiTec, Gronau, Germany) on one side and conventional anesthesia to the other side, with one week between them. Both the side and the order of administration were randomly assigned. One pediatric dentist performed both methods and data collection. Children were asked questions to assess their acceptance/preference for the two methods. Data were analyzed statistically with linear/logistic regressions at alpha=5%. **Results** Both techniques demonstrated clinical efficacy. While assessing the acceptance, intraosseous anesthesia was associated with significantly less discomfort at insertion (Odds Ratio [OR]=0.35; 95% Confidence Interval [CI]=0.16-0.74), at injection (OR=0.10; 95% CI=0.04-0.29), reported discomfort/pain after application (OR=0.07; 95% CI=0.02-0.19), and less fear (OR=0.38; 95% CI=0.17-0.85) compared to the conventional method (P<0.05 in all instances). Intraosseous anesthesia was associated with longer anesthesia administration (+2.80 minutes; 95% CI=1.57 to 4.03 minutes) and less numbness (-1.9 hours; 95% CI=-2.0 to -1.7 hours) (P<0.001 for both). However, intraosseous anesthesia was associated more often with bad taste, strange feeling of the tooth, and bruising, but with less soft-tissue trauma or need for additional anesthesia. Both techniques presented similar results for pain intensity (P=0.58) and painkiller use (P=0.34). Most patients preferred the intraosseous (78%) than the conventional (22%) anesthesia method (OR=3.50; 95% CI=1.72-7.12; P=0.001).

Conclusions Both techniques were similarly efficacious. Intraosseous method was associated with longer anesthesia delivery and less numbness, demonstrated higher acceptance and was preferred by more children compared to the conventional method.



Objectives Jacobsen Syndrome is a rare genetic disorder associated with deletion of 11th chromosome at q23.3 and causing multiple abnormalities with mental retardation. The incidence of the syndrome is 1/100,000 with a ratio of for 2:1 female/male. Pre and postnatal growth retardation, microcephaly, V shaped mouth, retrognathia, low set ears, congenital heart disease and thrombocytopenia are some of the characteristics of the syndrome.

This case report aims to present oral findings and dental management of a 13-year-old patient with Jacobsen Syndrome. **Methods** A girl was born in 2009 as the second child of healthy parents. We report on this patient with mental retardation and hirsutism. According to analysis of cytogenetic, the patient's disorder's karyotype is determined as 46,XX,del(11)(q23.3q24.3). The extraoral clinical examination indicates V shaped mouth of the patient. Intraoral findings: hyperplastic gingiva, localized gingivitis and one decayed tooth. Restoration of the tooth was performed. Non-surgical periodontal treatment was done. The patient is under regular control.

Results Cases of Jacobsen syndrome are rare in the literature and evaluation of oral health for these children has never been reported before. In this case, oral manifestations and dental treatment of a 13-year-old patient with Jacobsen syndrome is reported. **Conclusions** Jacobsen Syndrome is a rare genetic disorder with various symptoms including oral findings.



Monomer Conversion of Orthodontic Adhesive Under Brackets of Various Kinds

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Objectives The aim of this study was to investigate light transmission through brackets with various filler and material compositions and the degree of cure (DC%) of orthodontic adhesive under the bracket with different curing directions. Surface microhardness was also measured to investigate the distribution of the DC%.

Methods Three ceramic, one glass-fiber reinforced polycarbonate and one stainless steel bracket were chosen. Light transmission through each group was determined with a spectrometer (n=6). Then, a total of 60 brackets were divided into 5 groups according to bracket label: Inspire ICE (ICE, ceramic), Fascination (FC, ceramic), Ovation C (OV, ceramic, white-colored), Elegance (EL, fiber-reinforced polycarbonate) and metal bracket (SS) and each group had two subgroups (n=6). The DC% of the adhesive was measured under the brackets when light curing was performed either from the sides or through the bracket. After curing each specimen was measured for surface microhardness of the adhesive immediately after initial 15min setting time. Data was analyzed statistically (ANOVA, Tukeys's, p<0.05).

Results Light attenuation was the greatest in the OV-group and the SS-group (P<0.05). Between groups ICE, FC and EL there wasn't a significant difference in light attenuation (P>0.05). ICE, FC, OV and EL showed significantly higher DC% when light curing was performed through the bracket (P<0.05) whereas in SS-group there wasn't a significant difference in the curing direction (P<0.05). The average differences in DC% with different curing directions were 12.8% for ceramic brackets, 18.1% for polycarbonate brackets and no difference were detected in stainless steel brackets. DC% values for directly cured ceramic brackets ranged from 48-52% whereas DC% under stainless steel brackets remained under 30%. Linear regression analysis revealed a significant correlation between the curing direction and the surface microhardness.

Conclusions Light curing through the bracket is recommended in case of ceramic and polycarbonate brackets to obtain a sufficient DC%.



Objectives This study aimed to investigate the effect of retainer stiffness and tooth resilience on force transmission and force distribution via finite element simulations.

Methods Based on a typodont lower jaw model (ANA-4, Frasaco, Germany), a finite element model was created from left to right canine (ANSYS R22, CADFEM, USA). Standardized root geometries enabled controlled variation of tooth resilience (0.1mm/100N to 0.3mm/100N in axial direction and 3-4 times the vertical resilience in horizontal direction). A retainer with circular cross section was added on the oral side and connected to each tooth by adhesive material (cylindrical bumps with 2.5mm in diameter). The diameter of the retainer cross-section was varied between 0.4 and 1.2mm, thus creating retainers with flexible to rather stiff bending behavior. A vertical bite force of 100 N was applied to the left central incisor.

Forces distributed by to the different teeth as well as forces transmitted by the respective adhesive bonding area were of interest. **Results** Force transmission to teeth next to the loaded central incisor increased with increasing tooth resilience and retainer stiffness. Thus, only roughly a third of the load being carried by the loaded tooth for highest tooth resilience and retainer stiffness compared to almost 90% for lowest tooth resilience and retainer stiffness.

With increasing retainer stiffness and tooth resilience, force transmissions via the adhesive bonding areas between the connected teeth and the retainer increased as well. With highest retainer stiffness and tooth resilience, about two thirds of the bite force had to be transmitted by the adhesive of the loaded tooth, making it the most susceptible for debonding. However, stresses within the bonding area were less homogeneous for small retainer diameters.

Von Mises stresses within the retainer increased with decreasing stiffness and increasing tooth resilience.

Conclusions Retainer stiffness has a tremendous effect on force distribution, especially in combination with resilient teeth.



Pain Experience of Adolescents in Orthodontic Treatment With Fixed Appliances

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Objectives To portray and compare pain perception between adolescent boys and girls after full engagement of an initial superelastic nickel-titanium archwire into slots of conventional brackets using the straight wire technique.

Methods The study included 160 orthodontic patients (80 boys and 80 girls) aged 14-18 years. Visual Analogue Scale (VAS) and modified McGill Pain Questionnaire were used for self-assessment of the pain triggers, type, location, duration, intensity, initiation of pain, and use of analgesics. Chi-squared test and post-hoc analysis were used to assess the pain perception of boys and girls. **Results** In the majority of adolescents included in the study, pain of moderate intensity (3 and 4 on VAS) was initiated by touching teeth and chewing. Boys reported the earlier onset of pain (immediately and after 6 hours) compared to girls (p<0.001). Girls reported spontaneous pain of higher intensity (7 and 8 on VAS) (p<0.001). Pain was perceived mostly as pressure and discomfort in both groups. Mild discomfort was described more frequently by boys, while girls felt more intense pain, such as headache and pulsating pain. Girls mostly experienced pain in all of their teeth, while boys primarily reported pain in their front teeth (p<0.001). Self-medication with analgesics was reported more often by girls (p<0.05).

Conclusions Adolescent girls perceived pain in all teeth as more intense, pulsating and spontaneous, with a delayed onset. Boys reported milder pain with early onset, perceived as discomfort and pressure, mostly in their front teeth. Knowledge of the pain patterns can help dentists to provide honest answers when navigating adolescents into acceptance of orthodontic treatment. Early advice regarding the characteristics and intensity of expected pain could provide favorable response in undertaking discomfort and challenges during the orthodontic treatment.



Objectives The aim of this study was to investigate the hygiene procedure of patients wearing removable orthodontic appliances. **Methods** A survey was conducted in the Orthodontic Unit of the University Hospital of Nice, France, on 40 consecutive patients wearing removable orthodontic appliances.

A questionnaire was therefore carried out with open and closed questions on several items : general characteristics, techniques and products used, changes observed on the appliance, advice received by their orthodontist, etc. After signing an informed consent form, the patients (and their parents) completed the questionnaire. A statistical analysis was then performed.

Results The sample of 40 patients consisted of 43% boys and 57% girls, mostly aged between 7 to 13 years old.

Of this 40 patients, 90% of patients brushed their appliances at least once a day with a manual toothbrush and toothpaste. The average brushing time was one minute. Of these patients, 57% also used a disinfectant (effervescent tablets or mouthwash). Finally, 10% of the patients in this study used only a disinfectant, without any mechanical action. Furthemore, interestingly, 75% of the patients had received cleaning advice from their orthodontist and considered it sufficient. In addition, patients reported changes in colour (37%), wear with tartar (30%) and an unpleasant odour (18%). 15% of the patients did not notice any change on their removable orthodontic appliance. Finally, the majority of the parents felt that their child was self-sufficient in the hygiene of their appliances, although most of the children did not have the opportunity to clean their appliances at school.

Conclusions The hygiene procedure of patients wearing removable orthodontic appliances in the Orthodontic Unit of the University Hospital of Nice was very heterogeneous. It is therefore necessary to develop guidelines and advice sheets for patients and orthodontists.



Quantitative Wear Analysis of Ceramic Inlays/Onlays After 14 Years

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Objectives Besides common clinical parameters for evaluating performance of dental restorations, other factors like long-term wear behavior are important for the survival of indirect restorations. The aim of the study was to evaluate the wear rate of IPS-Empress ceramic inlays/onlays measuring 3D-Volume change up to 14 years.

Methods 21 patients received 58 IPS-Empress (Ivoclar Vivadent, Schaan, Liechtenstein) ceramic restorations. A-silicone impressions (Panasil, Kettenbach GmbH und Co.KG, Eschenburg, Germany) were taken at baseline, 2, 4 and 14 years. Full arch models were produced using a polyurethane based material (AlphaDie MF, Schütz Dental GmbH, Rosbach, Germany) and scanned with a 3D optical model scanner (ATOS II Triple Scan, Carl Zeiss GOM Metrology GmbH, Braunschweig, Germany) creating respective .stl-files at each time-point. A region of interest was selected on the baseline scans, defined as the occlusal part of the ceramic restoration. 3D-matching was achieved using GOM Inspect Software (Carl Zeiss GOM Metrology GmbH), comparing baseline to 2, 4 and 14 years. Wear rates were evaluated as the difference between two scans in terms of height loss (mean distance [mm]) and volume loss (integrated distance [mm³]). Statistical analysis was performed using t-tests (p= 0.05).

Results After 2 years, surface abrasion showed a mean height loss of 0.25 mm, after 4 years of 0.37 mm and after 14 years of 0.53 mm. The mean volume loss evaluated was 9.75 mm³ after 2 years, 13.83 mm³ after 4 years and 18,57 mm³ after 14 years. Values for mean distance and integrated distance both showed statistically significant differences for each evaluation period (t-test,p<0.05). **Conclusions** Progression of wear rate of the evaluated ceramic restorations decreased over time and showed a clinically sufficient wear behavior after 14 years.



Functionalization of Cellulose Nanocrystals for Incorporation in Resin Composites

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Objectives Cellulose nanocrystals (CNC) have gained increasing interest thanks to their wide availability, low cost (compared to other nanoparticles), renewability, and high strength. Recent research showed very promising activity by CNCs against microbial adherence. However, CNCs are too hydrophilic to be used as is in hydrophobic resin matrixes, since agglomeration occurs. CNCs allow the grafting of different functional groups onto their surface to facilitate further applications. This research shows the development and preliminary testing of silanized CNC (SiCNC) for incorporation into methacrylate-based dentin bonding systems and resin nanocomposites.

Methods SiCNC were obtained by reaction of CNC with vinyltrietoxysilane (TEVS, 2.5:1 to CNC), in an ethanol-water solution (80:20 v/v) in the presence of acetic acid at pH=4.0, increasing temperature until 110 °C for 5 h (Scheme 1). SiCNC were extensively washed under ethanol, centrifuged, suspended in an aqueous solution, and lyophilized. SiCNC were characterized by ATR-FTIR, TGA, and water contact angle measurements. Non-functionalized CNCs served as control. The mechanical properties (flexural strength, three-point bend test) and microbiological behaviour (microbial adherence and biofilm formation by *S. mutans* and *C. albicans*) of two light-curable dentin bonding systems and a methacrylate-based resin nanocomposite (Majesty Flow, Kuraray-Noritake) containing different concentrations of SiCNC were assessed.

Results Characterization showed the successful synthesis of SiCNC with a 1% conversion value (p) and hydrophobic nature. Flexural strength showed no significant decrease in mechanical properties when 5% SiCNC was added. Quantification of adherent, viable microbiological biomass showed significant antiadhesive activity by CNCs against the tested microbial strains, while no antibiofilm activity was shown. Further studies are currently underway to ascertain the activity mechanism of SiCNC towards microbial cells. **Conclusions** Synthesis and incorporation of silanized cellulose nanocrystals were successful in both dentin bonding systems and resin composite. Such filler is highly promising for the development of innovative nanocomposites with enhanced behaviour from mechanical, aesthetic, and microbiological/biological points of view.



Scheme 1. Silanization reaction



0258 Intraoral Repolishing Affects Surface Roughness of Ceramic and Resin-Composite Materials A. Petropoulou, A. Vrochari, <u>E. Pappa</u>, M. Dimitriadi, S. Zinelis

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Objectives The aim of the study was to evaluate the surface roughness of one ceramic and one composite material, used for indirect posterior restorations after grinding and repolishing.

Methods The materials used were a lithium disilicate glass ceramic (IPS e.max Press/EMP) and indirect resin-composite restoration system (Gradia Plus/GRP). Disc-shaped specimens (n=10/material) were fabricated following the manufacturers' lab instructions (baseline). Simulating occlusal adjustment, specimens were ground with a fine diamond bur and were then repolished using Optrafine Polishing System (EMP) and Enhance Finishing and Polishing System plus Diapolisher Paste (GRP). Evaluation of the 3D-surface roughness of the specimens at baseline and after repolishing was performed using an optical profiler for the following parameters: Sa, Sz, Sdr and Sc. Accordingly, the elemental composition was examined by SEM/EDS (n=2/material). Statistical analysis of the roughness parameters was performed using t-test at a 95% confidence level (α =0.05).

Results For both GRP and EMP, repolishing using intraoral means significantly increased roughness, for all surface parameters evaluated in each group (p<0.001). EDS analysis showed no differences in the elemental composition of original compared to repolished surfaces.

Conclusions Increased values of surface parameters were found for both materials, when polished by intraoral means compared to original lab polishing. Both GRP and EMP exhibited surface roughness values above the critical threshold for increased plaque accumulation and periodontal inflammation, which highlights the need for further improvement of the chairside polishing procedure.



Additive Manufacturing of Polyester-Based Biomaterials to Design Piezoelectric Osteoconductive Devices.

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Objectives Recent developments in the additive manufacturing field were beneficial for the medical field. For example, computerassisted design and fabrication allow for a better training before each surgery. On another scope, bone reconstruction relies more and more on specific biomaterials to regenerate, rather than replacing the bone. Currently on the market, multiple solutions are available, taking advantage of the biocompatibility of phosphor-calcic ceramics. Currently studied, additive manufactured polymerceramic composites also rely on biological interactions. However, multiple research teams took interest in mimicking a physical property of the bone, the piezoelectricity. The latter allows the bone to produce electrical charges under mechanical stress, stimulating bone-generating cells. Our study aims towards the fabrication by additive manufacturing of tailor-shaped, porous and piezoelectric scaffolds that could allow a quicker recovery, then being degraded and assimilated in vivo. **Methods** Our process is composed of four steps :

The formulation of biobased polymeric matrixes and bio-composites by extrusion.

The shaping of materials into 3d printing filament of controlled diameter.

The printing of devices from lab-made filaments to produce analysis specimens and create different architectures.

The polarization of said architectures by an intense electric field to induce the piezoelectric effect.

Results The first mechanical results show a better elastic strain at the cost of rigidity for polymer blend matrixes, compared to neat PLA matrix. The piezoelectric analysis confirmed the effectiveness of corona polarization in inducing a piezoelectric effect in our 3D-printed parts.

Conclusions The next step will be the comparison between different architectures, while optimizing the printing parameters for each material. This will render the polarization more effective and therefore translate to a higher piezoelectric effect.



Objectives The aim of the study was to evaluate the color stability (CIE L*a*b*) and changes in translucency parameter (Tp) and opacity (Op) of one shade composites before and after photoaging.

Methods The materials tested were Charisma Topaz (CT), Essential Universal (EU), Majesty ES (ME) and Omnichroma (OM), whereas an A2-shade composite (Gaenial Anterior/RF) was used as a control. Disk-shaped specimens (14mmX2mm, n=10/material) were prepared (4x20s exposure/surface, 1.5W/cm²) and measurements of Δ E, Δ Tp, Δ Op, were recorded before and after photoaging (96h 300-800nm, 37°C, 765 W/m² irradiance) employing a UV-Vis spectrophotometer with an integrated sphere. Statistical analysis was performed by 1-way ANOVA plus Tukey test per property.

Results The rankings of the statistically significant differences were OM>RF>ME>3.3>CT>ES (Δ E), OM>ME>RF>CT>EU (Δ Tp) and ME>OM>EU>RF>CT (Δ Op).

The most impostant color changes were registered in OM (Δ E:9, Δ L*:-6.2, Δ b*:-6.6, Δ Tp: -7.6) and ME (Δ Op: -4.3).

Conclusions Photoaging, which reveals the inherent material color instability due to the presence of chromophore or auxochrome groups, without any external staining capacity, demonstrated important levels of color, transparency and opacity changes mainly on one shade composites. These changes may create esthetic problems in simplified one shade restorations.



0261 In Vitro Properties of Commercial Prefabricated Fiber Reinforced Root Canal Posts <u>R. Prinssi¹</u>, L. Lassila², E. Säilynoja¹ ¹Stick Tech Ltd – Member of GC Group, Turku, Finland, ²Turku Clinical Biomaterials Center, Turku, Finland

Objectives The aim of this study was to compare mechanical and chemical properties of four commercial prefabricated glass fiber reinforced root canal post (FRC-post): MI Core Fiber Post (GC Corp.), Relyx Fiber post (3M ESPE GmbH), Rebilda Post (VOCO GmbH) and FRC Post Plus (Ivoclar Vivadent AG). The flexural strength (FS) and modulus (FM), radio-opacity (RO), light translucency (TL) and bond strength were investigated.

Methods All tested root canal posts had diameter around 1.6 mm except FRC Post Plus having diameter of 2 mm. A 3-point bending test was used to determine FS and FM (Lloyd Instruments[™] LR30k plus, Ametek[®] Inc.). Used span length was 10 mm and prior the testing each post diameter was checked with a digital caliper. Bond strength between post and luting cement was measured by using push-out test method. Prior luting posts with either dual-curing composite cement (Link-Force G-Cem, GC corp.) or short fibre-reinforced composite (everX Flow Bulk, GC corp.) they were treated with G-Multi Primer (GC Corp.). The prepared test discs had height of 1.8-2.0 mm. For TL maeasurements the posts were shortened until the thickest part of post was reached, approximately 12 mm final lengths. Light translucency specimens were then attached to silicone putty molds and polished with #1200 grit (SiC-paper). Measurements were carried out with Marc[®] Resin Calibrator. The RO was digitally photographed with an X-ray imaging equipment. Aluminum discs were used as reference. Data were analyzed using ANOVA (p = 0.05).

Results The flexural strength and modulus, translucency and push-out test results are presented in table 1. MI Core fiber post had highest flexural strength and translucency (p < 0.05). There were no significant differences in push-out strength (p > 0.05). All materials had acceptable bond strength values.

Conclusions MI Core Fiber posts has all mechanical values to meet clinical requirements of a root canal post. It is strong material with high radio-opacity and excellent optical properties. Bonding of this material to surrounding luting matrix is good which ensured a satisfactory retention of the post.

	FS [MPa]	FM [GPa]	Translucency [mV/cm2]	PUSH-Out [MPa] everX Flow BULK	Push-Out (MPa) G-CEM LinkForce
Rebilda Post (VOCO)	963 (± 45)	22.5 (± 3.6)	0 (± 0)	34 (± 15)	22 (± 5)
Relyx Post (3M)	922 (± 33)	18.4 (± 0.2)	57 (± 1)	16 (± 3)	27 (± 5)
FRC Post PLUS (Ivoclar)	916 (± 52)	28.0 (± 1.0)	53 (± 1)	27 (± 12)	19 (± 6)
MI Core Fiber Post (GC)	1075 (± 53)	27.0 (± 3.0)	84 (± 4)	29 (± 6)	28 (± 12)

Properties



Load-Bearing Capacity of Short-Fiber Composite and Glass Ceramic Partial Dentures

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Objectives To evaluate the load-bearing capacity of conventional lithium disilicate computer-aided design/computer-aided manufacturing (CAD/CAM) block fabricated, and short fiber-reinforced composite (SFRC) CAD/CAM block fabricated fixed partial dentures (FPD).

Methods Two groups (n=12/group) of three-unit CAD/CAM fabricated posterior FPDs were made. The first group used experimental SFRC blocks, and the second group was fabricated from lithium disilicate (IPS e.max CAD, IVOCLAR) material. All FPDs were luted on a zirconia testing jig with adhesive dual-curing resin cement (G-Cem One, GC). Half of FPDs per each group (n=6) were quasi-statically loaded until fracture. The other half underwent cyclic fatigue aging for 100.000 cycles (Fmax=550 N) before being loaded quasi-statically until fracture. The fracture mode was visually examined using optical and scanning electron microscopy (SEM). Data were statistically analyzed using a two-way analysis of variance (ANOVA) followed by Tukey's HSD test (α =.05).

Results ANOVA demonstrated that both material type and aging had a significant effect (p<0.05) on the load-bearing capacity values of FPDs. Data showed that FPDs made of experimental SFRC CAD/CAM without fatigue aging had significantly the highest (p<0.05) load-bearing capacity (2096 ± 149 N) among all groups. Cyclic fatigue aging decreased the load-bearing capacity of the SFRC group (1709 ± 188 N) but increased it for the lithium disilicate group compared to the same material without aging (1546 ± 155 N and 1170 ± 226 N, respectively). Fractures of all FPDs occur at the connector region between the abutment and pontic. SEM images revealed that the short fibers in the SFRC FPD had the capability to alter the direction of cracks and impede their propagation.

Conclusions CAD/CAM fabricated FPDs made of experimental SFRC blocks showed promising performance for clinical testing in terms of fracture behavior.



Efficacy of Experimental Enzyme Agents on the Restorative Composites

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Objectives The idea of incorporating nanocapsules into the gel matrix to develop a natural product with remineralization and whitening capabilities has been recently explored by lots researchers.

The objective of this paper was to study the influence of various experimental whitening agents with enzyme, upon the surface morphology and color of some restorative biomaterials.

Methods The materials used in this study was experimental whitening agents with nano-capsules [nanohydroxyapatite, enzyme (bromelaine, papaine)], commercial agent Opalescence ® 16%, and restorative biomaterials [ESCOM 100 and C1, C2 (experimental composites)]. Each of the biomaterials were light-cured in Teflon molds (1 × 1.5 mm) with Woodpeker LED Lamp and further divided into three groups (n = 5/group). Samples were placed in artificial saliva, coffee, and TEDI juice, for 10 days and bleached with experimental and commercial gels. Color measurements were taken before and after the immersion in solutions, and after bleaching, using Vita Easy Shade Advance 4.0 spectrophotometer. Results were than compared to digital images, using the original software application "Discolor". Two methods were used: Atomic Force Microscopy (AFM - NTEGRA Spectra (NT-MDT)), to observe surface roughness (Ra) and Scanning Electron Microscopy (SEM – FEI), to observe the effects on biomaterials surface morphology. **Results** All biomaterial samples immersed in coffee showed significant coloration compared to baseline values. Discoloration in samples immersed in artificial soliva was not significant compared to baseline. The interaction between immersion time and bleaching gel type was also significant. ΔE values obtained from the Vita Easy Shade spectra and digital imagine were significantly different to all three types of biomaterials stored in coffee; whilst no significant difference was observed in the ones stored in juice. Also no major changes of the dental composites' surface morphology were observed.

Conclusions Experimental gels with enzymes are promising materials for teeth whitening.



Surface Treatment of Titanium Alloy for Bonding to Composite Resin

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Objectives The superstructure of dental implants is a determining factor in providing esthetic, function, and longevity. The success of customized superstructure relays heavily on composite resin-titanium bonding. This study aimed to characterize different surface modifications of Titanium 6-aluminum 4-vanadium (Ti6Al4V) alloy regarding surface roughness, topography, and micro-shear bond strength (µ-SBS).

Methods Fifty-eight Ti6Al4V samples ($10 \times 10 \times 2$ mm) were mechanically polished using SiC papers and cleaned with acetone in an ultrasonic bath for 10 min. Ti6Al4V blocks were prepared and divided into four study groups (n=12) and one control group as follows: Group (1), untreated; Group (2) sandblasted using 50 µm alumina particle; Group (3) etched using 9% HF (60s); Group (4) etched in 48% H₂SO₄ (60°C, 30min), and Group (5) etched by 50% silica-sulfuric acid gel (SiO₂-H₂SO₄) (60°C, 30min). After etching, the block surfaces were characterized by scanning electron microscopy (SEM) and surface roughness measurements. The universal adhesive was applied to blocks and light cured. The tygon tubes were placed perpendicularly on the block surfaces and filled using a nanohybrid composite resin. Specimens were then subjected to 2000 thermal cycles. µSBS test was performed using the wire loop method. The samples were assessed under a stereomicroscope to determine the mode of failure. The data were analyzed, at a significance level of 0.05.

Results The highest surface roughness with the most uniform pattern was observed in Group 5 (Ra = 0.8 ± 0.07) and the lowest in Group 3 (Ra = 0.6 ± 0.1). All study groups showed significantly higher μ -SBS values than the control group (p <0.001). μ -SBS was highest in Group 2 followed by Group 5, Group 4, and Group 3; however, there were no statistically significant differences among the study groups regarding the fracture mode.

Conclusions Surface treatment of Ti6Al4V with sandblast, sulfuric acid, and silica-sulfuric acid improved surface roughness and µSBS values.







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Micro-shear bond strength ($\mu\text{-SBS}$) values in MPa for all the groups

Group no.	Mean µ-SBS values (SD) (MPa)
1	8.53 (2.62)
2	17.43 (5.29)
3	14.12 (4.42)
4	15.36 (2.49)
5	15.99 (5.38)

SD: Standard deviation



Adhesion to Dentin Contaminated With Ammonium Polyfluoride

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Objectives The objective was to evaluate the influence of the self-etching ceramic primer contaminated on dentin to the adhesion of dental adhesive.

Methods Eighty sound human third molars were horizontally sectioned at the middle of the crown and were divided into ten groups. The adhesives were applied in each group as follows: $1)HF+H_3PO_4+SBU$; $2)MEP+H_3PO_4+SBU$; $3)H_3PO_4+MEP+SBU$; $4)H_3PO_4+SBU$; 5)HF+SBU; 6)MEP+SBU; 7)SBU; 8)HF+SEBond; 9)MEP+SEBond; and 10)SEBond. The specimen was filled with composite (Filtek Z250) and stored in artificial saliva at 37° C. After one week, the specimen was sectioned into resin-bonded dentin sticks for evaluating the microtensile test (uTBS). The data was statistically analysed using one-way ANOVA, followed by Post hoc Tukey's HSD multiple comparisons at $\alpha < 0.05$.

Results The dentin contaminated with Ammonium Polyfluoride, etch-and-rinse mode adhesive was not significantly different to the control, except for group $3)H_3PO_4+MEP+SBU$ showed a significantly higher bond strength than the control. In contrast, the self-etch mode adhesive significantly decreased bond strength in contaminated dentin than the control.

Conclusions The dentin adhesion was influenced by Ammonium Polyfluoride contamination. For etch-and-rinse mode adhesive, the contamination sequence influenced the dentin adhesion, which the contamination after phosphoric acid treatment increased uTBS. For self-etch mode adhesive, the contaminated dentin decreased the adhesion on dentin. Furthermore, dentin contamination with Hydrofluoric or Ammonium Polyfluoride influenced dentin adhesion in the same direction.

Microtensile bond strength of adhesion to Ammonium Polyfluoride contaminated dentine

Groups	Microtensile bond strength
HF + H3PO4 + SBU	30.0±5.1c,d
MEP + H3PO4 + SBU	31.0±5.2b,c
H3PO4 + MEP + SBU	50.2±4.6a
H3PO4 + SBU	38.9±6.7b,c
HF + SBU	11.8±5.7e
MEP + SBU	10.0±2.6e
SBU	38.0±9.0b,c
HF + CSE	16.1±5.9e
MEP + CSE	20.0±7.1d,e
CSE	40.0±8.5a,b



Filler Addition Influences the Strength of Adhesive Resin

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Objectives To investigate the influence of filler type/loading on the micro-tensile fracture strength (µTFS) of adhesive resins measured 'immediately' upon preparation and after 1-week water storage ('water-stored').

Methods The morphology and particle-size distribution of three filler particles, referred to as 'Glass-S' (Esschem Europe), 'BioUnion' (GC) and 'CPC_Mont', were correlatively characterized by SEM, TEM and particle-size analysis. These filler particles were incorporated into an unfilled adhesive resin ('BZF-29_{unfilled}', GC) in different concentrations to measure the 'immediate' µTFS. After 1-week water storage, the 'water-stored' µTFS of the experimental particle-filled adhesive resins with the most optimum filler loading specific for each filler type was measured. In addition, the immediate and water-stored µTFS of the adhesive resins of three experimental two-step universal adhesives based on the same resin matrix but varying for filler type/loading, coded as 'BZF-21' (containing silica and bioglass), 'BZF-29' (containing solely silica), and 'BZF-29_hv' (highly viscous with a higher silica loading than BZF-29), and the adhesive resins of the gold-standard adhesives Optibond FL ('Opti-FL', Kerr) and Clearfil SE Bond 2 ('C-SE2', Kuraray Noritake) was measured along with that of BZF-29_{unfilled} (GC) serving as control/reference. Statistics involved two-way ANOVA followed by post-hoc pairwise comparisons (p<0.05).

Results Glass-S, BioUnion and CPC_Mont represent irregular filler with an average particle size of 8.4-10 μ m. Adding filler to BZF-29_{unfilled} decreased μ TFS regardless of filler type/loading (figure). One-week water storage reduced μ TFS of all adhesive resins except BZF-21, with the largest reduction in μ TFS recorded for BZF-29_{unfilled}. Among the three filler types, the μ TFS of only the 30wt% Glass-S filled adhesive resin was not significantly different from the μ TFS of BZF-29_{unfilled} upon water storage.

Conclusions Adding filler particles into adhesive resin did not enhance its micro-tensile fracture strength, but appeared to render them less sensitive to water storage as compared to the unfilled adhesive resin.





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Objectives To compare the bond strength of different types of dual-cure resin cements to metals.

Methods A self-adhesive (3M[™] RelyX[™] Unicem 2 Automix Self-Adhesive Resin Cement, RXU2), three adhesive (3M RelyX Ultimate Adhesive Resin Cement with 3M Scotchbond[™] Universal Adhesive, RXUL; Panavia[™] V5 with Clearfil[™] Ceramic Primer Plus, Kuraray Noritake, PV5; Calibra[®] Ceram with Prime&Bond elect[®], Dentsply Sirona, CCM) and one universal cement (3M RelyX Universal Resin Cement without/with 3M Scotchbond Universal Plus Adhesive, 3M, RXUV_SA/ RXUV_A). Specimens of titanium (25x12x2mm, grade 2), gold alloy (7x10x2mm, Degulor[®] M, DeguDent), CoCr alloy (20x7x2mm, Remanium[®], Dentaurum) were ground flat, finished and sandblasted with 50 µm alumina. When applicable primers/adhesives were applied to the sandblasted metal surface according to IFU. Steel rods (4 mm diameter) were sandblasted with Rocatec[™] Plus (3M), silanized (ESPE[™] Sil, 3M) and cemented under standardized pressure (20 g/mm²). After wiping off the excess, glycerin gel was applied, and specimens were stored for 10 min under pressure at 36°C. Shear bond strength was tested after 24h storage at 36°C and 100% relative humidity with a universal testing machine (Zwick Z010; n=6; speed 0.75 mm/min). Data analysis was performed for each metal via One-Way ANOVA (Fisher; p<0.05). **Results** See table (values in MPa).

Conclusions In general, all resin cements delivered high bond strength to the metals tested. The self-adhesive resin cement RXU2 performed statistically equivalent to the CCM adhesive resin cement. Universal resin cement RXUV delivered high adhesion performance with and without adhesive primer on all substrates and achieved significantly higher values on Titanium compared to the other resin cements tested.

	RXU2	RXUL	RXUV_SA	RXUV_A	PV5	CCM
Gold	29,2 ± 5,1 c	34,7 ± 6,1 a,b,c	41,6 ± 9,2 a	32,6 ± 4,8 b,c	40,0 ± 3,6 a,b	36,2 ± 7,7 a,b,c
Titanium	36,3 ± 2,1 d	51,9 ± 6,8 b	61,6 ± 1,5 a	58,5 ± 2,7 a	42,6 ± 3,3 c	38,8 ± 2,1 c,d
CoCr	32,7 ± 5,0 c	50,8 ± 6,2 a	44,2 ± 2,3 b	42,7 ± 3,8 b	39,4 ± 3,9 b	29,1 ± 2,6 c

Shear Bond Strength (MPa)

Same small letters indicate no significant difference in the row.



Objectives To determine the shear-bond strength (SBS) of a bulk-fill flowable composite bonded to Biodentine (Septodont) immediately after setting and one week later using different adhesion strategies.

Methods 136 cavities (3-mm diameter, 4-mm deep) were digitally printed in plastic blocks and filled with Biodentine. Specimens were randomly distributed into two groups according evaluation time: Biodentine surfaces were treated 12 minutes after mixing (immediately) and one week later (specimens were kept in relative humidity at 37°C). Specimens received one of the following treatments (n=17): 1) Scotchbond Universal Plus (SBUP, 3M Oral Care) applied in self-etch mode (SE); 2) SBUP in etch-and-rinse mode (ER) 3) Surface roughening with a low-speed round tungsten carbide bur before SBUP application in SE mode (Bur), 4) Surface roughening with 27 µm alumina particles (Kavo Rondoflex) and SBUP with SE strategy (RF). Bulk-fill flowable composite-resin (SDR Flow+, Dentsply) cylinders (2-mm diameter, 2-mm high) were bonded to Biodentine and submitted to SBS test in a universal test machine (Instron 3345). The debonded surfaces were evaluated under a stereomicroscope a 20X magnification to determine the failure type. One specimen from each group was observed under SEM to evaluate the topographical changes produced on Biodentine by surface treatment. SBS results were statistically analysed by Kruskal-Wallis test with Bonferroni correction (pre-test failures were included in the statistical analysis as 0 MPa and equally distributed to both evaluation times (p<0.05) (Table 1) **Results** No SBS data were collected from RF group as 100% of pre-test failure were obtained. Similar SBS values were determined immediately after Biodentine setting regardless of the surface treatment (p>0.05). However, one week later, specimens roughened with a bur exhibited significantly lower SBS results (p<0.001).

Conclusions Biodentine should not be pretreated with bur abrasion nor alumina particle abrasion before an adhesive procedure. The adhesive strategy, ER or SE, seems not to influence shear bond strength when applied immediately after Biodentine setting or one week later.

Group	Immediate			One week		
	SBS MPa (sd)	Mode of Failure % AB/AC/CB/M/CC	Pre-test Failure %	SBS MPa (sd)	Mode of Failure % AB/AC/CB/M/CC	Pre-test Failure %
SBUP-SE	10.12 (5.05) aA	0/5.9/52.9/41.2/0	0	8.15 (6.19) aA	11.8/0/17.6/70.6/0	0
SBUP-ER	7.00 (5.74) aA	13.3/0/53.3/33.3/0	11.8	7.73 (6.53) aA	0/42.9/7.1/50.0/0	17.6
Bur+SBUP-SE	7.15 (5.68) aA	0/13.3/13.3/66.7/6.7	11.8	2.31 (3.80) bB	5.0/22.5/12.5/60.0/0	47.1
RF+SBUP-SE	Not applicable		100	Not applicable		100

Mean (standard deviations) of SBS values expressed in MPa (n=17), mode of failure (%) and Pre-test failure (%)

AB: adhesive in Biodentine-adhesive, AC: adhesive in resin composite-adhesive, CB: cohesive in Biodentine, M: mixed, CC: cohesive in composite. Lower case letters show statistical differences regarding Biodentine treatment at each evaluation time. Upper case letters show statistical differences regarding evaluation time per treatment.



Occlusal Veneers and Load-Bearing Capacity of Restored Tooth

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Objectives The aim of this study was to evaluate the influence of restoration bonding and type of preparation on load bearing capacity of a tooth restored with indirect glass ceramic or hybrid ceramic occlusal veneer restoration.

Methods Occlusal surfaces of extracted human molar teeth were prepared for indirect occlusal veneers with or without circumferential chamfer. The occlusal veneers were milled either from CAD/CAM hybrid ceramic (HC) Cerasmart (GC) or lithium-disilicate glass ceramic (LDGC) IPS e.max CAD (Ivoclar Vivadent) blocks according to manufacturer's instructions. Finalized veneers were bonded to teeth following manufacturer's instructions (bonded) or according to the technique for the intended deteriorated bonding (non-bonded) using n-hexane wax solution preconditioning on restorations (n=8/group). The ultimate fracture load was recorded, and fracture types were analyzed and classified visually. Statistical analysis was performed by the means of one-way ANOVA.

Results The highest mean fracture load was recorded in teeth with bonded LDGC veneer ($p \le 0.0007$). The bonded HC veneers had only marginally higher fracture load compared to non-bonded veneers. In all groups with deteriorated bonding, veneers got loose without tooth fracture whereas in the bonded veneer groups tooth fractures were observed.

Conclusions Bonded LDGC occlusal veneers have high load bearing capacity which exceeds the fracture resistance of tooth structure. Circumferential chamfer preparation for occlusal veneer has no influence on fracture load of restored tooth.



Figure 1. Schematic representation of restored teeth with both flat and chamfer preparations and dimensions of restorations.





Figure 3. Load-displacement curves in each group. Groups are classified in the Figure 2.



Figure 2. Mean ultimate fracture load within groups with standard deviations respectively to each group. Red line between tooth and restoration illustrates deteriorated bonding. Groups not connected by the same letter above the column are statistically significantly different (p<0.05).



Material	Composition	LOT	Manufacturer
IPS Ceramic Etching Gel	4.5% Hydrofluoric acid	Y03912	Ivoclar Vivadent, Schaan, Liechtenstein
Scotchbond Universal Etchant	37% Phosphoric acid	6115193	3M ESPE, Neuss, Germany
G-Multi Primer	Ethyl alcohol (90-100%), MDP, MDTP, silane	2010191	GC Europe, Leuven, Belgium
Adhesive Enhancing Primer	Ethyl alcohol (25-50%), MDP, 4-MET, MDTP	2012021	GC Corporation, Aichi, Japan
Self-Adhesive Resin Cement	UDMA, DMA, MDP, inhibitor, initiator	2010291, 2010291, 2010261, 2201121	GC Europe, Leuven, Belgium
Cerasmart270	71wt% silica (20nm) and barium glass (300nm) nanoparticles, Bis- MEPP, UDMA, DMA	1906036, 1903281, 2104141, 2101281, 2011161	GC Corporation, Aichi, Japan
IPS e.max CAD	SiO2 57-80wt%, Li2O 11-19wt%, K2O 0-13wt%, P2O5 0-11wt% and other oxides.	W02812, W34762, V37852, V44582, Z033G5	Ivoclar Vivadent, Schaan, Liechtenstein

MDP= 10-Methacryloyloxydecyl dihydrogen phosphate; MDTP = 10-methacryloyloxydecyl dihydrogen thiophosphate; 4-MET = 4-[2-(methacryloyloxy)ethoxycarbonyl]phthalic acid; Bis-MEPP = bisphenole A ethoxylate dimethacrylate UDMA= urethane dimethacrylate; DMA= dimethacrylate

Table 2. Fracture type distribution within test groups.

	Partial tooth fracture	Complete tooth fracture	Loosed veneer
Group 1, HC, bonded	5	3	
Group 2, HC, non-bonded			8
Group 3, LDGC, bonded	7	1	
Group 4, LDGC, non-bonded			8
Group 5, HC, bonded.	5	3	
Group 6, HC, non-bonded			8
Group 7, LDGC, bonded	1	7	
Group 8, LDGC, non-bonded			8



0270 The Effect of Experimental Nanohydroxyapatite on Enamel Surface After Bleaching

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Objectives The aim of this study was to examine the physical and morphological changes caused by the use of experimental nanohydroxyapatite gel on the enamel surface after the application of two different vital bleaching agents.

Methods In our study, 52 human maxillary incisor crowns were used.Chitosan added nanohydroxyapatite(n-HA) powder was synthesised using high temperature oxidation method.The characterization was performed by XRD and SEM analysis.This powder was mixed with phosphate buffered saline solution to form a gel.Teeth were divided into four groups(n=13).Biowhiten In-office (Group B),Opalescense Boost (Group O),Biowhiten In Office+n-HA gel (Group Bn),Opalescense Boost+n-HA gel (Group On).In Groups Bn and On,n-HA gel was applied to the enamel surface of the teeth for 5 minutes after bleaching.Color change, microhardness and roughness(Ra) measurements were done before,after and 1 week after bleaching.SEM/EDS analysis of three samples from each group were performed.Analysis of variance and Bonferroni test were used for microhardness and roughness results,Welch ANOVA test was used for color change results (p=0.05).

Results Visible color change was detected in all groups after bleaching treatment(p<0.05). There was no difference between the groups in terms of color change(p>0.05). When the test groups were compared after bleaching, highest Ra value was observed in Group O(p<0.05). Microhardness values were decreased after bleaching in all groups(p<0.05). Group O showed the lowest microhardness value after bleaching (p<0.05). As a result of SEM images, the roughest and most irregular surface was seen in Group O. Non-homogeneous particle deposition was determined in Group On, Bn and B. As a result of EDS analysis, the lowest Ca/P value was observed in Group O. An increase in the Ca/P ratio of the enamel surface was observed after n-HA application. **Conclusions** It was concluded that the use of experimental n-HA gel gave positive results to the physical and morphological properties of the enamel surface without any negative effects on the whitening effectiveness.



Are Fast-Setting Calcium Silicate Cements Biocompatiblewith Vital Pulp Therapy?

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Objectives MTA has been considered the gold standard in biomaterials for vital pulp therapy. However, it requires long duration of setting after application. To overcome the drawbacks of MTA, several calcium silicate cements are developed. The purpose of this study was assess the biocompatibility and bioactivity of newly developed calcium silicate cements.

Methods *In-vitro* samples of ProRoot MTA white (control), TheraCal LC, and TheraCal PT were prepared. Release of residual monomer (Bis-GMA and PEGDMA) was assessed using LC-MS/MS. Also, SEM/EDS mapping and ICP-OES analysis was performed to evaluate Ca^{2+} weight volume and release. Next, a direct pulp capping model was employed to the maxillary molars from Sprague-Dawley rats (*n* =8 per group). Intentional pulp exposure was made on the occlusal surface of the tooth. Then the exposure site was disinfected by 2% chlorohexidine. After confirmation of hemostasis, the materials were applied and the cavity was sealed. The animals were sacrificed either 7 or 28 days after the experiment. Histological analysis was performed to evaluate *in-vivo* biocompatibility and bioactivity.

Results LC-MS/MS assay demonstrated that release of residual monomers was significantly lower in TheraCal PT compared to TheraCal LC (p < 0.05). Ca²⁺ release was significantly higher in TheraCal LC compared to TheraCal PT (p < 0.05). *In-vivo* histological analysis showed that there were no significant differences in inflammation score between TheraCal LC and TheraCal PT. However, TheraCal LC showed a significantly higher inflammation score compared to MTA (p < 0.017).

Conclusions Within the limits of this study, TheraCal PT and TheraCal LC were biocompatible and bioactive for vital pulp therapy.



Figure 1. Release of residual monomers (Bis-GMA and PEGDMA) from the materials. *Statistically significant (p < 0.05), ThLC, TheraCal LC; ThPT, TheraCal PT.





Figure 2. Ca^{2+} weight volume and release. SEM/EDS mapping of (A) ProRoot MTA, (B) TheraCal LC, (C) TheraCal PT. (D) Release of calcium ion. Quantification of Ca^{2+} release was assessed by ICP-OES. *#Statistically significant (p < 0.017), MTA, ProRoot MTA; ThLC, TheraCal LC; ThPT, TheraCal PT.



Figure 3. Histologic evaluation. TheraCal LC group showed significantly higher grade of pulp inflammation compared to MTA (p < 0.017). Degree of inflammation was assessed by the inflammation score (1 = no inflammation; 2 = less than 25% of inflammatory cells in ROI; 3 = less than 50% of inflammatory cells; 4 = more than 50% of inflammatory cells). MTA, ProRoot MTA; ThLC, TheraCal LC; ThPT, TheraCal PT.



In-Vitro Bulk-Fills Composites Genotoxicity

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Objectives This study aims to evaluate genotoxicity of three bulk-fill extracts resins: Filtek One Bulk-fill, Tetric EvoCeram Bulk-fill and Coltene Fill-Up!

Methods Composite resin specimens were made from the application of the resins in a cylindrical metallic mold of Ø4×4 mm and polymerized using a high intensity LED curing light, during the time stipulated by the manufacturers: Filtek Bulk-fill - 20s, Tetric EvoCeram Bulk-Fill - 10s and Coltene Fill-Up! - 7s. After photopolymerization, resin specimens were incubated in culture medium, according to ISO-10993-12-2012, for 24 hours at 37 °C under 5% CO₂.

Extracts genotoxicity was determined by cytokinesis-blocked micronucleus assay (CBMN) using mouse embryo fibroblast cells (NIH/3T3; ATCC CRL-1658). Cells were incubated with different concentrations of extracts for 24 hours. Unexposed and Mitomycin C exposed cell cultures were used as negative and positive controls. DNA damage events were evaluated using the genotoxicity index (‰MNBN), which was calculated from the frequency of micronucleated cells found in 1000 binucleated cells.

Results In the presence of extracts from the various resins, the frequency of micronuclei (MN) in binucleated cells (MNBN) showed an increasing dose-response trend.

Filtek One Bulk fill, Tetric EvoCeram Bulk fill and Coltene Fill-Up! showed genotoxicity rates of 2 to 5 times, 3 to 8 times and 4 to 15 times higher than the negative control, respectively.

Conclusions Coltene Fill-Up! resin was the most genotoxic, followed by Tetric EvoCeram Bulk fill. Filtek One Bulk fill was the one that showed the lowest genotoxicity in the concentrations of the extracts tested, proving to be safer for clinical uses.



Fluoride-Containing Calcium-Phosphates: in Vitro Cytotoxicity Evaluation on HDPSCs

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Objectives Dental tissues may undergo demineralization and for this reason experimental dental adhesives containing fluorine have been developed. The fluorine ions can replace the hydroxyl groups present in hydroxyapatite, forming fluorapatite. Therefore, the aim of this study was to evaluate the cytotoxicity of innovative dental adhesives and their components on human dental pulp stem cells(hDPSCs).

Methods Adhesive systems in fluid form containing different concentrations of fluorine (0, 5, 10 and 20%) and their corresponding inorganic component were cultured as extracts in presence of hDPSCs. The extracts were prepared by dipping the samples into hDPSCs medium, according to ISO/EN 10993-12. The undiluted eluate, 1:5 and 1:50 dilutions were tested. The cytotoxicity on hDPSCs was examined for 24, 48, and 72 hours using the MTT assay.

Results The treatments had different effects on hDPSCs viability. Indeed, all undiluted samples, both inorganic components and adhesives, showed a statistically significative cytotoxicity. On the other hand, 1:5 dilution did not provide significant cytotoxicity except for 20% fluorine of inorganic component. Finally, 1:50 dilution seemed to promote cell proliferation; moreover, an increase of 15% of cell proliferation was obtained by 20% fluorine of inorganic component.

Conclusions Our data confirmed that adhesives and their inorganic components seemed to be toxic in contact with hDPSCs regardless of fluorine percentage; however, controlled concentration of the same percentage would promote cell proliferation. Hence, the obtained results may be considered promising to establish the most adequate fluorine concentration within adhesives for preventive purposes.



Experimental Investigation of the Cytotoxicity of Nitinol Dental Alloy

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Objectives To quantify the release of nickel ions from Nitinol discs immersed in a solution of complete growth medium and to assess dental pulp stem cell proliferation in the supernatant containing the investigated material. **Methods** Preparation of the materials eluent

The samples (Nitinol discs, Ni (55.20 wt.%) and Ti (44.80 wt.%); n = 3) were placed in a tube containing 10 mL of CM (DMEM F-12 with 10% fetal bovine serum and 100 U/I antibiotic/antimitotic), incubated at 37 °C for 24 h, and removed. The remaining supernatant was used in further experiments.

Inductively coupled plasma measured the amount of nickel ions in the medium.

Indirect NR assay

Cells were seeded onto 96-well plates and incubated with material supernatants. After 24 hours of incubation, the solution was discarded and replaced with 150µl of Neutral red solution (3-amino-7dimethyl- 1-2-methyl phenazine hydrochloride) (Sigma-Aldrich, St. Louis, USA) and incubated for 4 hours at 5% CO2 and 37 °C. Next, the wells were washed with PBS, and 150µl of NR eluent (96% ethanol: dH2O: CH3COOH 50:49:1) was added to each well and incubated at room temperature for 15 minutes. Optical density was measured at 540 nm using an ELISA reader (RT-2100c, Rayto, China). The percentage of viable cells was calculated as different from the control group (cells grown in CM).

Results Ni ions released in CM were 1.05 µg/L(ppb).

After 24h of indirect exposure to dental pulp cells, the cell viability observed in the tested group (mean = 96%) was almost similar in comparison to the untreated cells (the control group, mean = 100%). The difference was not statistically significant (p > 0,64). **Conclusions** The nickel ion emission from the investigated alloy was not clinically significant and had no negative effect on the proliferation of dental pulp stem cells. In addition, Nitinol alloy demonstrated excellent biocompatibility when in indirect contact with human DPSCs.



0275 The Effect of Current Finishing and Polishing Systems on the Surface Roughness of Different Resin Composites A. C. Terzi, T. Y. Sarikaya, C. Atalay, S. Gürgan

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Objectives The aim of this *in-vitro* study was to evaluate the effect of current finishing and polishing systems on the surface roughness (R_a) of different resin composites which can be preferred in anterior aesthetic restorations.

Methods One hundred and eighty discs (8 mm $ø_x 2$ mm) were fabricated from three resin composites; G-aenial Universal Injectable (GC Corp), G-aenial ACHORD (GC Corp), Essentia (GC Corp). Five different polishing systems were randomly assigned 12 specimens from each composite group. A multiple-step system consisted of Sof-Lex XT discs (3M ESPE) followed by DiaPolisher diamond paste (GC). The two-step systems were Enhance/PoGo (Dentsply) and Diacomp Plus Twist (Eve) and the one-step systems used were; Opti1Step (Kerr) and OneGloss (Shofu). Following finishing and polishing, R_a of the samples were measured by a profilometer. Sample surfaces were analyzed by scanning electron microscopy. Statistical analysis was conducted using one-way ANOVA and Pearson correlation tests.

Results Finishing and polishing systems produced significant differences between the R_a values of G-aenial Universal Injectable, G-aenial ACHORD adn Essentia composite resin specimens (p<0.05). Among the resin composites tested, the highest R_a values were obtained in the groups treated with the OneGloss polishing system (p<0.05). Polishing with Sof-Lex XT discs showed the lowest roughness values for all composites, followed by the Eve Diacomp Plus Twist similarly (p>0.05). Data showed that there was an interaction between the resin composites and the polishing systems. The findings of SEM analyses were consistent with the profilometric measurements.

Conclusions In addition to the preferred type of resin composite, the finishing and polishing systems greatly affected the R_a value of resin composite. Newly developed diamond impregnated spiral polishing systems (Diacomp Plus Twist) can be successful at a comparable level to the 'gold standard' multiple-step system consisted of Sof-Lex XT discs.


Effectiveness of Laser-Assisted Bleaching Using Er,Cr:YSGG Laser: Split-Mouth Clinical Study.

0276

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Objectives The aim of this study was to evaluate the tooth color change and dentin hypersensitivity after performing a laser-assisted in-office bleaching with two different protocols, two 20-minutes applications with or without laser activation of the bleaching gel. **Methods** Twenty patients with tooth shade A3 or darker were selected for this single-blind, split-mouth study. The bleaching session was conducted with two 20-minutes application of a 40% hydrogen peroxide bleaching agent assisted with Er,Cr:YSGG laser (2780nm) activation on one side of the maxillary and mandibular teeth and without laser activation on the other side. The color change was evaluated with optical observation according to VITA shade, polarized photography and spectrophotometer at baseline, 1 week and 1 month after the bleaching. Tooth sensitivity was documented pre operatively and immediately post operatively using a visual analogue scale (VAS).

Results The color evaluation showed a significant change in tooth color in both groups at the three time intervals of observation (Δ E>2.8). The highest color change was observed after one week and the results remained mostly the same after one month. Between the two groups, no statistically significant difference was observed regarding tooth color change (Δ E) evaluation (p<0.05). The visual color observations showed no difference between the two groups. Tooth sensitivity was noticed in less than half of the patients, whereas the control group presented higher VAS score (p<0.05).

Conclusions Although Er,Cr:YSGG laser-assisted tooth bleaching did not present better tooth color change compared to the conventional one, tooth sensitivity was slightly occurred in both groups but it was less in the laser group.



The Effect of Three Desensitizing Powders on Bleaching Efficacy

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Objectives The aim of this study was to evaluate the effect of air-abrasion of enamel with one of the following desensitizing powders (Sylc, Pearls and Biomin F) on the whitening efficacy of a bleaching gel containing 40% H₂O₂, which is used for in-office tooth bleaching.

Methods A total of 40 extracted human incisors were obtained, prepared and randomly assigned into 4 groups (n=10). The specimens of the control group received no treatment before the bleaching procedure, while each of the other 3 groups were airabraded with a desensitizing powder (Sylc, Pearls and Biomin F, respectively), 1 h prior to the bleaching procedure with Opalescence Boost PF 40%. Color measurements were obtained by means of a double-beam UV-Vis spectrophotometer at four time intervals (before, 1, 15 and 30 days after the bleaching procedure) and converted to L*, a* and b* units of CIELAB color space. Between all treatments and measurements, the specimens were stored in artificial saliva at $37\pm1^{\circ}$ C. Color changes after bleaching procedures were estimated on the basis of 50:50% acceptability (AT: Δ Eab* = 2.7 and Δ E00= 1.77) and 50:50% perceptibility (PT: Δ Eab* = 1.2 and Δ E00= 0.81) thresholds.

Results The mean Δ Eab* values after 1, 15 and 30 days for each group were: Control (10,70±4,60 / 8,10±4,24 / 8,33±5,27), Sylc (12,00±4,92 / 9,40±4,16 / 9,11±2,89), Pearls (11,14±3,77 / 8,91±4,87 / 8,27±4,28) and Biomin F (12,30±4,75 / 11,23±4,25 / 9,10±4,10). Similarly, the mean Δ E00* values were: Control (9,39±4,26 / 7,30±3,75 / 7,77±4,76), Sylc (10,65±4,37 / 8,51±3,70 / 8,41±2,72), Pearls (10,36±3,46 / 8,15±3,78 / 7,64±3,38) and Biomin F (11,15±4,50 / 10,00±3,67 / 8,38±3,50). Lastly, the mean Δ Wl_D values were: Control (11,59±3,24 / 10,69±3,03 / 9,43±3,22), Sylc (11,39±3,11 / 10,58±2,69 / 9,41±2,37), Pearls (13,04±4,14 / 11,61±3,87 / 10,92±3,62) and Biomin F (12,33±2,15 / 11,87±2,82 / 10,52±2,30).

Conclusions The use of the tested desensitizing powders before the bleaching procedure does not seem to affect the tooth color change of Opalescence Boost PF 40%.



0278 Effect of Mouthrinses on Color Stability of Bioactive Restoratives

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Objectives To evaluate the effect of mouthrinses with or without alcohol on color stability of different types of bioactive restoratives. **Methods** Four different types of restorative materials were fabricated in disc-shaped teflon molds (10x2mm); a resin composite-Filtek Z550(F), a giomer-beautiful II(B), a glass hybrid-Equia Forte(EF), an alkasit-Cention N(CN) and a bioactive material-ACTIVA(A). Thirty specimens of each material were prepared and divided into three subgroups(n=10): an alcohol-free mouthrinse(Listerine Totalcare 0), an alcohol-containing mouthrinse(Listerine Totalcare) and distilled water(control). After the baseline color measurements were obtained using a spectrophotometer(Vita Easyshade V), all specimens were immersed in the solutions for 12h at 37C degree. Then final color was remeasured. CIE L*a*b* data was used to calculate Δ E for each group. Data were analyzed using ANOVA/Welch-ANOVA and Tukey HSD or Games-Howell test was conducted for pairwise comparisons(p<0.05).

Results There was a statistically significant difference among restorative materials and mouthrinses in terms of Delta E values(p<0.05). The only statistically significant difference between alcohol-free and alcohol-containing mouthrinse was found in Equia Forte group(p<0.05). No difference was detected between these mouthrinses for the rest the tested groups(p>0.05). In alcohol-containing mouthrinse group, Filtek Z550 showed significantly lower Δ E values than all tested groups(p<0.05) except similar to Beautiful II group (p>0.05). The rest of the tested materials showed statistically similar Δ E values(p>0.05). In alcohol-free mouthrinse group, no difference was found between Filtek Z550 and Equia Forte(p>0.05). Cention, Activa and Beautiful II showed statistically significantly higher Δ E values than F and E(p<0.05). The color change was visually perceptible(Δ > 3.3) for all materials except for Filtek Z550 in both mouthrinses and Equia Forte in alcohol-free mouthrinse.

Conclusions The mouthrinses' effect on color stability differs according to the alcohol content and the type of bioactive restoratives.



Effect of Minimal Invasive Applications on Various Discolored Composite Materials

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Objectives Composite restorations discolored over time that these colorations are mostly superficial and instead of replacing restorations with spending extra time and effort, minimal invasive applications are being used. Thus, aim of the study is to evaluate the effect of minimal invasive applications on the color change and surface roughness of discolored composite materials. **Methods** A total of 180 disc-shaped(8mmx4mm) samples were formed from a bulk-fill(OpusBulkFill), a microhybrid(Llis) and a nanohybrid(HanFil) composite materials. After finishing and polishing procedures, all samples were immersed in red wine for 20 minutes for 5 days. Afterward, baseline values of surface-roughness and color parameters were recorded by using contact profilometer and spectrophotometer. Then, samples were divided into four different minimally invasive applications (n=15): i)Brushing with whitening toothpaste,ii)In-office bleaching,iii)Re-polishing and iv)Microabrasion. Final measurements were recorded as same as the baseline measurements. Then, surface roughness and color change(Δ E) values were evaluated at p<0.05 significance level using Kruskal-Wallis and Wilcoxon-Signed-Ranks tests.

Results According to results, there were statistically significantly higher surface roughness values were gained among the microabrasion and brushing groups of the bulkfill composite, repolishing group of the microhybrid composite and brushing and repolishing groups of the nanohybrid composite(p>0.001). However, there was no significant difference between other groups of tested composites.

There was statistically significantly lower ΔE among bleaching samples of the bulkfill composite(p<0.001). There was no significant difference between the groups of microhybrid composite. However, there was statistically significantly higher ΔE at brushing samples for the nanohybrid composite(p>0.001).

Conclusions Instead of other minimal invasive applications, brushing with a whitening toothpaste had superior results on minimizing the discoloration. However, it also increased the surface roughness of tested bulkfill and nanohybrid composites. Thus, effect of minimally invasive applications on surface roughness varies according to the filler type of composites.



Objectives The aim of this clinical case report is to describe the clinical procedures for oral rehabilitation of a complex case suffered with Dandy Walker Syndrome (DWS).

Methods 15-year-old female patient suffered with DWS referred to our clinic with the chief complaint of several fractured anterior teeth because of dental caries. In the clinical examination, it was determined that the patient's anterior teeth (12,11,21,22) were recently treated with endodontic treatments and needed permanent restorations. Several caries lesions were detected on 11 vital permanent teeth. Due to severe material loss in teeth 12,21 and 22, the core structures were initially formed with fiber-posts (Cytec-Blanco,Hahnenkrat,Germany), and then tooth preparations were made for the crowns to maintain ferrule effect. Full crowns were made directly from composite resin (Gradia Direct Anterior,GC-Corparation,Tokyo,Japan) with the help of adjusted translucent strip crowns (Practice,New Stetic,Colombia). Teeth numbers of 11,13,23,24,31,32,35,36,45 were restored with direct composite resin (Gradia Direct Anterior). Teeth 14,15 and 25 were restored with high-viscosity glass ionomer restorative (Equia Forte,GC-Corparation). Totally, 15 teeth of the patient were restored, and after her dental treatments topical fluoride gel was applied. There was difficulty in construction because the patient's head moved too much due to the syndrome. For this reason, each tooth was restored in a separate session. Oral hygiene motivation was given to her caregiver (mother). The patient was called for control after 6 months and one year.

Results No fracture, secondary caries or debonding failures were observed in any of the restorations after 6-months and 1 year. At the end of the first year, a new caries was observed on the buccal cervical of the patient's tooth 14 and it was restored with composite resin.

Conclusions An effective preventive oral rehabilitation together with regular professional monitoring of a patient suffered with DWS is crucial to maintain long-term oral health.



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Objectives Five patients complained of caries on their posterior teeth applied to the Department of Restorative Dentistry (Case 1: 17year-old female; Case 2: 18-year-old male; Case 3: 16-year-old male; Case 4: 20-year-old female; Case 5: 17-year-old female). After radiographic and clinical examinations, it was decided to perform direct composite resin restorations with the occlusal stamp technique as there were no large cavitations on the teeth.

Methods The teeth were isolated with a rubber dam, then the application of separating medium (Vaseline) on the teeth surfaces was performed with a microbrush. A stamp was fabricated using a microbrush placed into a gingival dam placed on the intact occlusal surfaces of the teeth. Then the stamp was cured and will further act as a guide to replicate the occlusal anatomy. After caries removal, the direct restorative process with composite resin was initiated. Enamel surfaces were roughened with 37.5% orthophosphoric-acid gel (Etching Gel, Kerr) and a two-step adhesive system (Clearfil SE Bond, Kuraray, Japan) was applied and light-cured for 20 seconds. The cavity was gradually restored with Estelite Posterior Quick (Tokuyama, Japan) up to 1mm below the occlusal surface and light-cured for 20 seconds. The last layer of composite resin was then placed, and a piece of Teflon tape was affixed to the occlusal surface. Then the occlusal stamp was placed over the tape, adapted with light pressure, and the composite resin was polymerized. Minimal finishing and polishing procedures were performed using rubber wheels (Twist Dia, Noritake, Japan).

Results No aesthetic or functional problems were found in the 3-month early clinical follow-up of the patients. All the patients were very satisfied with the results.

Conclusions The occlusal stamp technique is an easy and efficient technique for restoring the patient's original occlusal morphology with direct composite resins.



0282 Trueness of Two Intraoral Scanners Measured by a Novel Method D. Borbola, J. Vág

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Objectives The primary aim of this study was to compare the trueness of two intraoral scanners (IOS) in complete arch models. Secondly, we investigated the effect of the cement gap on the simulated fit of the designed prosthetic framework.

Methods Four complete arch models with prepared teeth were scanned by a high-precision industrial scanner (ATOS Core) to produce reference scans. Models were also scanned by Planmeca Emerald S and Medit i700 intraoral scanners three times each. Then, the teeth abutments were digitally segmented from the models for further analysis. Two fixed complete denture frameworks with 70 µm and 140 µm cement gaps on each IOS scan were designed in Exocad software (n=48). The framework was aligned with the reference scan in GOM Inspect software without being interwoven. The mean absolute distance (MAD) between the surfaces was measured in the internal and marginal areas and is given in the median (first – fourth quartiles) for each IOS and cement gap. The median MADs were compared by the Mann-Whitney U Test.

Results In the internal area, MAD was 37 (28-47) μ m for Emerald S and 58 (53-96) μ m for the Medit i700 with a 70 μ m cement gap (p<0.001). MAD was 31 (28-50) μ m for Emerald S and 52 (47-58) μ m for the Medit i700 with a 140 μ m cement gap (p<0.01). In the margin, MAD was 66 (60-76) μ m for Emerald S and 104 (83-155) μ m for the Medit i700 with a 70 μ m cement gap (p<0.001). MAD was 73 (66-81) μ m for Emerald S and 105 (86-113) μ m for the Medit i700 with a 140 μ m cement gap (p<0.001).

Conclusions Both IOSs would be recommended for complete arch rehabilitation with slightly better performance of the Emerald S. Increasing the cement gap does not improve the fit of the restoration.



0283 Phantom Taste Before and After Removal of Amalgam Restorations L. Björkman, T. L. Berge, B. F. Lundekvam, A. Bergstø

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Objectives Metal taste is a common symptom among patients with subjective complaints attributed to dental amalgam restorations. Since "metal taste" is not one of the five basic taste qualities it is classified as a phantom taste. The objective of the present study is to gain knowledge about intensity of taste complaints before and after removal of all amalgam restorations and to evaluate associations between intensity of taste complaints and other local and general health complaints.

Methods Patients (n=32) with subjective complaints attributed to dental amalgam participated in a prospective cohort study (registered at ClinicalTrials.gov NCT01682278) and had all amalgam restorations removed and replaced with other dental restorations. Questionnaires were distributed before and one year after amalgam removal. Local (n=11) and general (n=12) health complaints (GHC) were registered using numeric rating scales from 0 (no complaint) to 10 (strongest imaginable intensity). Metal taste was registered using a four-level Likert scale (0: not at all, 1: a little, 2: quite a lot, 3: very much).

Results Intensity of taste complaints was significantly reduced after removal of all amalgam restorations (effect size 0.6; p = 0.002). For metal taste the effect size was large (0.9; p < 0.001). There were significant associations between change scores for intensity of taste complaints and change scores for metal taste (r=0.795; p < 0.001), four local health complaints (intraoral burning sensation [r=0.356; p=0.045], stiffness and paresthesia of face or lips [r=0.426 p=0.015], pain from temporomandibular joints [r=0.392, p=0.027]), and two general health complaints (cardiovascular symptoms [r=0.454, p=0.009] and symptoms from ear/nose/throat [r=0.380, p=0.032]).

Conclusions Intensity of taste complaints and metal taste is considerably reduced after amalgam removal. It could be hypothesized that similar mechanisms are mediating change of intensity of taste complaints and change of the intensity of general health complaints. Additional studies on the mechanisms are warranted.



Adverse Reaction Reports Related to Occlusal Splints

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Objectives The Norwegian Dental Biomaterials Adverse Reaction Unit is responsible for a national register concerning suspected clinical biologic adverse reactions associated with dental biomaterials. The register is based on voluntary reporting from dentists, dental hygienists and physicians. The main objectives of the adverse reaction register are to gain knowledge about material-associated adverse reactions and to monitor changes over time. In this study we focused on reactions reported in relation to occlusal splints. Occlusal splints are made of polymer materials (e.g., auto-polymerized, heat cured, thermoplastic, light cured, or 3D-printed). For some of these the biocompatibility is not well characterized.

Methods A customized reporting form is available from the Norwegian Dental Journal, from the internet pages of the Norwegian Dental Biomaterials Adverse Reaction Unit, and from the most used electronic patient record software in Norway. Data from received adverse reaction reports were registered in a database and reports regarding reactions related to occlusal splints were searched for. The number of reports where the reporter suspected occlusal splints as a possible cause of the reaction was counted for each year. **Results** From 1993 to the end of 2022, 20 out of a total of 2725 reports registered were related to occlusal splints. Six of these reports were received the last two years. Analysis using logistic regression indicated a significant increase over time (p=0.002).

The symptoms reported were relatively consistent and included mainly burning and painful sensations in the orofacial region. The objective findings were less consistent.

For most splints there was no detailed information about the manufacturing process used.

Conclusions The increase of adverse reaction reports related to occlusal splints could be interpreted as a signal and the mechanism behind the experienced adverse reactions warrants additional investigation.



Oral Hygiene Benefits of a Toothpaste-Mouthwash-Cleanser Combination in Partial-Denture Wearers

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Objectives Maintenance of oral hygiene is especially important for wearers of removable partial-dentures (RPD) owing to their risk of further tooth loss. This Covid-affected study examined the effect on oral hygiene through usage of a three-product combination (a SnF₂-containing toothpaste (1100ppm F), a NaF-containing mouthwash (90ppm F), and a sodium laurylsulphate-based foam denture cleanser) in a population of RPD wearers.

Methods Forty-nine healthy, adult participants (not regular denture-cleanser users) with one conventional RPD, \geq 4 teeth in each arch and generalized mild-moderate plaque-induced gingivitis, were given a prophylaxis and randomized into a single-centre, singleblind, 2-treatment, parallel-group study. Twice-daily, participants in the Treatment group brushed their teeth (2 minutes), brushed their RPD with the cleanser, then swished with the mouthwash (1 minute). The No-intervention group continued their usual dental/denture cleansing habits. All subjects received a baseline dental and RPD prophylaxis. Partial-Denture Cleanliness Index (PDCI), Turesky Plaque Index (TPI) and Oral Hygiene Index (OHI) were assessed at 6 and 12 weeks. Data from the Forty-eight participants who completed the study were analysed using ANCOVA (PDCI/TPI) or Van-Elteren test (OHI). TPI and OHI were performed for the whole-mouth and for abutment-teeth only.

Results After 12 weeks' usage, comparing the whole-mouth scores for the Treatment to No-Intervention groups: PDCI was (adjusted mean[standard error]): 1.1[0.11] versus 1.9[0.10]; OHI was 0.30[0.065] versus 0.64[0.062]; TPI was 2.07[0.100] versus 3.02[0.096]. Differences were statistically significant (p<0.001 [for PDCI/TPI] and p=0.0173 [for OHI]) in favour of Treatment. For the abutment-teeth, the TPI was 2.17[0.126] versus 2.93[0.121] (p<0.001) and the OHI was 0.21[0.099] versus 0.55[0.095] (not statistically significant [p=0.3058]), both in favour of the Treatment.

Conclusions Participants using the three-product combination of SnF₂ toothpaste, NaF mouthwash and foam denture cleanser were found to have improved general oral hygiene after 12-weeks use compared to no intervention. Study treatments were generally well-tolerated.



0286 Haptics as an Educational and Training Tool in Prosthetic Dentistry <u>D. Symeonidis</u>, E. Dimitriadou, C. Hadjichristou School of Dentistry, European University Cyprus, Nicosia, Cyprus

Objectives Haptic devices have been used in the past for the flight simulation training. Remote training via simulators has been gaining interest after the isolation posed by the pandemic. This study aims to compare the students' subjective perceptions and objective outcomes comparing two methods of crown preparation, the traditional preparation on typodonts and a simulation method for teeth preparation using haptic devices.

Methods Second year dental students were given instructions for the preparation of the upper second premolar. After completing their standard practice on typodonts they were asked to prepare the same tooth on simulators. They were given two minutes of familiarization time and then thirty minutes for the actual preparation. Following this task, they were asked to complete a questionnaire about their experience. Their preparations were objectively compared by measuring the total occlusal convergence-TOC angle on typodonts that they had prepared and have that compared to the TOC produced on simulators.

Results Students reported that the use of simulators can inspire the learning process and that they would use this new tool for skill training in the future. The overall experience was regarded positively by the majority of the students. The TOC of the prepared teeth using haptics was not inferior to that prepared using the traditional methods.

Conclusions Dental Simulators seem like a powerful tool in the educational process of students and they deserve a viable position in dental institutions as they can offer an alternative to traditional methods for training at a preclinical level.



Establishing a Protocol for the Cultivation of Pulp-Organoids From DPSC

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Objectives The term "organoid" refers to self-assembling structures from stem or progenitor cells that resemble the respective target organs in their architecture and functionality. This 3D microenvironment with spatial cell contacts better reflects the *in vivo* configuration than a 2D culture system with flat adherent cells. Therefore, organoids resembling organs such as intestines, kidneys or the CNS have been established from pluripotent cells, allowing realistic insights into the *in vivo*-like cell behavior and signaling pathways. Although multipotent dental pulp stem cells (DPSCs) are promising for different clinical applications, data on the cultivation of DPSC organoids remain sparse, and point to a limited possibility of long-term cultivation and difficult handling properties. Therefore, we aimed to establish an improved protocol for the cultivation of DPSC organoids.

Methods Stro1-positive DPSCs were isolated, seeded into low-attachment plates and cultured in MEM alpha supplemented with fibroblast growth factor 2. Additionally, three different additives were tested: 1. fetal calf serum (FBS) 2. FBS with ROCK inhibitor 3. knockout replacement serum. Embryonic bodies were individually embedded in MatrigelTM and differentiation was initiated by the addition of beta-glycerophosphate, dexamethasone and ascorbic acid. Immunocytochemistry (ICC) and quantitative real-time PCR was performed with odontoblast-associated markers (DSPP, NES, COL1A1).

Results After one day, cell aggregates formed that increased in size over time. The addition of ROCK inhibitor promoted the formation of particularly uniform and round organoids with a sharp outer border, from which cells proliferated after 35 days. A minimum cultivation period of 6 weeks was achieved for all experimental groups. ICC stainings revealed a dental pulp-like morphology, and the dental markers NES, COL1A1 and DSPP were expressed.

Conclusions The proposed protocol is suitable for long-term cultivation of organoids from DPSCs. The latter render a promising tool for enabling studies of pulp physiology under *in vivo*-like conditions.



Objectives This report covers the treatment of a complicated crown fracture in tooth no 11 and lateral luxation in teeth no 21-22 caused by trauma, along with a one-year follow-up.

Methods After a traffic accident, a 17-year-old male patient was applied to our clinic with upper incisor loosening and fractures. Lacerations were found outside the mouth. In the intraoral examination, teeth 11-12 responded positively to vitality tests, while teeth 21-22 did not. Computerized tomography showed lateral luxation and a fracture line in the alveolar bone, and buccal and palatal displacement of the roots of the teeth no 21-22. The apical lesion in tooth 22 was also observed, and chronic apical periodontitis was diagnosed. A flexible splint and alveolar bone repositioning were performed. Root canal treatments of teeth 21-22 were started while partial pulpotomy with mineral trioxide aggregate (MTA) was applied to tooth no 11. After two weeks of treatment with Calcium hydroxide, the root canals were completed. The splint was removed after four weeks. Teeth were aesthetically restored. **Results** After one year, clinical and radiological evaluation revealed healthy periodontal tissues and teeth. Teeth were both functional and aesthetic.

Conclusions After correct diagnosis and treatment planning, repositioning teeth and alveolar bone and splinting teeth immediately repairs periodontal ligaments and positions teeth optimally.



R9 - Newly Developed Fluorescent Dye Tested on SCAP

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Objectives In this research study, the focus was on assessing the cytotoxicity of a newly developed fluorescent dye, R9, on stem cells from the apical papilla. The aim was to test the effectiveness of the dye in connecting with proteins and RNA, which are crucial components of cellular processes. The researchers evaluated the nucleic acid binding properties of the dye, in particular its specificity towards RNA and DNA.

Methods To test the cytotoxicity of R9, a three-step protocol was followed. Mesenchymal stem cells were isolated from the apical papilla, and then the dye was administered to the cells in two different vessels - a 48 well plate and a 25 cm2 plastic flask. The plate was used for immediate observation using the InCell Analyzer 6000, while the flask was observed using flow cytometry after 24 hours of adding the dye.

Results The researchers observed cellular penetration and recorded the results using the InCell Analyzer 6000 at intervals of 30 minutes for six hours. The differentiation between apoptotic and alive cells was made using the Anexine V kit for flow cytometry on Navios (BioRad). The apoptotic cells were further analyzed using FITC-conjugated anti-anexine V antibody, while the nuclei were counterstained with DAPI.

The study's results indicate that a majority of the tested dye did not exhibit any cytotoxic effects on the cells. Furthermore, differences were observed between live and fixed cells. In live cells, the dye's spectrum was in the excitation peak at 559 nm and an emission peak at 583 nm. On the other hand, in fixed cells treated with 4% formalin, the spectrum shifted to 651 nm with an emission peak at 670 nm.

Conclusions The researchers emphasized the need for new and specific dyes that can aid in understanding cellular processes. Currently, there is only one RNA-specific binding dye available on the market. Developing new nontoxic dyes that can distinguish between RNA and DNA or bind to specific regions in proteins would provide valuable tools for understanding transmembrane transport, RNA translation, and protein folding and interactions.



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Objectives We assess and compare dynamics of proliferation of Dental pulp stem cells and Bone marrow stem cells after 20 passages (more than 30 cell doublings).

Methods Dental pulp stem cells were isolated from routinely extracted third molars via enzymatic digestion (3 mg/mL collagenase type I and 4 mg/mL dispase) and cultured continuously up to passage 16. Cell count and population doubling were evaluated at each passage. The enzymatic activity of telomerase and betagalactosidase

were assessed, as these are wellknown markers for cell senescence and aging. The following kits were used for these purpose, following the manufacturer's instructions: Human TERT / Telomerase Reverse Transcriptase ELISA Kit (ELISAGenie, Dublin, Ireland) and ELISA Kit for Galactosidase Beta (GLb) (Cloud Clone Corp, Katy, TX, USA). Total protein amount was previously identified in all samples using Nanodrop 1000 (Thermo Scientific).

Results The results showed two peaks of significantly increased cellular proliferation rate at passages 6 and 12, with slight differences between cells from the first and 20th passages. The study indicates that dental pulp stem cells do not enter cell proliferation arrest phase after long-term in vitro cultivation, as there was no significant decrease in proliferation ability. However, alveolar bone stem cells showed a gradual decrease in proliferation after passage 15.

Conclusions These findings contribute to a better understanding of the behavior and potential clinical applications of dental and alveolar bone stem cells in regenerative medicine.



0292 Evaluation of Platelet Rich Fibrin Efficacy in Bone Regeneration After Apical Surgery

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Objectives To evaluate and report the efficacy of bone healing and regeneration in periapical tissues using platelet rich fibrin (PRF) after apical surgery.

Methods Patients whose cases required periapical surgery after standard endodontic therapy failed were chosen. By using the randomization principle, patients were split into two groups: Group I received autologous PRF material to fill a bone deficiency in order to promote bone regeneration, while Group II received no PRF treatment. Before and after apical surgery, patients had clinical, radiological, and ultrasonographic examinations. Recall visits were scheduled for six months after the surgery. I-Dixel, Moritta, Japan, was used to evaluate radiological pictures. Apolio A550, a high frequency hockey stick linear transducer with a 20 mm wide scan, was used to conduct the ultrasound imaging examination.

Results A higher rate of healing and bone regeneration was observed after follow up in Group where PRF was used. Ultrasound imaging investigation was performed using a high frequency hockey stick linear transducer with a 20 mm width scan (frequency 15-18 MHz, Apolio a550, Canon

Conclusions Apical surgery with PRF may provide good healing rates and therefore the use of PRF in the study continues.



Does Apical Resection Affect the Pulp Sensibility of Adjacent Teeth?

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Objectives During the apical resection procedure, there is a potential risk of damaging the tissues around the surgical area, such as inhibiting neurovascular support to the pulp of adjacent teeth. The objective of this prospective clinical study was to evaluate the effect of apical resection on the sensibility of teeth adjacent to the surgery area using the thermal cold test. **Methods** The study sample included 36 patients undergoing apical resection. Sixty-nine teeth were operated surgically and total 66 adjacent teeth were evaluated for tooth sensibility. Dental sensibility was evaluated using cold spray once 1-3 days before surgery and six months after surgery. One corresponding contralateral tooth in each patient was served as control. The responses were categorized as positive, delayed positive or no response. The data was statistically analyzed using the Chi-square test (α =0.05). **Results** All of the adjacent teeth showed positive response to cold stimuli before surgery. The results of cold test was significantly reduced too (p<0.05). Distal adjacent teeth showed more reduction in response to cold than mesial adjacent teeth (p<0.05). **Conclusions** For both mesial and distal adjacent teeth, the number of teeth that did not respond or showed delayed positive response was higher at 6 months after surgery and significantly different from baseline. It appears that apical resection can affect the pulpal response of adjacent teeth and follow the sensibility test. Therefore, dental clinicians should be aware of the possible effects of apical surgery on adjacent teeth and follow the sensibility test.



Association of Proinflammatory Gene Polymorphisms With Pain-Related Temporomandibular Disorder

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Objectives Studies have already pointed out the association between polymorphisms in inflammatory genes and pain-related temporomandibular disorders (TMDp), but results remain conflicting. Therefore, in order to further elucidate, we investigated the association between polymorphisms in cytokine and chemokine genes with TMDs.

Methods Study involved 170 individuals:85 TMDp patients, diagnosed according to DC/TMD, and 85 healthy controls. Intensity of orofacial pain was measured through Characteristic Pain Intensity (CPI) score from Graded Chronic Pain Scale, whereas TMD patients with CPI>50 were considered as a high pain intensity group (HPI). Genomic DNA was extracted from buccal mucosa swabs. Single nucleotide polymorphisms (SNPs) in genes encoding interleukin 8 (*CXCL8; rs2227306, rs2227307*), transforming growth factor β (*TGFB1, rs4803455*) and tumour necrosis factor-alpha (*TNF, rs1800629*) were analysed by real time-PCR using Taqman Genotyping assays. Assessment was performed according to dominant and recessive genetic models where minor allele represented the risk allele. Chi-Square Test, Fisher's Exact Test and Mann-Whitney U test were used for data analysis.

Results The frequency of patients carrying minor allele G of *rs2227307* was higher in TMDp patients than in CTRs (70% vs. 55%, p=0.041). Carriers of minor allele G and T of *rs2227307* and *rs2227306* respectively were significantly more represented in HPI group when compared to the rest of participants (75% vs. 57%, p=0.023; 71% vs. 55%, p=0.047, respectively). Also, TMDp subjects carrying GG+GT of *rs2227307* polymorphism reported significantly shorter pain duration in last 6 months (80 vs.112 days, p=0.041) and significantly higher *worst facial pain* (7.3 vs. 6.5, p=0.031) compared to the subjects with the TT genotype.

Conclusions Certain SNPs may predict pain intensity and chronicity in TMDp patients. Our results support the association between SNPs in pro-inflammatory chemokine genes and TMDp, highlighting the potential utility of genetic testing in predicting pain severity. Further research is needed to confirm these findings and explore underlying mechanisms.



PTH1R Variants and Molecular Causes for Primary Failure of Eruption

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Objectives Variants of the parathyroid hormone receptor 1 (PTH1R) are associated with primary failure of eruption (PFE), but the disease-causing mechanisms are poorly understood. We discovered a missense mutation in the open reading frame of PTH1R in one of our patients, which is up to now categorized as a variant of unclear clinical significance. Therefore, we set out to identify the disease-causing mechanism of this variant.

Methods PCR and Sanger sequencing was used to detect the sequence variant in the patients' relatives. PTH1R variants were generated by site-directed mutagenesis of commercially available wildtype PTH1R expression plasmid. EGFP-fusions of PTH1R variants were produced by standard cloning procedures. Intracellular localization was determined by transfection of PTH1R-EGFP expression plasmids into HEK293T cells and comparing fluorescence signal to pan-membrane stain CellMask orange (Thermo Fisher). **Results** The identified PTH1R variant could be detected in all analyzed patients' relatives suffering from PFE but not in healthy ones (N=5), underlining the relevance of this mutation as cause for PFE. To gain understanding of the molecular disease-causing mechanism, we checked intracellular localization of the PTH1R variant from our patient as well as two control PTH1R variants. Interestingly, the variant identified in our patient localized to the cell membrane like wildtype PTH1R, whereas the two other mutants expectedly were stuck in intracellular compartments. This result raises the question about the disease-causing mechanism. We now focus on signal transduction downstream of PTH1R to identify the molecular reason for PFE caused by the PTH1R mutant found in our patient.

Conclusions Gained results might lead the way to genetic counseling and may help to identify patients who need interdisciplinary treatment.



Opiorphin Release After Capsaicin Stimulation With Respect to Genotypes of Opiorphin Gene

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Objectives Opiorphin is an endogenous peptide isolated from saliva that has an exceptional analgesic effect. The study aimed to evaluate whether the opiorphin release after capsaicin stimulation depend upon genetic variants of opiorphin gene in chronic orofacial pain patients and healthy controls.

Methods Buccal mucosa swabs (for DNA extraction) and saliva samples were taken from 16 patients with burning mouth syndrome (BMS) patients, 16 patients with temporomandibular disorders (TMD) and 16 healthy controls. Single nucleotide polymorphism (SNP) in the opiorphin gene (*OPRPN*, *rs1387964*) was genotyped by real time-PCR using the Taqman Genotyping assays. To elicit a burning pain sensation, a series of 10 capsaicin-soaked disks were put in contact with dorsal tongue during 5 minutes. Saliva was collected three times, before capsaicin stimulation (1st sampling), immediately after the end of stimulation (2nd sampling) and 20 minutes after the end of stimulation (3rd sampling). Chi-Square Test and Mann-Whitney U Test were used for statistical analysis. Dominant and recessive genetic models were used in the assessment. The minor allele (C) represented the risk allele in both models.

Results The frequency of two minor allele carriers (CC genotype) of *rs1387964* was higher in chronic pain patients (TMD+BMS) than in controls. In all samplings higher opiorphin levels were observed in orofacial pain patients carrying the CC genotype when compared to subjects carrying the TC+TT genotype; a statistically significant difference was observed only in the 3rd sampling (p<0.05). In the control group, subjects carrying the TC+CC genotype presented higher opiorphin levels in 2nd sampling, when compared to subjects carrying the TT genotype (1.21 vs. 0.40 pg/µl, p=0.014).

Conclusions In patients with orofacial pain opiorphin levels were generally higher compared to healthy controls. A more intense reaction to the experimental stimulus with capsaicin was observed in carriers of minor allele C (of *rs1387964* of *OPRPN* gene). These results indicate that the specific regulation of opiorphin release may be genetically determined.



COVID-19 and Temporomandibular Disorders -Comparison of 3 Time Periods

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Objectives The objective of the present study was to compare the effect of the pandemic on painful and non-painful TMD in men and women, at three consecutive time periods: before the pandemic (pre-COVID), during the lockdown periods (during-COVID) and after the pandemic subsided and all social restrictions were abolished (post-COVID).

Methods A total of 587 adult patients (108 in the pre-COVID group, 180 in the during-COVID group and 252 in the post-COVID group), who arrived for a routine dental treatment at the School of Dental Medicine, Tel Aviv University, between October 2018 and January 2023 were evaluated according to Axis I diagnosis of the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD). Neither of the subjects arrived for treatment with a specific complaint referring to TMD. Each patient received a DC/TMD Axis I diagnosis as follows: (i) *Painful TMD* (defined by the presence of at least one of the following - local myalgia, myofascial pain with referral, arthralgia, or headache attributed to TMD); (ii) *Non painful TMD* (defined by the presence of disc displacement with/without reduction, degenerative joint disorders and/or dislocation).

Results Logistic regression analyses showed that the odds of subjects to be diagnosed with painful TMD in the post-COVID period were 3.3 times higher than pre-COVID period (95% C.I. 1.438-7.585). The odds of subjects to be diagnosed with non-painful TMD during-COVID were 4.0 times higher than at the pre-COVID era (95% C.I. 1.332-12.542). The odds of female subjects to be diagnosed with either painful or non-painful TMD were 3.7- 4.4 times higher, compared to males.

Conclusions Results indicate that with regard to TMD the adverse effects of the pandemic persist also after COVID-19 subsides and the restrictions caused by it are abolished. Apparently, during the pandemic females were affected more seriously by painful and non-painful TMD than males.





Improvement of Postoperative Third Molars Surgery Through Low Level Laser Therapy.

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Objectives Pain, edema and trismus are common consequences in third molars surgery. This study was aimed to evaluate effects of LLLT in the management of postoperative discomfort after complex third molars surgery.

Methods Helsinki Declaration and local ethics committee approval. Healthy volunteer with totally/partially impacted third molars were enrolled.

T0: collection of the maximum opening with digital caliber as trismus indicator, the presence of edema according to the method of Amin MM (1983) by measuring the distance between the cutaneous pogonion-tragus, and commissure-tragus, the disto-buccal and disto-lingual/palatal probing value of II molar.

T1 after 48h: the previous parameters + VAS scale.

T2 after 7 days: same T1 parameters.

After the surgical extraction, test sites were treated with laser (Medency Triplo) with an avarage power of 0.10W, red light with wavelenght 635nm, for 60 seconds with moving tecnique. The data was subjected to Two-Way mixed ANOVA.

Results Twelve healthy patients were enrolled, seven female and five male. Fourteen third molars were considered, seven test and seven controls.

Parameters are shown in Table 1.

Conclusions The differences between the averages in different observation times is more reliable than the observation of the difference within the single test and controls since it evaluates the parameter variation in the same population, reducing the differences due to sampling. LLLT is a non-invasive and rapid method. Its use seems to improve pain and edema reduction, but not trismus. LLLT can act on reducing postoperative pain.



Post-extraction socket.





Laser setted in LLLT mode.



LLLT.



Main results.

Parameter	CTR	TEST
Tg-Pg' T1	0.23	0.45
Tg-Comm T1	0.24	-0.26
Tg-Pg' T2	-0.42	0.49
Tg-Comm T2	-0.41	-0.1
PPD T1	0.47	0.37
PPD T2	0.28	0.18
Trismus T1	-3.21	-8.45
Trismus T2	2.48	0.91
VAS T2	-2.35	-3.12



The Effects of Doxycycline on Lip Wound Healing in Rats

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Objectives This study aimed to compare the effect of doxycycline with botulinum toxin A on wound healing caused by lip cleft surgery in rats.

Methods This animal study was performed on 15 male Wistar rats weighing. After creating wounds on the lips of rats of equal size, they were randomly divided into three groups: control (normal saline), doxycycline 202 and doxycycline 404. Three months after the last intervention, skin wounds were studied histologically and wound repair parameters including inflammatory cell density, angiogenesis, fibroblast proliferation, granulation tissue and epithelial tissue were evaluated and scored (none, mild, moderate, severe). The data were analyzed statistically (α =0.05).

Results No significant difference existed between the study groups in the parameters of inflammatory infiltration, angiogenesis, fibroblast proliferation, and granulation tissue (P>0.05). The intensity of epithelial cells in the studied groups showed a significant difference (P<0.001) with doxycycline 404 group showing the highest number of epithelial cells and the control group showing the least.

Conclusions Doxycycline 404 can be used for faster epithelialization in the wound healing process.



Microbiological Findings in Septic Patients of the Helsinki University Hospital

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Objectives Bacteria entering the bloodstream through oral mucosa cause bacteremia and lead to septic or metastatic infections. We investigated microbiological blood cultures of patients referred for oral examination by attending physicians due probable oral origin of systemic infection.

Methods Bacteremia patients (n = 128) suspected of having generalized infection due to oral infectious foci were referred to the Department of Oral and Maxillofacial Diseases for oral and radiological examinations during years 2012-2017. Patients were identified by WHO ICD-10 diagnoses for systemic or remote infections. Data came from medical and dental records. Each patient was scored according to a modified Panoramic Tomography Index (mPTI). Study groups were formed according to the blood culture findings of probable oral origin, non-oral origin, or culture negative.

Results *Streptococcus viridans* (16.4%) was the most common pathogen detected and followed by *Staphylococcus aureus* (13.3%) *and Streptococcus anginosus* (7.8%). mPTI score was lower in the "probable oral origin" group (1.4; 1 [0-8]), compared with "non-oral origin" (3.3; 2 [0-14]) and "blood culture negative" groups (3.10; 2 [0-17]) (p<0.005), respectively. In the blood cultures, *S. viridans* was identified in 4/14 cases with endocarditis and 15/28 cases with native valve prosthesis. 4/7 patients having *S. aureus* in the blood culture were intravenous drug users.

Conclusions Within the limits of this study, *Streptococcus viridans* sepsis was a relatively common finding. Lower mPTI scores were also significantly associated with pathogens from probable oral origin. A clinical oral examination with oral microbiological samples might have given different results. In the present study this had not been possible due to the patients condition. This finding emphasizes the importance of the oral clinical examination.

		Total number N=128
Age	In years, mean±SD (median; min-max)	56.1±16.7 (56; 17-91)
	Men	93 (73 %)
	Women	35 (27 %)
Radiological	PTI, mean±SD (median; min-max)	2.6±3.4 (1; 0-17)
Clinical examination		
	Endodontic foci	58 (45 %)
	Periodontal foci	66 (52 %)
PPD	4-mm	37 (46 %)
	5-mm	31 (40 %)
	6-mm	21 (25 %)
Pericoronitis	Present	9 (8 %)

Table 1. Descriptive and clinical variables of the study population.

PPD= Probing pocket depth



Table 2. Descriptive and clinical variables stratified by blood culture finding.

	Propable oral origin n=42 (33%)	Non-oral origin n=44 (34%)	Blood culture negative n=42 (33%)	p values
Age in years, mean±SD	56.5±14.9	54.4±20.3	57.7±14.1	0.651 a
Men Women	34 (81%) 8 (19%)	33 (75%) 11 (25%)	26 (62%) 16 (38%)	0.134 b
PTI, mean; median (min-max)	1.4; 1 (0-8)	3.3; 2 (0-14)	3.10; 2 (0-17)	0.005 c
Dental examination				
Endodontic foci	18 (43%)	17 (39%)	23 (55%)	0.300b
Periodontal foci	18 (43%)	25 (57%)	23 (55%)	0.380b
Caries	14 (35%)	3 (7%)	15 (37%)	0.002b
PPD				
4-mm	15 (50%)	10 (46%)	12 (43%)	0.859 b
5-mm	12 (43%)	7 (32%)	12 (43%)	0.669 b
6-mm	9 (29%)	6 (23%)	6 (21%)	0.775 b
Pericoronitis	3 (8%)	4 (10%)	2 (5%)	0.715 b
Oral mucosal lesions	2 (5 %)	5 (12 %)	2 (5 %)	0.442 b

PPD= Probing pocket depth (data available for 85 patients) Data are presented as number and percentage (%) Ns not significant aAnova test bChi-square test cKruskal-Wallis test



Does Systemic Inflammation Mediate Associations Between Gut Microbiome and Periodontitis?

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Objectives The gut microbiome has a strong symbiotic relationship with the human body and, potentially, also with the oral cavity. The relationship between the oral and gut microbiome might be bidirectional. Studies have suggested that alterations in the gut microbiome composition can lead to changes in the systemic inflammatory response, which may contribute to the development and progression of periodontitis.

Methods We considered cross-sectional data from the Study of Health in Pomerania (SHIP-TREND-0; 2008-2012; N=4420). Stool samples were collected and sequenced via the MiSeq platform (Illumina, San Diego, USA). The microbiome dataset was recorded and assessed at the genus level. Genera significantly associated with periodontitis were selected via sparse principal component analysis (sPCA) and sparse partial least squares – discriminant analysis (sPLS-DA). Regression models were performed between all the genera selected in the first component and the inflammatory biomarkers such as C-reactive protein (CRP) levels, fibrinogen levels, and white blood count (WBC) from the entire dataset as well as the individual inflammatory biomarkers from the Bioplex panel utilising the SHIP-TREND-0 Premium subset data. P values were adjusted for multiple testing controlling the false discovery rate at 5%. **Results** Gut microbiome data and periodontal data were available for 3088 subjects. In total, 350 genera were identified. The microbiome differed significantly across CDC/AAP periodontitis groups (p<0.0001). Among genera associated with the CDC/AAP case definition, Holdemania and Solobacterium were found to be significantly associated with increased serum CRP (Beta=24.09 g/l (95% CI:6.47-41.71)) and fibrinogen levels (Beta=0.83 g/l (95% CI:0.08-1.58)). Furthermore, Alloprevotella and Solobacterium were significantly associated with increased IL-10 (Beta=0.05 (95% CI:0.01-0.09)) and MMP1 (Beta=11.12 (95%CI:1.81-20.44)) levels, respectively. However, all significant associations relating to systemic inflammatory markers were lost after accounting for multiple testing.

Conclusions Associations of the gut microbiome with periodontitis were not explained by variations in systemic inflammation markers.



Prevalence of Periodontitis in 70-Years Old in Western Norway

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Objectives The aim of the present study was to assess the prevalence of periodontitis in an elderly cohort (born in 1950-1951) from Western Norway, by using two different periodontitis case definitions.

Methods This cross-sectional study was based on data from an oral health screening examination and a health survey (HUSK-3) in Western Norway. Periodontal conditions were assessed for 1298 adults with at least two natural teeth. Probing depth and gingival recession were measured from six sites per tooth and clinical attachment loss was recorded. Self-reported history of diabetes and tobacco use were collected from questionnaires. The 2018 EFP/AAP periodontitis classification criteria and the diagnostic criteria by Eke et al. 2015 were used for case definition.

Results

Almost all the elderly participants had periodontitis. According to the 2018 classification and Eke et al 2015, the majority were in Stage III (61%) and had moderate severity (65%), respectively. Smokers and diabetic participants were over-represented in stage III/IV and moderate/severe periodontitis.

Conclusions This study shows a very high burden of periodontitis. The 2018 periodontitis case definition did not discriminate between those with and without periodontitis.

Periodontitis case definitions	All Participants n=1298 N (%)	Current smoker n=71 N (%)	Diabetic n=75 N (%)
The 2018 world Workshop EFP/AAP			
No periodontitis	1 (0.08)	-	-
Stage I	45 (3.47)	3 (4.23)	3 (4.00)
Stage II	230 (17.72)	8 (11.27)	8 (10.67)
Stage III	790 (60.86)	41 (57.75)	44 (58.67)
Stage IV	232 (17.87)	19 (26.71)	20 (26.67)
Eke et al, 2015			
No periodontitis	100 (7.70)	5 (7.04)	5 (6.67)
Mild	3 (0.23)	-	-
Moderate	846 (65.18)	34 (47.89)	40 (53.33)
Severe	349 (26.89)	32 (45.07)	30 (40.00)



Impact of Red Complex Pathobionts on the Maturation of Osteoclast-Like Cells

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Objectives Osteoclasts are multinucleated giant cells that originate from mononuclear cells. In addition to the host related factors, in periodontal disease also bacteria may contribute to the bone destruction through induction of osteoclast differentiation from monocyte/macrophages. Cathepsin K is a protease secreted by mature osteoclasts, which destroys connective tissues and contributes to destruction of tooth supporting tissue. We analyzed the effect of periodontal pathobionts of the "red complex", composed of *Porphyromonas gingivalis, Treponema denticola* and *Tannerella forsythia*, on osteoclast maturation.

Methods For osteoclast generation, human primary blood mononuclear cells were isolated from peripheral blood and cultured in the presence of macrophage colony-stimulating factor and receptor activator of nuclear factor-κB ligand to stimulate the monocyte-to-osteoclast differentiation. During the differentiation the cells were stimulated with lipopolysaccharides (LPS) isolated from red complex pathobionts. We measured the mRNA expression of cathepsin K on day 1, 3, 7 and 14 using qRT-PCR.

Results The expression of cathepsin k (*CTSK*) was significantly upregulated on day 14 marketing the osteoclast maturation. Stimulation of the cells with LPS derived from *T. denticola* and the mixture of the red complex pathobionts significantly enhanced the gene expression of *CTSK* by day 14 compared to the unstimulated cells.

Conclusions Among red complex pathobionts, especially *T. denticola* LPS enhanced the maturation of osteoclast-like cells thereby potentially contributing to the pathogenesis of periodontal disease.



Objectives Diode lasers can be used in the treatment of periodontal diseases as they have an anti-bactericidal effect, and regulate oral tissue inflammatory responses. This study aimed to evaluate the adjunctive effects of Diode 940 nm laser on mechanical periodontal debridement.

Methods In this split-mouth single-blind randomized clinical trial, 12 patients with chronic periodontitis and systematically healthy were included. All patients signed informed consent before the study and the protocol of the study was approved by the ethics committee. 44 oral segments including the first premolar, second premolar, and first molar were enrolled in the scaling and root planing (SRP) group and SRP+Laser group with a 1:1 allocation ratio following a simple randomization procedure (coin flip). Clinical parameters (Pocket Depth (PD), Clinical Attachment Loss (CAL), and Bleeding on Probing (BOP)) in six areas were measured at baseline. After the Scaling and root planing and oral hygiene instructions to patients, a 940 nm Diode laser [1 Watt power and continuous wave mode] was used in the SRP+Laser group as an adjunctive treatment. The clinical parameters were remeasured 2 months post-treatment. Statistical analysis was carried out using an unpaired t-test (P P<0.05).

Results Although all clinical parameters had more improvements in the SRP+Laser group, the differences were not significant between the two study groups (P>0.05). Only in individual tooth evaluations, CAL changes in first and second premolars and BOP changes in second premolars show statistically significant improvement in the SRP+L group compared to the SRP group (P<0.05). **Conclusions** Using a diode 940 nm laser as an adjunctive treatment for SRP may be helpful and can be suggested for periodontal treatment.

Teeth	Method	Mean±SD	p-Value	
First premolars	SRP	0.81±0.29	P=0.042	
	SRP+Laser	1.17±0.45	Significant	
Second premolars	SRP	0.86±0.51	P=0.048 Significant	
	SRP+Laser	1.26±0.4		
First molars	SRP	0.92±0.54	P=0.23	
	SRP+Laser	1.15±0.29	NS	

The changes of CAL in the SRP and SRP/Laser groups (mm)

SD: Standard deviation, NS: Not significant

The changes of BOP in the SRP and SRP/Laser groups (mm)

Teeth	Method	Mean±SD	p-Value	
First premolars	SRP	3.81±3.18	P=0.51	
	SRP+Laser	4.72±3.25	NS	
Second premolars	SRP	2.91±2.02	P=0.006 Significant	
	SRP+Laser	6.16±3.12		
First molars	SRP	2.54±2.84	P=0.54	
	SRP+Laser	3.36±3.41	NS	

SD: Standard deviation, NS: Not significant



The changes of overall PD, CAL and BOP in the SRP and SRP/Laser groups.

Clinical Parameter	Method	Mean±SD	p-Value
PD	SRP	1.12±0.38	P=0.56 NS
	SRP+Laser	1.21±0.27	
CAL	SRP	0.88±0.31	P=0.07
	SRP+Laser	1.14±0.21	NS
BOP	SRP	3.03±2.49	P=0.06
	SRP+Laser	5.16±2.44	NS

PD: probing depth, CAL: clinical attachment loss, BOP: bleeding on probing, SD: Standard deviation, NS: Not significant



Multidimensional (3D) Customized Scaffolds for Bone Regeneration in Periodontal Patients.

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Objectives The application of regenerative medicine in the field of periodontology follows the principles of tissue engineering tailormade for the environment of the oral cavity. The computer-aided technology has enabled the manufacturing of multidimensional (3D) customized scaffolds via cone beam computed tomography (CBCT).

This review aimed to examine whether 3D customized scaffolds facilitate bone regeneration in periodontal patients.

Methods A total of 7 electronic databases (Pubmed, Scopus, Science Direct, Google Scholar, Cochrane, Web of Science, Ovid) were searched and the appropriate studies were identified with the use of specific eligibility criteria, according to PRISMA guidelines. Two reviewers independently screened and selected the studies and made the data extraction and the assessment of risk of bias, by using the Newcastle-Ottawa Scale for non-randomized clinical trials.

Results The search strategy included initially 795 articles that remained 471 after duplicates removal. Following screening articles on title and abstract level, 5 studies were left for full-text assessment. Finally, merely two studies met all eligibility criteria. Both of them were prospective non-randomized clinical trials so they were assessed with the Newcastle-Ottawa Scale, and scored 6 out of 9 stars. Both studies concluded that multidimensional customized scaffolds seem to facilitate periodontal regeneration.

Conclusions Overall and despite the positive effects reported, further research is needed to define the ideal 3D scaffold for periodontal regeneration.



Leveraging Human Oral-Derived Neural Crest-Derived Stem Cell Homing

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Objectives Recently, cell homing has resulted in remarkable biological discoveries in the laboratory as well as great curative successes in preclinical scenarios. Here, we review using the results of an initial clinical- and histological-controlled study the biological evidence underlying *in vivo* cell mobilization and homing with the aim of leveraging endogenous reparative cells for therapeutic applications in dental regenerative implantology.

Methods Oral neural-derived stem cells (oNCSCs) often referred to as the fourth germ layer, comprise a migratory, stem and progenitor cell population and are synonymous with vertebrate evolution and development. The cells follow specific paths to migrate to different locations of the body where they generate a diverse array of cell types and tissue. Due to this intrinsic potential to give rise to cells of two germ layers (ectoderm and mesoderm), NCCs possess an extraordinarily high developmental potential surpassed only by totipotent cells of the zygote and pluripotent embryonic stem cells. There are oNCSCs which are maintained in an undifferentiated state throughout the life in the oral tissues.

Results oNCSCs express higher levels of cytokeratin 18 and 19 (CK-18 and CK-19). Further, oNCSCs showed faster proliferation rate and a higher telomerase activity. oNCSCs express higher level of BMP-2 and BMP-6 mRNA. Further underlining the neural crest origin of these cells, all oNCSCs described so far have the intrinsic ability to give rise to osteogenic cell types. Osteogenic induction at early phase can be assessed by determination of the activity of alkaline phosphatase (ALP) or by RT-PCR or qPCR-based measurement of marker gene, o.g. Osteopontin, Osterix, Osteonectin.

Conclusions The human palate has been shown to be of critical importance in the regenerative process. Although it is clear, that oNCSCs residing in the subepithelial soft tissues of the palate can achieve bone regeneration, this population is heterogenous. These so called oral neural crest-derived stem cells (oNCSCs) were isolated by minimally invasive periodontal surgery and cultured as so-called dentaspheres under serum-free conditions.



Proteomic Analysis of Gingival Cell-Secretomes From Healthy and Periodontitis Patients

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Objectives Gingival fibroblasts (GF) play an important role in periodontal tissue homeostasis, disease progression, wound healing, and regeneration. GF can regulate the local microenvironment through paracrine mechanisms via the secretion of bioactive molecules and vesicles. Cell secretomes have also emerged as a promising strategy for periodontal regeneration. The objective of this study was to compare the proteomic profiles of secretomes derived from GF of healthy and periodontitis patients.

Methods GF were isolated from gingival biopsies obtained from adult Stage III/IV periodontitis patients during periodontal surgery (n=6) and healthy donor-controls (n=6). Conditioned media of passage 2-3 healthy (h-GFS) and periodontitis GF (p-GFS) were obtained following 48 h serum-free culture and subjected to label-free mass spectrometry and multiplex immunoassay. Bioinformatics was performed to determine global profiles, differentially expressed proteins (DEP), and gene ontology (GO) enrichment of biological processes (BP), molecular functions (MF) and cellular components (CC).

Results Proteomic analysis revealed a total of 2627 proteins in h-GFS and 2625 in p-GFS; 2425 proteins were common between the groups (Fig. 1a,b). These included several growth factors, cytokines/chemokines, and extracellular matrix (ECM) proteins (Table 1). Quantitative analysis revealed 93 DEP between the groups, of which 91 proteins were significantly increased in h-GFS (Fig. 1c). GO analysis of the increased proteins revealed significant enrichment of several CC, MF, and BP (Fig 1d). A majority of the enriched CC (extracellular vesicle, extracellular space, cytoplasm), MF (cadherin binding, calcium binding, protein binding), and BP (cellular metabolic process) were related to cell metabolism and function.

Conclusions Global proteomic profiles of GF-secretomes from healthy and periodontitis tissues were largely similar, including several key proteins important for healing and regeneration. Given the relative ease of harvesting during surgery, GF from periodontitis patients may represent a promising source of secretomes for regenerative therapies.



Figure 1: (a) Venn diagram showing common and exclusive proteins in healthy (h-GFS) and periodontitis GF secretomes (p-GFS), (b) unsupervised hierarchical clustering analysis of all proteins in h-GFS and p-GFS (n=6 donors each), (c) volcano plot showing differentially expressed proteins (DEP) in h-GFS (right, n=91) and p-GFS (left, n=2), (d) top enriched GO biological processes, molecular functions and cellular components.

Table 1: Common proteins in h-GFS and p-GFS classically associated with growth factors, inflammation and extracellular matrix (ECM) formation/remodeling



Category	Protein (gene symbol)
Growth factors	TGF-family (TGFB1, TGFB2, TGFB1, TGFBR2, TGFBR3, LTBP1, LTBP2, LTBP3, LTBP4), BMP1, FGFRL1, PDGF-family (PDGFD, PDGFRA, PDGFRB), EGF-family (EFEMP1, EFEMP2, EGFR, EPS15, EPS15L1), IGF-family (IGF1, IGF2, IGF2R, IGFBP2, IGFBP3, IGFBP4, IGFBP5, IGFBP6, IGFBP7), MEGF-family (MEGF10, MEGF6, MEGF8), VEGF-family (VEGFA, VEGFC, FLT1, FLT4), ACE, ANGPTL2, ANGPTL4, CCN-family (CCN1, CCN2, CCN3), CLEC11A, CTNNB1, EDIL3, HDGF, MET, HGF, KITLG, MYDGF
Chemokines	IL-family (IL1RAP, IL6ST, ILF2, ILF3), MIF, TNF-family (TNFAIP6, TNFRSF10B, TNFRSF11B, TNFRSF12A, TNFRSF1A), CAPG, CCL2, CSF1, CTSK, CXCL12
ECM proteins	Collagens (COL1A1, COL1A2, COL3A1, COL5A1, COL5A2), ECM1, SPARC, CLEC3B, MMPs (MMP1, MMP10, MMP14, MMP2, MMP3), TIMPs (TIMP1, TIMP2, TIMP3), MXRA5, MXRA8


Evaluation of Mandibular Trabecular Bone Structure in Ankylosing Spondylitis Patients

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Objectives Fractal analysis is a mathematical method that enables the quantitative description of complex structures and shapes. It has been reported that bone density is low in individuals with ankylosing spondylitis (AS) compared to healthy individuals. The aim of this study was to compare the fractal dimension values of mandibular trabecular bone on panoramic radiographs of patients with AS and healthy control subjects.

Methods In the study, panoramic radiographs of individuals who were identified as AS in the anamnesis records in the dental school database and systemically healthy individuals matched in terms of age and gender were used. Fractal analysis was performed on 6 different ROIs: right and left condylar region, right and left angular region, dentate alveolar region: anterior to the right and left mental foramen without any tooth root. Box-counting method was used for fractal analysis and was performed with ImageJ program. The results of the statistical analysis were evaluated according to a significance level of 0.05.

Results A total of 136 panoramic images of 136 individuals, 68 cases and 68 controls, were analyzed. There were 55 females and 81 males with a mean age of 40±7 years. The mean fractal dimension values of 6 different regions were as follows: right dentate: 1.38, right gonial: 1.42, right condyle: 1.40, left dentate: 1.37, left gonial: 1.43, left condyle: 1.40. There was no statistically significant difference in fractal dimension values between case and control groups (p>0.05).

Conclusions The fractal dimension of mandibular trabecular bone in individuals with AS is similar to healthy individuals. It is recommended to investigate possible changes with different image processing methods.



0309 Immediate Loading of Dental Implants: a Nine-Year Randomized Clinical Study

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Objectives Within a prospective long-term study the prognosis of immediately loaded mandibular overdentures retained by two locator attachments or an egg-shaped joint bar should be investigated. Furthermore, the effect on oral health related quality of life was analyzed.

Methods Forty-six patients with edentulous mandibles received within 72 h after implant placement, two implant retained dentures with either two Locator attachments or an egg-shaped joint bar. Follow-up examinations included documentation of implant related complications, modified gingiva index (mGI), modified plaque index (mPI), OHIP-G and radiographic measurements of bone loss. **Results** Up to nine years after restauration twenty-seven patients with fifty-four implants were available for the follow-up. During the observation period, nine implants in six patients were lost. Implant survival was 89.1% in the bar group and 91.3% in the locator group. The mPI values were significantly higher in the bar group than the locator group, whereas no difference was seen in the mGI values. During the observation period 152 prosthetic complications occurred that required aftercare measures. Interventions for complications, such as refixing retention clips, relining mandibular overdentures, and changing or activating the clips, were frequent in both groups. Scores for the different OHIP-G domains at the first and last follow-up did not differ significantly between the two periods. 100% from the locator group and 84.62% from bar group would recommend the selected treatment option.

Conclusions There is no difference in implant survival between Locator or joint bar attachments over a nine-year observation period. Joint bar attachments were associated with more complications while patients in the locator group were able to maintain better oral hygiene.



Objectives Recently, cooper containing nanoparticles have been used as antimicrobial agents against different pathogenic organisms and during the last years have been incorporated on dental materials.

In the present work, we studied the effect of Cu⁰, Cu₂O, and CuO nanoparticles on the growth, viability, and biofilm formation of two caries-associated pathobionts (*S. mutans* and *L. rhamnosus*), and two commensal microorganisms (*S. salivarius* and *S. sanguinis*). **Methods** We use Cu⁰, Cu₂O, and CuO nanoparticles of 30-40 nm size. We test their antibacterial properties by MIC assays and CFU counting, and antibiofilm activity of nanoparticles in vitro, using crystal violet, and ex vivo, using electronic microscopy. **Results** Our results show that Cu⁰, Cu₂O, and CuO NPs differentially affect bacteria being *S. sanguinis* the most tolerant, and *L. rhamnosus* the most sensitive. Interestingly, CuO NPs exhibited higher toxicity over pathobionts than commensal bacteria. This phenomenon was also observed when the bactericidal effect of CuO NPs was evaluated, resulting in a stronger bactericidal effect (> 99.99 % dead of *S. mutans* and *L. rhamnosus*) compared to *S. sanguinis* (94 % dead). We also showed that Cu NPs decreased *S. mutans* biofilm formation. Interestingly, no effect over biofilm formation was observed in *S. sanguinis* exposed to Cu⁰, Cu₂O, and CuO NPs over biofilm formation on teeth crowns. Ex vivo assays showed that all Cu NPs diminished the biofilm formation and produced detachment of its mature biofilm.

Conclusions To our knowledge, this is the first work analyzing the effect of NP-Cu on beneficial and pathogenic oral bacteria. Our results revealed that bacteria associated with health and pathogenicity have different sensitivity to Cu NPs, being the oxides the most toxic compounds for pathogenic bacteria.



0311 Dental Trauma Knowledge in Public Dental Services: Need for Updating

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Objectives General dentists employed in the Public Dental Services (PDS) in Norway, are the primary care providers for traumatic dental injuries (TDI). This cross-sectional study aimed to evaluate the knowledge of general dentists regarding the management of TDI in the PDS in Western Norway.

Methods An electronic questionnaire was distributed to all general dentists of Vestland County, Norway (N=165). The sociodemographic and professional profiles of respondents were registered and clinical case scenarios on emergency treatment and further follow-ups of TDI were used to calculate a "Dental Trauma Knowledge Score (DTKS; range: 0-14). Mann-Whitney U, Kruskal-Wallis tests, and univariate logistic regression analysis were performed for statistical analysis.

Results The final study group consisted of 76 dentists. The median Dental Trauma Knowledge score (DTKS) was 9 (IQR: 7,75-11). No significant differences in total DTKS could be seen regarding gender, age, and work experience. However, dentists aged 30-39 years and 40-49 years had significantly lower DTKS compared with younger dentists (< 30 years) regarding the emergency treatment of complicated crown fractures (P< 0.01) and complications after tooth avulsion (P< 0.01). Furthermore, female dentists had significantly lower DTKS scores compared with male dentists on emergency treatment of pulp exposure in mature and immature teeth (P< 0.001 and P< 0.01, respectively).

Conclusions Overall, a good level of knowledge on TDI management was observed among dentists in PDS of Vestland County, Norway. It seems that younger dentists that recently graduated had a more up-to-date knowledge on TDI management of pulp exposures. There seem to be knowledge gaps when it comes to complicated crown fractures and avulsion. An update in TDI knowledge in PDS is indicated.



Empathy of 4th Year Dental Students in Cote d'Azur University.

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Objectives Empathy is essential in physician-patient relationship, on physical and mental patients' health and on their satisfaction as well as physicians' well-being at work. This study aims at exploring the scores of empathy from 4th year dental students in Cote d'Azur University.

Methods An information letter was sent to students to obtain their consent. Then, the 48 forth-year dental students participated in a cross-sectional study using a self-evaluation of empathy: the structured Jefferson questionnaire (JSE-HPS), a 20- item 7-point Likert scale (strongly disagree = 1, strongly agree = 7), with an individual score range of 20 to 140. They also filled in a socio demographic questionnaire. Categorical variables were summarized as frequencies and proportions. Continuous variables were expressed as means and standard deviations. Independent t-test and analysis of variance (ANOVA) were used to analyze differences in mean empathy scores across gender, specialty preference and socioeconomic background.

Results The total mean empathy score was 80.75 ± 11.23 . The mean empathy score was higher for the female students (82.05 ± 21.17) than for males (75.8 ± 21.17)(p= 0.016). In terms of professional project, students motivated by general practice had highest empathy scores (82.67 ± 7.10) compared with those interested in specialties (79.60 ± 13.21) although, this was not statistically significant (p = 0.576). Students coming from high socioeconomic backgrounds tended to have higher empathy scores (82.8 ± 7.19) than others (77.33 ± 15.85) (p=0.17).

Conclusions Disclosure of risk factors for low empathy levels may be useful for teachers to ensure the development of a positive and empathic attitude for dental students.



Objectives Numerous techniques have been employed for the assessment of enamel remineralisation. This study aims to compare the changes in surface morphology with different varnishes in the remineralization of artifical enamel caries lesion in permanent molars using scanning electron microscope(SEM).

Methods The extracted molars were kept in a 0.1% thymol solution until the experimental procedure was initiated. Fifteen enamel samples were used in our study. Samples randomized into 5 groups (n=3) after demineralisation: Group 1(G1): 5 %Sodium Fluoride (NaF) + 3 %Rennou (Theobromine and Calcium/Phosphate), Group 2 (G2): 3% Rennou, Group 3 (G3): 5 % NaF, Group 4(G4): Rosin and Group 5(G5): Deionised Water. Each group was subjected to a pH cycling model for 6 days. The scanning electron microscope was used to determine and compare the morphological changes between the different treated samples. Images were obtained at x1000 and x2500 magnification.

Results SEM photomicrographs of the varnish groups demonstrated a uniform layer with dispersed amorphous precipitates. After treatment within 5 % NaF group, many flaky sediments were found on the enamel surface. Similarly, the maximum mineral gain was seen in all 3% Rennou groups.

Conclusions In conclusion SEM observations showed altered surface morphologies within the artificial lesions in all varnish groups. Under in vitro conditions, all varnish groups treated artificial enamel caries lesions demonstrated particles scattered on the surface at different degrees. Rennou varnishes were as effective as NaF varnish in remineralizing initial caries lesion. Additional investigation is needed to be further confirmed with regards to clinical application



Near-Infrared Light Transillumination Enabled Early Caries Detection Among Finnish Adolescents

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Objectives The aim was to evaluate the ability of near-infrared light transillumination (NIR-LT) to detect interproximal enamel and dentinal caries lesions compared to clinical-visual (VI) examination using the International Caries Detection and Assessment System (ICDAS), aided by fibre-optic transillumination (FOTI), among a low caries risk population.

Methods

The study population comprised 170 15–17-year-olds in the Physical Activity and Nutrition in Children (PANIC) study. Interproximal surfaces of premolars and molars (n=5294) were first inspected visual-tactilely (VI) and using FOTI (VI+FOTI) and secondly using NIR-LT. VI+FOTI findings were recorded using ICDAS criteria and NIR-LT findings using the Söchtig and modified classification (MC) criteria. For the analyses, teeth were grouped as upper and lower premolars and molars. Distribution of lesions was presented as frequencies. Differences between the findings using NIR-LT and VI+FOTI at tooth and tooth surface level were analysed by Chi square and Fisher's tests with a statistical significance level of 0.05. Sensitivity and specificity of the NIR-LT method was calculated with the cut-off point sound/any lesion using VI+FOTI as the gold standard.

Results Of the analysed surfaces, 92.4% were classified as sound and 7.0% having initial lesions by VI+FOTI, and 88.2% and 11.6% by NIR-LT, respectively. Outcome of initial lesions detected by NIR-LT was nearly double for all tooth groups except for lower molars, where the trend was similar. In 66% of the surfaces, the difference between NIR-LT and VI+FOTI findings was statistically significant. Of those detected as being decayed by VI+FOTI, 7% were diagnosed as sound by NIR-LT, when the respective proportion in the opposite case was 46%.

Conclusions More specific classification of NIR-LT findings offered useful information on the depth and type of initial lesions. NIR-LT provides a non-invasive supplementary method for caries detection in a population with low risk for caries, even for initial lesions.



Leakage From Fluoride-Releasing Restoratives Influence Streptococcus Mutans Virulence Characteristics

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Objectives Modern restoratives can influence bacterial growth by releasing or exchanging ions (e.g., fluoride, calcium, strontium) with the oral environment. This study investigated how restoratives' effluents (fluoride) influence *Streptococcus mutans* (SM) genetic virulence response (*vicR*, *atpD*) and glucosyltransferase production (*gtfB*, *gtfC*, *gtfD*).

Methods Discs from six restoratives: Caredyne (CA), Fuji VII (FU), Ketac (KE), Fx Ultra (FX), Activia BioActive (BA), Beautifil (BE) were anaerobically incubated (37^oC, 24hrs) with SM suspension in pH adjusted (5.5, 7.0) Brain-Heart-Infusion (BHI) broth. NaF (10ppm, 25ppm) solutions and non-treated control were included in the assay. Reverse-Transcriptase qPCR was used to quantify expression levels of five target genes with 16S rRNA as internal reference gene. Fluoride release was measured with a fluoride-ion electrode. Samples were run in duplicates and were statistically analyzed (t-test, ANOVA, Tukey's, p<0.05).

Results BE leakage upregulated expression of *gtfD* (3.8) *atpD* (6.1) *vicR* (4.2) significantly in pH 7.0. Additionally, the expression of *gtfD* was significantly upregulated (4.9; 3.8; 4.3) in pH 5.5 for BE, FX and BA, respectively.

FU downregulated all target genes in both pH conditions. Significant difference for *gtf B (0.1), gtfC (0.2), and gtfD (0.1)* gene expression in pH 7.0 was observed in comparison with BE (2.6; 3.0; 3.8) and 25ppm NaF (3.0; 2.8; 2.7). Neither concentration of NaF significantly influenced target genes expression regardless of pH.

Differences between the two pH conditions were observed only for the *gtfB* gene for KE, CA, and 25ppm NaF. Released fluoride ranged from 0.23–0.14 mg/mL for CA, FU, KE, FX and 0.013-0.003 for BA and BE.

Conclusions The glucosyltransferase group of genes significantly responded to the presence of tested restoratives regardless of the released fluoride amount. However, adding NaF did not induce any response, suggesting that other factors are responsible for the changes.

Acidurity (*atpD*) and stress response (*vicR*) remained unchanged.



The Feasibility of Managing Caries in Children With Minimal Intervention Dentistry

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Objectives This practice-based study assessed the facilitators and barriers in researching the effectiveness of Minimal Intervention Dentistry (MID) in children with dental caries.

Methods Dental professionals in primary care dental practices in the UK were asked to participate and deliver MID to children that presented with dental caries in their permanent molars. Clinicians, children, and parents were asked to complete questionnaires on fidelity, quality of life, dental anxiety and treatment acceptability. A sample of participants were also invited to semi-structured qualitative interviews exploring their experiences of taking part in the study.

Results After development of the complex intervention, 46 dental professionals across 10 dental practices attended MID training workshops, and then provided MID to 86 children (mean age11.7yrs) with dental caries. Following training 96% of dental professionals felt it supported their decision to participate in the trial. The sample of children recruited included an even range of carious lesions from ICDAS caries code 1 to 5.

Overall, 24 dental professionals participated in qualitative interviews. They supported the value of MID research in practice. Wider practice team support, training in MID, and practice organization facilitated research participation. Dental Professionals highlighted the competing pressures of conducting research whilst trying to deliver routine dental activity.

Analysis of interviews with children and parents reinforced positive support for participation, and highlighted additional resources that may be desirable such as videos for patient information.

Conclusions Dental professionals, children and parents gave positive support for practice-based research in MID. Facilitators such as wider practice team involvement, MID training incorporating scenario-based training, and practice organization, were seen as helping research delivery. A definitive trial of MID for children with dental caries is feasible. Refinements in the study design would aid delivery of a definitive practice-based trial assessing effectiveness of MID.



25-Hydroxyvitamin D Strongly Correlates to LL-37 in Saliva

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Objectives The oral cavity is a unique environment. During the last years, there has been an increased interest regarding the innate immunity of the mouth and especially of the mechanisms by which vitamin D impacts oral health. The interest of researchers has recently been focused on the relationship between vitamin D and the antimicrobial peptide LL-37 as recent studies have shown that the gene CAMP, that encodes the peptide LL-37, is a direct target of both vitamin D and its receptor (Vitamin D Receptor, VDR). The present study aimed toinvestigate the correlation between the 25-Hydroxyvitamin D levels and the concentration of the LL-37 in circulation or topically in the oral cavity.

Methods Serum and whole saliva levels were obtained from 72 healthy adults (mean age 28.68±8.35). 25-Hydroxyvitamin D and LL-37 levels were determined in both saliva and serum samples by the Enzyme-linked immunosorbent assay (ELISA) using commercially available kits.

Results 25-Hydroxyvitamin D levels in serum (median 5.92 ng/ml, min-max 2,7-10,4 ng/ml) correlated to LL-37 serum levels (62 ng/ml, min-max 18-378 ng/ml) (Pearson's r 0.328, p=0.005), and 25-Hydroxyvitamin D levels in saliva (median 1,16ng/ml, min-max 0,54-2,12 ng/ml) strongly correlated to LL-37 salivary levels (median 44 ng/ml, min-max 6.5-205 ng/ml) (Pearson's r 0.667, p<0.001). **Conclusions** Vit D salivary levels strongly correlate to LL-37 salivary levels. This finding enhances the significance of the vitamin D role in the immune response of the oral cavity.



Vital Pulp Therapy in Symptomatic Permanent Molars: a Case Series

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Objectives The objective was to investigate the effectiveness of vital pulp therapy (VPT) in symptomatic young permanent first molars at 12 months follow up.

Methods Nine patients (mean chronological age 13 years), with nine carious first permanent molars, five upper and four lower, and symptoms of either reversible (n=3) or irreversible (n=6) pulpitis were presented in the Post Graduate clinic of Paediatric dentistry (NKUA). The following clinical and radiographic parameters were registered at 12 months after the therapy: the absence of spontaneous pain, pain on percussion, and the absence of swelling and fistula , the absence of widening of the periodontal ligament, and internal or external root resorption as well as the root development and maturation.

Results Treatment performed was complete pulpotomy in all but two cases where partial pulpotomy was chosen. Mineral Trioxide Aggregate was the material used, with the final restoration being either a stainless steel crown (n=4), a composite resin restoration (n=3) or an onlay (n=2).

Clinical and radiographic evaluation revealed no signs of sinus or fistula and absence of widening of the lamina dura or periapical radiolucency in all cases.

Twelve months post-treatment all cases were considered successful as there was no clinical or radiographic evidence of further progression of pulp inflammation and the patients remained asymptomatic.

Conclusions VPT can be an effective alternative to endodontic treatment for teeth with symptoms of reversible or irreversible pulpitis, with the most important factor affecting treatment success being the proper control of pulpal inflammation.



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Objectives Charcot-Marie-Tooth (CMT) disease is characterized by hereditary motor and sensory neuropathy with muscle weakness, atrophy predominating in the lower extremities and rarely with dental findings. The aim of this case report is to present the dental findings of a patient with CMT disease.

Methods A 9-year-old male patient referred to Ege University, Faculty of Dentistry, Department of Pedodontics with the complain of enamel-dentin fracture in his maxillary central incisor, caused by trauma. According to his anamnesis, he had no systemic disease. The clinical and radiographic examinations revealed that his maxillary central incisor was single and positioned on the midline without labial frenulum and the other maxillary central incisor was congenitally missing. In addition, the patient had caries at the primary molars and he had poor oral hygiene. After the esthetic restoration of incisor tooth with composite (GC G-aenial, Tokyo, Japan) and treatment of primary molars, the patient was referred to Ege University, Faculty of Medicine, Department of Medical Genetics, due to his dental findings. After his genetical analysis, he was diagnosed as Charcot-Marie-Tooth (CMT) hereditary neuropathy. **Results** The patient was undertaken to routine controls at the Departments of Pedodontics, Orthodontics and Medical Genetics at Ege University. He was followed up every 6 months at 3 years. During the recalls, special emphasis was given to the oral hygiene and motivation.

Conclusions Genetic disorders are showing an upward trend and dentists have an important role at the diagnosis of these disorders according to the dental findings of their patients. Dentists should proceed their dental treatments with awareness.



0186 **Traumatic Dental Injuries of Children/Adolescents in Croatia: 8-Year Retrospective Study** <u>L. Vranic</u>, B. Špiljak, L. Bergman, D. Negovetić Vranić School of Dental Medicine Zagreb, Zagreb, Croatia

Objectives Traumatic dental injuries (TDI) are a common reason for children and adolescents to visit a dentist. This paper presents the distribution, prevalence, type, and etiology of dental and soft tissue injuries, as well as the relationship between time of arrival and soft tissue injury.

Methods A retrospective study was conducted to collect data from patients aged 1 month to 18 years with primary and permanent tooth injuries. Trauma charts were organized by age, gender, place, source, hour, season, interval between injury and treatment, number of traumatized teeth, injured teeth, type of trauma, and soft tissue injuries. TDI were classified into three groups based on the need for urgent treatment or treatment priorities: green (conditions for delayed treatment), yellow (subacute conditions; within 24 hours), and red (urgent/acute conditions; treat as soon as possible).

Results The study included 1040 children (59% male and 41% female) with a median age of 7 (Q1 3 - Q3 9 years). Zagreb (capital city) was home to 56.15% of the patients. The spring season had the highest rate of TDI (28%), with the other three seasons being equally represented. The majority of TDI cases (25.38%) occurred while children were playing or at home (23.85%). A more detailed description of the accident revealed that they either fell (38.27%) or had TDI while riding a bicycle or roller skates (27.7%). Soft tissue injuries were found in 274 (26.35%) of the patients. The most common time between injury and therapy was 1-7 days (31.15%). Over an 8-year period, 266 (25.58%) TDI were in the green, 554 (53.27%) in the yellow, and 220 (21.15%) in the red group. **Conclusions** Immediate treatment is essential for traumatic dental injuries, and preventive measures such as mouthguards should be used to evaluate potential psychosocial factors.



Long-Term Comparison Between Mini-Implant Assisted and Tooth-Borne Rapid Maxillary Expansion

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Objectives Tooth-borne rapid maxillary expansion (T-RME) has been used for correcting transverse maxillary deficiency. Mini-implant assisted (M-RME) has been recently introduced, but few studies have compared the long-term stability between the two RMEs in adult patients. This study was conducted to investigate differences in long-term stability between the tooth-borne and mini-implant assisted RMEs in adult patients.

Methods Fifteen patients with T-RME and twelve patients with M-RME were included. Dentoskeletal and soft tissue variables at pretreatment, three months after expansion (T1), and at least 12 months after expansion (T2) were measured using lateral and posteroanterior cephalograms and frontal photographs. The changes within each group between T1 and T2 were evaluated using the Wilcoxon signed-rank test. Differences in dentoskeletal and soft tissue changes between the two groups were determined using the Mann-Whitney U test.

Results There were no significant differences in the sex distribution and pretreatment conditions between the two groups. Both RME groups showed similar dental expansion at T1 and T2. Both RMEs induced skeletal expansion, but M-RME exhibited more skeletal expansion effect at both T1 and T2. M-RME exhibited forward displacement of the maxilla without significant vertical changes in the mandible, while T-RME demonstrated clockwise rotation of the mandible without significant changes in the maxillary position at T1. The sagittal skeletal effects tended to decrease over time, but still remained at T2 in both RME groups. There were no significant differences in soft tissue changes between the groups at T1 and T2.

Conclusions Although M-RME provided better skeletal expansion than T-RME, this study suggests that the use of the T-RME may be also used as an alternative in adult patients who cannot undergo invasive procedures, because T-RME induced long-term dental expansion with a noticeable skeletal expansion at T2.

Table 3-1. PA measurements - treatment changes in the RPE group

Parameter	T1 - T0	Significance [†]	T2 - T0	Significance [†]	
U6 crown distance	5.25 ± 2.56	0.00	2.66 ± 2.05	0.00	
U6 root distance	2.77 ± 4.08	0.02	3.64 ± 3.63	0.01	
U1 crown distance	-0.53 ± 0.82	0.04	-0.04 ± 0.92	NS	
U1 root distance	2.32 ± 2.50	0.00	0.30 ± 1.60	NS	
L6 crown distance	1.60 ± 2.05	0.01	1.06 ± 2.71	NS	
Upper intermolar angle	8.35 ± 11.05	0.03	-6.15 ± 11.65	NS	
Lower Intermolar angle	-4.40 ± 9.71	NS	0.79 ± 20.85	NS	
Inter incisal angle	-8.09 ± 8.20	0.00	-0.86 ± 6.29	NS	

† Wilcoxon signed rank test was used to evaluate treatment changes at a significant level of α < .05

Table 3-2. PA measurements - treatment changes in the MARPE group

Parameter	T1 - T0	Significance [†]	T2 - T0	Significance [†]	
U6 crown distance	6.47 ± 2.63	0.00	2.87 ± 2.45	0.01	
U6 root distance	5.83 ± 1.78	0.00	3.92 ± 3.32	0.01	
U1 crown distance	-0.03 ± 1.48	NS	-0.16 ± 0.51	NS	
U1 root distance	4.92 ± 1.68	0.00	1.07 ± 1.33	0.01	
L6 crown distance	0.4 ± 1.29	NS	0.35 ± 2.96	NS	
Upper intermolar angle	-0.28 ± 3.69	NS	-3.79 ± 10.16	NS	
Lower Intermolar angle	-2.7 ± 11.90	NS	-6.51 ± 16.08	NS	
Inter incisal angle	-13.73 ± 5.85	0.00	-2.93 ± 4.52	0.04	

† Wilcoxon signed rank test was used to evaluate treatment changes at a significant level of α < .05



In Vitro Aging Effect on Young's Modulus of Orthodontic Aligners

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Objectives The aligner system technology offers an orthodontic treatment option with transparent thermoplastic polymers for patients who prioritize aesthetics. To maximize their therapeutic usefulness, it is crucial to understand how their mechanical properties alter with time.

Methods The 4mm x 10mm common dimensions for aligner material testing were used to create specimens of four brands: Duran+ (0.75mm PETG), CA® Pro (0.75mm 3-layer copolyester and elastomer blend), Zendura A (0.76 mm PU) and Zendura FLX (0.76 3- layer PU). Each brand's 24 samples were split into three groups as follows: G1 being thermoformed, G2 being thermoformed and underwent 500 thermocycles (simulating 7 days), and G3 being thermoformed and underwent 1000 thermocycles (simulating 14 days). Three-point bend test was performed to investagate Young's modulus. The samples were submerged in distilled water for 24 hours prior to thermocycling.

Results Duran+ and Zendura A had the highest modulus of elasticity values in the control group, and they differed statistically significant from Zendura FLX, which had the lowest values. After 500 thermocycles, Zendura FLX and CA Pro showed the lowest Young's modulus (171.66 MPa and 109.41 Mpa) and were significantly different from single-layer PETG (Duran+) and PU (Zendura A). While after 1000 thermocycles, Duran+ had the highest modulus of elasticity and differed statistically from all other groups. The values from highest to lowest were: Duran+ > Zendura A > CA Pro > Zendura FLX). Intragroup comparison showed that only Duran+'s elastic modulus significant changed after 1000 thermocycles in comparison with control group.

Conclusions One-layer PETG failed to demonstrate stability after in vitro aging, suggesting clinicians should be aware of the change in mechanical properties when using onelayer PETG in 2 weeks regime.



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Objectives To translate and to evaluate the psychometric properties of the Italian version of the Parental-Caregiver Perceptions Questionnaire-16 (PCP-Q-16) and of the Family Impact Scale (FIS).

Methods After translation, back translation, and cross-cultural adaptation of the original PCP-Q-16 and FIS, the first Italian versions of the two questionnaires were pre-tested. The final versions of the Italian PCP-Q-16 (I-PCP-Q-16) and FIS (I-FIS) were administered to 160 parents/caregivers(68.7% mothers) of adolescents aged between 10 and 18 years (83 females, 77 males, mean age 13.7 \pm 2.5 years), recruited from among patients attending the Dental Clinic of the University of Naples Federico II (Italy) for a first consultation. Oral status and malocclusion of young patients were recorded using the DMFT/dmft index and Dental Aesthetic Index (DAI). Structural validity was assessed by means of factorial analysis. Internal consistency was measured with Cronbach's alpha coefficient (α). Convergent validity was assessed by means of Spearman correlation. Test–retest reliability was calculated with intra-class correlation coefficient (ICC). Criterion validity was evaluated with linear regression analysis.

Results The factorial analysis pointed out 4 domains for the I-PCP-Q-16, and 3 domains for the I-FIS. The α of the I-PCP-Q-16 domains ranged between 0.54 and 0.86, while for the I-FIS domains ranged between 0.51 and 0.87. The ICC of the I-PCP-Q-16 ranged between 0.632 and 0.941, while for the I-FIS ranged between 0.581 and 0.815. The regression analysis showed a statistically significant association between the social well-being domain of the I-PCP-Q-16 and the DAI and DMFT scores, and between the total score of the I-PCP-Q-16 and the DAI score.

Conclusions The satisfactory psychometric properties make I-PCP-Q-16 and I-FIS usable tools for future studies on oral health related quality of life among Italian adolescents from the perception of parents/caregivers and it's impacts on their family.



0437 Microhardness of Bulk-Filled Composites: Effects of Pre-Heating and Light-Curing Mode <u>M. Tuncer</u>, E. Öztürk, N. M. Baseren

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Objectives The aim of this study was to evaluate whether pre-heating and light-curing mode have an effect on the microhardness of bulk-filled composites.

Methods Two different bulk-fill resin composites (Admira Fusion and Viscolor) were selected for this study. Four composites discs were prepared 10 mm in diameter and 4 mm in thickness for each group. For each specimen 5 measurements were performed at both bottom and top surfaces. Light curing modes were: 1. conventional mode, 2. soft-start mode (step-cured), 3. pulse-cured mode. Each specimen was light-cured for 40 s on the top surface. Resin composites were prepared with or without pre-heating. Twelve groups were included in the study. Micro-hardness test was conducted on the top and bottom surfaces using Vickers microhardness (VH) tester. Data were statistically analyzed with Kruskall Wallis test and Bonferoni correction.

Results Significant differences were found among the experimental groups (p < 0.05). The highest microhardness was obtained from Viscolor composite cured without pre-heating by conventional mode (VH top =82.2, VH bottom =76). In this group, there was a significant difference

between the median values of the top and bottom measurements (p<0.05). The lowest microhardness was found at the bottom surface of Admira Fusion cured by pulse-cured mode without pre-heating (VH bottom =48). The microhardness values of this group were

significantly lower from the measurements made on the bottom surfaces of all other experimental groups (p<0.05), except for only a few groups, according to the pairwise comparisons. Pre-heating did not affect the microhardness values in all groups (p<0.05), however, when the light mode was pulse-cured, the microhardness values decreased significantly compared to the other two application modes.

Conclusions Pre-heating is not a factor affecting the surface microhardness of bulk-fill composites. However, the light curing mode can be an important factor.



Laser Polymerisation of Bulk-Fill Composites by Curing and Co-Curing Method

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Objectives The aim was to investigate the effects of light source (high-power LED curing unit and diode laser) and curing method on shear bond strength of bulk composite materials bonded to dentin using universal adhesive

Methods To create flat bonding substrates; coronal sections of teethth were embedded in an acrylic resin. Composite cylinders studs of SDR Plus (Dentsply Sirona) and Ever X Flow (GC, Japan) were bonded to dentin substrates using Adhese Universal (Ivoclar Vivadent) both for curing and co-curing (c) method with Power Cure (PC) (Ivoclar Vivadent) and blue diode laser (BL) (449 nm, 1.6 W, Jinjiang Co., China) for: 5 s (2000mW/cm²) and 10 s (1000 mW/cm²). Specimens were stored at 37 °C in distilled water and fractured in shear mode after 24 hours.

Results For SDR, the highest average bond strength value of 25.7 MPa was measured in experimental group BL10c (1000mw/cm² 10 sec BL co-curing) while the lowest average bond strength was measured in group PC5c (2000mw/cm² 5 sec co-curing), and was 9.9 MPa. When using Ever X Flow material, the highest average bond strength value of 20.5 MPa was measured in experimental group PC5 (2000mw/cm² 5 sec) while the lowest average bond strength of 8.9 MPa was measured in group BL5 (2000mw/cm² 5 sec BL). **Conclusions** Optimal dentin bond strength for SDR was recorded after curing and co-curing for 10 s using 1000mw/cm² with both blue laser and high-power LED unit. For Ever X Flow, optimal bond strength was obtained only with high-power LED unit polymerization.



Ion-Substituted Glasses Through Different Routes of Synthesis for Glass-Ionomer Cements

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Objectives To determine if ion-substituted glass particles (partial substitution of strontium with magnesium and zinc ions) obtained though different routes of synthesis affect the physical properties of glass-ionomer cement (GIC)

Methods Strontium-based alumino-fluorosilicate glasses of different compositions were obtained using two routes. A known glass, LG99Sr, (based on glass precursors of molar ratios, $4.5SiO_2-3Al_2O_3-1.5P_2O_5-3SrF_2-2SrO$) and an experimental glass, LG99Sr-Mg-Zn, of novel composition $4.5SiO_2-3Al_2O_3-1.5P_2O_5-3SrF_2-0.5SrO-1MgO-0.5ZnO$ were synthesized using conventional melt-quench method. A new hydrolytic sol-gel method was an alternative route used to obtain glasses of similar compositions as the melt-processed glass. Sodium metasilicate served as the starting silica-precursor instead of traditional tetraethyl orthosilicate for the sol-gel process. Silica extracted was dissolved in citric acid to form a complex used to encapsulate other glass precursors. Precursors used were nitrates of corresponding oxides used for the melt process at same ratios. The silica-citric acid-precursor moiety was burnt-out and calcined to obtain the sol-gel glass. Each batch of melt and sol-gel glasses was milled to obtain $\leq 45\mu$ m particles. Glass characterisation was performed using X-ray diffraction, Fourier transform infrared spectroscopy, scanning electron microscopy-energy dispersive X-ray spectroscopy. Compressive strength (CS), flexural strength (FS), and microhardness (VHN) of GIC groups were determined in accordance with ISO-specifications after storage of the specimens in distilled water for 24h at 37°C. Results were analysed using two-way ANOVA and Tukey's post-hoc tests at significance level of 0.05.

Results At 24h setting, the CS, FS and VHN values of melt-processed glasses, LG99Sr and LG99Sr-Mg-Zn were significantly higher (p<0.05) than the respective sol-gel glasses of similar compositions. However, there was no significant difference (p>0.05) when comparing the mechanical properties of LG99Sr and ion-substituted LG99Sr-Mg-Zn prepared using the same synthesis route. **Conclusions** Melt-processed glasses had significantly higher mechanical properties than sol-gel glasses of similar composition. However, the compressive strength of sol-gel glasses still met the ISO-minimum standards for restorative GICs.



Ethanol Softening of Alkasite as a Function of Curing Mechanism

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Objectives To investigate microhardness and ethanol-induced softening in light-cured and self-cured specimens of the "alkasite" material.

Methods Cylindrical specimens of Cention (Ivoclar Vivadent, Schaan, Liechtenstein) were prepared in Teflon molds (d=6 mm, h=2 or 4 mm) and subjected to one of the following curing conditions: (I) immediate irradiation with 1100 mW/cm² for 20 s, (II) irradiation with 1100 mW/cm² for 20 s after an initial 5-min delay, and (III) self-curing without light exposure for 20 min. The cured specimens were stored in distilled water at 37 °C for 24 h in the dark. Vickers microhardness (load = 100 g, dwell time = 15 s) was measured on the specimen surfaces (0 mm), 2 mm, and 4 mm. Eight specimens per experimental group were used (n=8). Specimens were immersed in absolute ethanol for 7 days and Vickers microhardness was re-measured using the same parameters. The ratio of microhardness values after/before ethanol immersion was evaluated as an indicator of crosslinking density.

Results For 0-mm and 2-mm depths, microhardness values before ethanol immersion were significantly lower in self-cured specimens (51.8-53.8 VHN) compared to the irradiated specimens (59.6-69.8 VHN), whereas at 4-mm depths statistically similar microhardness was obtained regardless of curing conditions (44.3-52.9 VHN). After ethanol immersion, microhardness values at 0-mm and 2-mm were statistically similar for all curing conditions (44.3-47.2 VHN), while at 4-mm the delayed curing produced significantly higher microhardness compared to immediate curing (42.9 vs. 35.0, respectively). The ratios after/before ethanol immersion were statistically similar within each tested depth regardless of the curing conditions and amounted to 67.8-82.2% for immediate light-curing, 75.0-77.1% for delayed light-curing, and 75.7-92.2% for self-curing.

Conclusions Light-curing, either immediate or delayed, of the alkasite material Cention produced significantly higher microhardness than self-curing. However, no significant effect of curing conditions on susceptibility to ethanol softening was observed.



Objectives The purpose of this in vitro study was to investigate the effect of three different pulp capping materials on the shear bond strength (SBS) of a universal adhesive system in deep dentin.

Methods Thirty two molars were sectioned perpendicular to the long axis of the tooth to form flat occlusal sound deep dentin surfaces. A long fissur bur was used to remove dentin up to 0.5 mm from the pulp chamber to ensure accessing deep dentin (within 0.5 mm of the highest pulp horn), and teeth were embedded in PVC tubes using self-cured acrylic resin. Then teeth were randomly assigned to four groups according to the capping materials used: (1) Control; no pulp capping material; (2) Dycal; (3) Theracal LC; (4) Biodentin. After the application of capping materials (1*1 mm), a universal adhesive was applied in self etching mode. Buildups (d:3mm, h:4 mm) were made over the deep dentin surfaces by a resin composite and the SBS values of the specimens were determined. The maximum shear bond strengths were noted at the time of the fracture. Fracture types were evaluated using a stereomicroscope.

Results Regarding SBS values, there was a statistically significant difference between the pulp capping materials (P.05). Therecal's SBS (18,42 MPa) was significantly higher than Dycal's SBS (14,41 MPa) and Biodentin's SBS (9,66 MPa), while the control group showed the highest SBS value (30,39 MPa).

Conclusions Application of pulp capping materials used in this study (Dycal, Therecal LC and Biodentin) in sound deep dentin lowered the SBS value of a universal adhesive. However the results obtained with Therecal LC showed clinically acceptable results.



Effects of Proanthocyanidin-Functionalized Hydroxyapatite Nanoparticles on Dentin Bonding.

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Objectives To evaluate the effect of proanthocyanidin-functionalized hydroxyapatite nanoparticles (nHAp_PA) used at different concentrations as therapeutic primer on the microtensile bond strength (µTBS) and endogenous enzymatic activity of a universal adhesive to dentin.

Methods Human sound dentin blocks were randomly allocated into five groups (n=10): i) no treatment (negative control); ii) 14 days of pH-cycling (positive control); iii) pH-cycling + nHAp_PA 2% for 60s; iv) pH-cycling + nHAp_PA 6.5% applied for 60s; v) pH-cycling + nHAp_PA 15% applied for 60s. A self-etch adhesive (Clearfil Se Bond 2, Kuraray) was used for bonding procedures before resin composite build-ups (Brilliant Ever Glow, Coltene). Specimens were tested with the µTBS test after 24h (n=20) and 6 months (n=20) of laboratory storage. The proteolytic activity in each group was evaluated with gelatin zymography. Data were statistically analyzed (p<0.05).

Results At 24h all treated samples had significantly higher μ TBS than controls (p<0.05), with no differences between them. Artificial aging significantly decreased the bond strength in all groups; however, experimental groups still yielded higher bonding values than the control groups (p<0.05). In addition, the negative control had the lowest while nHAp_PA 2% and nHAp_PA 15% the highest bond strengths (p<0.05). Gelatin zymography showed that the groups pre-treated with nHAp_PA exhibited less MMP-9 and MMP-2 activities, in their pro and active forms, than the positive control group, irrespective of the concentrations.

Conclusions Dentin pretreatment with nHAp_PA prior bonding procedures increased the bonding performances of a self-etch adhesive and inhibited MMP-2 and MMP-9 activities after 6 months.



0443 Aging Effect on Push-Out Bond Strength of Six Resin Cements.

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Objectives To determine the push-out bond strength of six resin cements used to lute fiber posts, at 24-hours and 6-months aging. **Methods** Sixty human roots received endodontic treatment before fiber post luting (FRC Postec Plus size 0 and 1) using different resin cements: three self-adhesive resin cements (RelyX Unicem, RX; G-Cem, GC; NormoCem, NC), two universal resin cements (RelyX Universal, RU; G-Cem One, GO) and one self-etch resin cement used as control (Multilink Automix, MA). Resin cements were light-cured through the post for 60s (Spec3). After storage time, six slices were transversally obtained from each root, two corresponding to each root third: cervical, middle and apical. Push-out test was performed at a crosshead speed of 0,5 mm/min using a universal testing machine (Instron 3345). Type of failure was determined under steromicroscope (Olympus SZX7) and representative specimens were observed under SEM (Philips XL30 ESEM).Data were statistically analyzed by two-way ANOVA and Tukey tests.

Results Mean and standard deviations are shown in Table 1. The root third did not influence on the bond strength at 24 hours nor at 6 months (p>0.05). All resins cements yielded similar bond strength values at 24 hours (p>0.05). At 6 months RX, GC, GO exhibited the highest strength, RU and MA intermediate values and NC the lowest values. After 6-month storage, bond strength significantly decreased for NC and MA. The adhesive failure was the most representative for all cements at both evaluation times except for MA, which showed adhesive and mixed failures equally at 24 hours.

Conclusions Storage time had a detrimental effect on NC and MA bond strength. Immediate bond strength was similar for all cements. At 6 months, the lowest bond strength values were yielded by NC.

	Storage Time				
	24 h Mean (sd)	6 m Mean (sd)	24 h vs 6 m		
RelyX Unicem	12.0 (7.2) a	11.5 (5.5) AB	p>0.05		
G-Cem	12.7 (5.6) a	14.2 (6.9) A	p>0.05		
NormoCem	13.4 (7.0) a	3.3 (2.9) C	p<0.05		
RelyX Universal	13.0 (4.5) a	12.3 (6.0) A	p>0.05		
G-Cem One	13.0 (7.0) a	15.2 (7.7) A	p>0.05		
Multilink Automix	13.8 (5.0) a	7.3 (4.6) BC	p<0.05		



0444 Repair Bond Strength of a CAD/CAM Material After Surface Modification With Er,Cr:YSGG Laser <u>P. Didangelou</u>, D. Dionysopoulos, C. Papadopoulos, D. Strakas, P. Mourouzis, K. Tolidis

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Objectives The aim of the present study was to evaluate the impact of various Er,Cr:YSGG laser settings on the repair bond strength of a resin-based CAD/CAM restorative after artificial aging.

Methods Twenty-four resin-based CAD/CAM blocks were prepared, and 48 rectangular slabs (3 x 12 x 14 mm) were obtained. The specimens were divided into four groups (n=12) based on their surface treatment: no treatment (CO), air abrasion with 50 µm-Al2O3 particles (SB), and laser irradiation with two different settings; 3.5 W (LAS1) and 4.5 W (LAS2) using Er,Cr:YSGG laser (2780 nm). After the surface treatments, a bonding protocol with silane was performed, and a flowable composite resin was used to prepare 48 microrods. Half of the microrods of each group underwent shear bond strength (SBS) testing after 24 hours, while the other half underwent artificial aging (15000 cycles, 5-55oC) prior to SBS testing. The debonded specimens were examined under an optical microscope to determine the failure mode, and all specimens were also evaluated using SEM to assess the adhesive interface formation and topography. One-Way ANOVA and Duncun's Post-Hoc test were used for SBS measurements, as well as Chi-square test was used to analyze the "failure" measurements.

Results Significant interaction effect between "Treatment" and "Aging" was observed (p<0.001). SB group presented significant higher SBS values after artificial aging (15.48 MPa), followed by a common subset of LAS1 (12.4 MPa) and LAS2 (12.12 MPa) groups, while CO group revealed the lowest SBS values (4,55 MPa). Fracture analyses revealed mainly failures in the adhesive interface without any correlation to surface treatment and artificial aging.

Conclusions The results of the current study indicated that Er,Cr:YSGG laser irradiation can be an alternative treatment for repairing the tested resin-based CAD/CAM restorative material.



0445 **Properties of Glass-Ionomer Cements Reinforced With Calcium-Modified Clay Nanoparticles** <u>I. Tsolianos</u>, A. Nikolaidis, E. Koulaouzidou

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Objectives Glass-ionomer cements (GICs) are considered classic restorative materials, mainly characterized by good chemical adhesion, fluoride release and biocompatibility. However, they possess low mechanical properties and calcium ion release. The application of nanotechnology could improve disadvantages derived from glass-ionomer cements. This study investigated whether incorporation of calcium modified clay nanoparticles into conventional glass-ionomer cements improved calcium release and affected compressive strength.

Methods Pristine natural clay (NaMMT) nanoparticles were initially enriched with calcium ions via an ion exchange reaction and subsequently incorporated into a conventional GIC (Fuji II). Six series of ten cylindrical (6mm x 4mm) specimens were prepared, namely GIC (Fuji II) (control), GIC + 15% clay (NaMMT), GIC + 3% calcium modified clay (CaMMT), GIC + 7.5% CaMMT, GIC + 15% CaMMT and GIC + 30% CaMMT. Specimens were stored in 5ml deionized water (37 °C) for 7 days and subjected to compressive strength tests with a dynamometer. Each aqueous extract was isolated, filtered and analyzed for calcium release by means of Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES).

Results Compared to control group, the enrichment with 3% calcium nanoclay on GIC increased the compressive strength, while calcium release ranged between 6.83 and 10.33 ppm among calcium montmorillonite groups.

Conclusions The incorporation of calcium nanoclay in glass-ionomer cements improved calcium release, without jeopardizing compressive strength. Additionally, 3% of calcium nanoclay doubled the compressive strength of GIC.



Hyaluronic Acid/Cellulose Film Delivery Facilitates Oral Wound Healing

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Objectives Evidences demonstrate that hyaluronic acid (HA) promotes oral wound healing. Currently, the gel-type of HA is widely employed in therapeutic uses. However, the limitations of gel-type delivery, such as rapid degradation and low adhesiveness, may compromise pharmacological action of HA in the oral environment. The purpose of this study was to elucidate the effect of HA film with addition of carboxymethyl cellulose (CMC) on oral wound healing.

Methods HA films with a molecular weight of 0.8 MDa and HA films with addition of 10% CMC were prepared. And the undiluted eluates from HA and HA/CMC films were prepared. The cell viability of human gingival fibroblasts (HGF) were assessed by FACS assay for 24 h. Expression of pro-inflammatory biomarkers (IL-6 and IL-8) and tissue regeneration biomarkers (FGF-2, COL1α1, and TGF-β1) was assessed by RT-PCR. Cell scratch wound assay was performed for evaluating wound healing efficacy.

Results FACS assay confirmed that both films did not affect the cell viabilities of HGF. Regarding pro-inflammatory biomarkers, HA/CMC film showed lower level of IL-8 expression compared to HA film (p < 0.05). Regarding tissue regeneration biomarkers, HA/CMC film showed higher level of COL1 α 1 expression and lower level of TGF- β 1 expression compared to HA film. In cell scratch wound assay, both films showed significantly lower open wound area compared to the control (p < 0.05). However, there was no significant differences in wound healing between HA and HA/CMC films.

Conclusions Within the limits of this study, HA/CMC film promoted oral wound healing with lower level of inflammatory responses.





0447 A Clinical Case Utilizing a New Collagen-Based Bone Xenograft T. Laplane

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Objectives To show the advantage of using a collagen-based porcine bone graft in bone regeneration.

Methods A 65-year-old patient came to our private dental clinic, complaining of pain in the right maxillary area and a fallen bridge. The radiographic examination revealed a radicular fracture in tooth 14, a deep tooth decay in tooth number 23, both were bridge abutments, and a large bone defect in the 21-22 area (Photo 1).

All abutment teeth were extracted, alveolar bone filling and onlay bone graft using GTO® Osteobiol® were performed (Photo 2). No membrane was placed to cover the biomaterial, and vertical mattress sutures were performed.

After 4-month healing period, four dental implants were placed, and a second onlay graft was performed to obtain the adequate bone volume.

Following another 4-month healing period, implant stability was measured using resonance frequency analysis technology (Osstell®). A screw-retained prosthesis was prepared, with a precise occlusal adaptation to optimize the biomechanical function and to preserve the bone tissue and implants.

Results After 4 months, significant bone graft volume was maintained. After clinical follow-up for 9 months, a large bone volume was observed as well as an improvement in the gingival biotype (Photo 3), no complications were observed. The radiological and clinical evaluations showed a stable graft. The high implant stability and the successful prosthetics provide evidence for the effectiveness of the collagen-based biomaterial in enhancing bone regeneration in dental surgery.

Conclusions GTO® Osteobiol®, a porcine collagen-based bone substitute, was successfully used for alveolar bone filling and onlay bone grafting. The resulting bone volume provided a high stability and successful osseointegration of the dental implants. The use of GTO® Osteobiol® may reduce the patient discomfort, surgical time, and morbidity.







Hesperetin-Loaded Nanoemulsion: Development, Characterization, Pro-Osteogenic and Anti-Inflammatory Activities

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Objectives The objective of this study was to develop and characterize a new hesperetin-loaded nanoemulsion (HT-NE) and evaluate *in vitro* its effect on I) the differentiation, metabolic activity and gene expression of osteoblasts and, II) the secretion of proinflammatory cytokines and matrix metalloproteinases (MMPs) in macrophages.

Methods The HT-NE was obtained by the sonication method and characterized by dynamic light scattering, its encapsulation efficiency was analyzed by high-performance liquid chromatography and the particle size was registered by transmission electron microscopy. To evaluate its pro-osteogenic activity, Saos-2 osteoblasts were treated with non-cytotoxic concentrations of HT-NE and cell proliferation was measured by Alamar Blue assay. Mineralized calcium nodule formation was assessed by Alizarin Red, alkaline phosphatase (ALP) activity using a colorimetric assay and collagen organization by Picrosirius Red. Additionally, gene expression of Runx2, ALPL, and TGF- β were analyzed by RT-qPCR. In order to evaluate its anti-inflammatory effect, monocytes/macrophages U937 cells were stimulated with *Fusobacterium nucleatum* and treated with non-cytotoxic concentrations of HT-NE. The expression of IL-6, IL-8, IL-1 β , TNF- α , MMP-1, MMP-3 and MMP-9 were measured by ELISA.

Results The HT-NE formulation showed a colloidal stability, satisfactory efficiency of encapsulation with values of 74.07 \pm 5,33%, values of droplet size less than 98 \pm 1.33 nm, polydispersity index less than 0.58 \pm 0.03 and zeta potential greater than -38.03 \pm 0.80 mV. Non-cytotoxic concentrations showed a significant increase in cell proliferation, mineralization nodules formation, ALP activity, collagen formation and gene expression (*p*<0.05). Moreover, HT-NE significantly decreased cytokines and MMPs levels produced by macrophages (*p*<0,05).

Conclusions Our study showed a great colloidal stability of a new HT-NE developed and suggests its promise pro-osteogenic and anti-inflammatory effects to treating inflammatory diseases involving bone. More studies exploring *in vivo* behavior of this new nanoemulsion are necessary to complement our findings.



0450 Masking Ability of Layered Resin Composite Restorations S. Wongkhantee

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Objectives The purpose of this study was to evaluate the masking ability of resin composites, restored with various layering techniques.

Methods Dentin shade and enamel shade of four brands of resin composite included FiltekTM Z350 XT (3M-ESPE, USA), HarmonizeTM (Kerr, USA), Ceram X[®] duo (Dentsply, Germany) and Estelite Σ Quick (Tokuyama, Japan) were prepared with five layering thickness in millimeters (Dentin thickness/Enamel thickness); 0.3/0.3, 0.4/0.4, 0.5/0.3, 0.5/0.5 and 0.7/0.3. The masking ability was interpreted through the color difference of resin composites on A4-shade tooth background (Δ E). The CIELAB coordinates were obtained by a spectrophotometer (ColorQuest[®] XE, Virginia, USA). The masking abilities were defined as clinically acceptable at Δ E ≤ 3.3. Kruskal-Wallis test (ANOVA) and Dunn's Bonferroni post hoc test were used to determine the significant difference of color difference (p<0.05).

Results The median color difference of the layered specimens were; Filtek[™] Z350 XT (1.52-2.00), Harmonize[™] (2.19-5.82), Ceram X[®] Duo (1.26-2.65) and Estelite Σ Quick (3.80-7.70). ΔE were significantly different amongst resin composite shades (p<0.05). Conclusions All resin composite shades likely demonstrated higher masking ability when increasing the thickness except for Filtek[™] Z350 XT. A minimum 0.6 mm thickness of Filtek[™] Z350 XT and Ceram X[®] Duo, and 1.0 mm of Harmonize[™] can mask the discolored background, whereas Estelite Σ Quick showed unacceptable masking ability at all thicknesses.



0451 Effect of Different Effervescent Vitamins on the Color of Composite Materials

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Objectives The potential discoloration of composite restorative materials induced by effervescent vitamins has not been examined previously. The aim of this study is to investigate the coloring effects of three different effervescent tablets on two different composites.

Methods Three distinct vitamin effervescent tablets and two different composites were employed in our research. The composite samples were divided into four groups of ten samples each. A clinical spectrophotometer was used for color measurements. The L*a*b* System of the International Commission on Illumination is used for the measurements. Three replicate readings were made for each sample, and mean L*, a*, and b* values were obtained. Color values (E*) were calculated. The baseline color measurements were made after immersion in distilled water, and the samples were randomly divided into 3 groups (n = 10). Composites were soaked in three different coloring solutions for 10 days. Solutions were renewed daily. The final color measurement was taken at the end of the study. The Shapiro-Wilk test was used to determine whether the ΔE_{2000} values fit the normal distribution, and a two-way analysis of variance was used to examine the data (ANOVA). Tukey tests were used for post-hoc comparisons. All tests were performed with SPSS 16 (IBM SPSS Statistics 22.0 (IBM Corp. 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, USA) package program (p = 0.05).

Results All E 2000 values were above the 1.8 acceptability value. The Redoxon-Tokuyama group displayed the greatest degree of color change; ΔE_{2000} =6.02 (±1.59). In the Charisma Sambucol group, the least color change was noticed ΔE_{2000} = 2.48(± 0.73). Tokuyama Omnichroma samples demonstrated statistically greater overall color shifts than Charisma Smart samples (p<0.001). In terms of the vitamins, there was a statistical difference between all groups (p<0.001) (Redoxon ΔE_{2000} = 5.15, Youplus ΔE_{2000} =4.1, Sambucol ΔE_{2000} = 3.1). The vitamin-composite interaction did not show a statistical significance (p= 0.146).

Conclusions Long-term usage of effervescent vitamins may induce color changes in composite fillings. This subject requires clinical research.









Objectives In order to quantitatively evaluate the aesthetic appearance of tooth-shaped samples, spatially-resolved color values and opacity were determined using a spectral-based method. Not limited, but as an example, VITA classical A1-D4® shade guide tabs A1 and A2 were evaluated considering white and black background.

Methods A Datacolor SpectraVision[™] hyperspectral-spectrophotometer obtained a spectrum from each pixel of a sample via whitelight illumination and pre-detector filtration through one of a series of notch filters. L*a*b*-values were calculated from such spectra according to CIE. Measurements can be done using black and/or white backgrounds. Data were taken along a line aligned with the centerline of the tooth, starting from the incisal edge (0mm) and continuing to cemento-enamel-junction. Opacity was calculated from difference of white and black background data. Different local zones were analyzed. As a hypothesis, data (+/-0.1mm) from a different location or sample are expected to be statistically different. ANOVA was used for statistical analysis.

Results Results of shade tab A1 are listed in Table 1. At the incisal (0-0.2mm), opacity is 67.1% and at the body (8.5-8.7mm), 91.9%. L*and b*-values are significantly different for background and location, a* is not. The difference in L* is the most obvious in the zones of shade tab A1, but not comparing to another shade tab A2. The difference of two shade tabs A1 and A2 was analyzed regarding L*a*b*-values at same, central positions (4.8-5.0mm from incisal), measured with black background. L*=72.78+/-0.14, or 71.69+/-0.02, a*=0.03+/-0.31 or 1.77+/-0.32, b*=11.58+/-0.39 or 16.87+/-0.57 were determined for A1 or A2 shade tab, respectively. As P=0.00, all determined data are statistically significant different.

Conclusions With the SpectraVision[™] hyperspectral-spectrophotometer, the difference of color, the influence of a white and black background on the color values and opacity of a dental restoration can be determined with spatially-resolved measurements on a tooth-shaped geometry.

A1	٤*		a*			b*			Opacity [%]	
Tooth-zone	white	black	Delta L*	white	black	Delta a*	white	black	Delta b*	
Incisal (0-0.2mm)	69.5+/-0.8	59.0+/-1.3	11.4	-0.2+/-0.3	-0.3+/-0.3	0.1	8.0+/-0.3	5.6+/-0.6	2.1	67.1+/-1.8
body (8.5-8.7mm)	74.8+/-0.1	72.3+/-0.2	2.4	0.4+/-0.3	-0.1+/-0.2	0.5	13.2+/-0.6	11.5+/-0.3	2.0	91.9+/-0.5





Table 1:

0453 **Clinical Color Selection Reliability of Conventional Versus Digital Methods** <u>K. Isikli</u>, E. Öztürk, F. Yalcin Cakir Department of Restorative Dentistry, Hacettepe University Faculty of Dentistry, Ankara, Turkey

Objectives The aim of this clinical study was to evaluate intra- and inter-observer reliability of 3 postgraduate students in natural tooth color selection using different conventional or digital tools.

Methods Color measurements were captured by three postgraduate students from the Department of Restorative Dentistry. Before starting the study, students were calibrated by giving lectures on tooth color selection. In 32 healthy patients, tooth colors were determined using 4 different conventional or digital tools on the maxillary right or left central incisor teeth. The conventional tools for visual color selection were VITA Classical (VC) and VITA 3D (V3D) shade guides (VITA Zahnfabrik). Digital color measurements were performed with a spectrophotometer (VE:VITA Easyshade V, VITA Zahnfabrik) and a digital camera (Canon D80 with a 100 mm macrolens and a twin flash). From an anterior composite resin set, enamel (incisally) and dentin (cervically) colors were temporarily adhered to the facial surface of the tooth using the button technique and then digital photos were first made on the original photographs. The enamel colors (E2) were made secondarily by converting the photographs to black and white. Dentin colors (D2) were also selected secondarily by increasing the contrast of the photos. The data were recorded and statistically analyzed with intraclass correlation coefficient (ICC).

Results In terms of intra-observer reliability, there was poor reliability between the VC-V3D (O1=0.31,O2=0.22,O3=0.47), VC-VE (O1=0.3,O2=0.1,O3=0.03) and V3D-VE (O1=0.002,O2=0.03,O3=0.08) color selection methods, while the reliabilities between E1-E2 (O1=0.57,O2=0.78,O3=0.54,p<0.05) and D1-D2 (O1=0.8,O2=0.61,O3=0.69,p<0.05) were good for all three observers. Reliability results between the observers were good for evaluations over photographs only (E1=0.5,E2=0.5,D1=0.5,D2=0.6,p<0.05), while reliabilities were poor for the other methods.

Conclusions Color selection can be made safely in the aesthetic region by using the button technique over digital photographs.



A Digital Protocol for Qualitative and Quantitative RPD Fit Analysis

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Objectives The aim of this study was to develop a digital protocol for qualitative and quantitative RPD fit analysis. Methods A single experimental prototype resin-model of an edentulous maxilla bearing three custom 3D geometric tooth-form shapes was constructed (3D-printing) and repeatedly (x10) digitised using a Trios-3 intraoral scanner (3Shape[™]A/S,Copenhagen,Denmark). A custom RPD framework CAD was performed on a single scan (Scan-M1) of the digitised resin-model and was then produced into a single SLM(CoCr) framework. Following sprue-removal from the cameo surface, the framework intaglio surface was repeatedly (x5) digitised using a laboratory scanner (E3,3Shape[™]A/S,Copenhagen,Denmark). A single framework-scan (Scan-F1) and Scan-M1 (STL-files) were imported into a free inspection software (GOM-Inspect,2018-Hotfix5,Rev.115656,GOM GmbH,Braunschweig,Germany). A custom digital protocol for model-framework fit-evaluation was then devised via virtual framework-to-model seating. The final virtual seating position was defined as the point where three non-colinear primary model-framework contacts were visually established. The mean fitting distance was calculated from 220 equidistant vertical framework-to-model measuring locations. Protocol and operator uncertainty evaluation was performed by repeated (x10) singleoperator execution followed by ANOVA. As an alternative, the framework-to-model gap was repeatedly (x10) recorded by weighing (Class-1 microbalance) silicone films (Variotime extra-light-flow,Kulzer,Germany). Scanning reproducibility was also performed by digital superimposition of: a) Scan-M1 versus the remaining 9 model-scans and b) Scan-F1 versus the remaining 4 framework-scans followed by Feltz & Miller tests.

Results Detailed qualitative colour distance-maps were created. Mean framework-to-model distances range: 230.8-327.1µm. ANOVA indicated the presence of significant (p<0.001) differences amongst these values for the proposed digital protocol. Feltz & Miller tests found no indication that a) the two protocols (digital VS weighing) and b) the two scanners (intraoral VS laboratory) differ in measurement repeatability (p=0.70).

Conclusions The proposed digital protocol may be used supplementary to weighing in qualitative and quantitative fit analysis of RPD fabrication via various processing routes.



A color distance-map of one of the attempts to virtually seat the experimental framework. The fitting area is shown in colour and the color gradient is indicative of the distance from the prototype model. The labels show the measurement sites in Y axis. Green or almost green areas indicate the areas of contact or near contact respectively between framework and model (\sim 0µm distance).



0455 Combined Treatment of Severe Snooring and Excessive Tooth Wear Comorbidity <u>e. günel</u>, h. kurtulmus, c. aktay, m. bursa Prosthodontics, Istanbul Aydin University, Istanbul, Kucukcekmece, Turkey

Objectives Bruxism is a comorbid disorder. Patients complain of facial, ear and neck pain, headache and temporomandibular joint dysfunction. Bruxism results, teeth worn and the occlusion vertical dimension loss (OVDL). In severe cases, snoring and sleep apnea develop. The aim of this study is treatment bruxism symptoms.

Methods A 46-year-old patient came to Istanbul Aydin University Faculty of Dentistry, with complaints about function loss as a cause of tooth wearing. As a result of the anamnesis and clinical examination, it was determined that the complaints were caused by bruxism. Combined treatment was planned for bruxism, snoring and OVDL. Since the patient did not have any myofascial pain, prosthetic treatment was started for direct vertical dimensioning. OVDL degree was determined by the Niswonger method. All teeth were prepared and covered with metal-fused porcelain crowns. Occlusion vertical dimension (OVD) has been increased 5mm. After cementation of the restorations, stabilization splint was given to the patient to wear during sleep for 1 month.

At the end of the first month, monoblock mandibular advancement device (MAD) (Durasoft, SCHEU-DENTAL GmbH, Germany) was produced for snoring treatment. As a result of night recording made with SnoreLab application, observed that the snoring score decreased from 118 to 10. The treatment was completed by wearing stabilization splint for 6 hours during day and MAD during sleep.OVDL was treated with full mouth metal-fused porcelain crown restorations.

Results At the first month control, observed that the snoring and functional complaints related to bruxism disappeared.

Conclusions Bruxism is a comorbid disorder. As a result of wear; OVDL, snoring and sleep apnea occur. Improvement in all symptoms and reduction of severe snoring noise and increase OVD, which is reduced due to tooth wear, is controlled by this combined treatment. it is possible to manage all symptoms with airway prosthodontics and dental sleep dentistry.



Objectives Observing cell proliferation and migration for further understanding of the cell process in oral mesenchymal stem cells (OMSC).

Methods Stem cells from apical papilla (SCAP) were isolated from non-fully developed third molars, using laboratory routine methods. All tissues undergo enzymatic digestion with 3mg/mL collagenase type I and 4 mg/mL dispase for 1h at 37°C in an incubator. Then the cells are seeded with DMEM Dulbecco modified eagle media supplemented with 1% antibiotics and 10% FBS fetal bovine serum. The cells were cultivated at standard cell culture conditions at 37°C and 5% CO2 in an incubator. The cell's media was changed every 2nd or 3th day and they were passaged and counted at 80-90% confluence. Further a MTT, telomerase and β -galactisidase tests were administered.

Results Comparing different passages of mesenchymal stem cells, we discovered that they continue to be vital with stem cell like characteristics further than passage 15. The cells were cultivated and passaged for several months. They did not show any significant decrease in their proliferation ability. These cells show promise for further evaluation in research.

Conclusions Therefore, the application of stem cells in regenerative medicine for research must be preceded by in vitro cultivation and multiplication. Currently there is no sufficient data on cell senescence in human cells isolated from non-fully developed third molars for experimental purposes.


Antioxidant Gene Polymorphisms in Temporomandibular Disorder Patients Compared to Controls

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Objectives To investigate the distribution of single nucleotide polymorphisms (SNPs) of genes glutathione peroxidase 1 (GPX1), superoxide dismutase 2 (SOD2), and catalase (CAT) in temporomandibular disorders (TMD) patients in comparison with healthy controls, and to explore whether psychosomatic characteristics and oral behaviors (OB) may be influenced by SNPs in these genes. **Methods** Eighty-five TMD patients (diagnosed with DC/TMD) and 85 controls were recruited. DNA from buccal mucosal swabs was analyzed for SNPs in GPX1 (*rs1050450*), SOD2 (*rs4880*), CAT (*rs1001179*). Participants completed questionnaires for anxiety (Generalized Anxiety Disorder-7, score: 0-21), depression (Patients Health Questionnaire-9, score: 0-27), hypervigilance (The Brief Hypervigilance Scale, score: 0-20), and waking-state (score: 0-76) / sleep-related (score: 0-8) oral behaviors (Oral Behaviors Checklist). Chi-Square Test and Mann-Whitney U Test were used for statistical analysis. The assessment was performed according to dominant and recessive genetic models. In both models, the minor allele represented the risk allele.

Results No differences in genotype distribution were found between TMD patients and controls in dominant and recessive models (p>0.05). Analysis of psychosomatic and behavioral characteristics according to genotype revealed that TMD patients with AA genotype of *rs1050450* (minor allele homozygous) reported significantly more waking-state OB compared to AA+AG genotypes (score: 30 vs. 23, p=0.019). TMD patients with the AA genotype of *rs4880* (dominant homozygous) reported significantly higher hypervigilance scores compared to GG+AG genotypes (6.1 vs. 3.2, p=0.0001). TMD patients with the CC genotype of *rs1001179* (dominant homozygous) reported significantly higher depression scores compared to TT+TC genotypes (7.1 vs. 4.1, p=0.002). In the control group, examined characteristics were not influenced by genotype.

Conclusions These findings suggest that some TMD patients may be genetically predisposed to specific psychosomatic symptoms and OB. Further research is needed to better understand the underlying mechanisms of gene-behavior associations in TMD.



Objectives The present study is investigating the changes in IL-6 and TNF- α saliva concentrations of patients with oral squamous cell carcinoma, leucoplakia and periodontitis, compared to healthy controls.

Methods The listed cytokines were examined in whole unstimulated saliva collected from 107 patients, divided into four groups - oral carcinoma (43 patients), OPL (21 patients), periodontitis (21 patients) and healthy controls (22 patients). Salivary samples were stabilized with SigmaFast Protease inhibitor, Sigma-Aldrich Co, and assayed with a fluorometric multiplex method using the ProcartaPlex[™] Multiplex Immunoassay.

Statistics included descriptive, correlation and variance analyses /ANOVA-test/.

Results For IL6 a difference with very high statistical significance was found (p = 0.000105) in the salivary concentration in patients with oral carcinoma compared to patients with preneoplastic lesions, periodontitis and healthy controls. The group of preneoplastic lesions showed significantly increased levels for both IL6 and TNF α compared to the healthy controls. IL6 and TNF α show a significant increase in periodontitis and preneoplasia compared to healthy controls.

Correlation analysis of the influence of smoking and alcohol consumption on cytokine levels showed moderate dependence for IL6. **Conclusions** The highly elevated levels of IL6 in the saliva of patients with oral carcinoma allow us to assume that these cytokines may have significance as biomarkers for oral carcinoma.



Objectives Oroantral communication is one of the clinical situation seen in oral and maxillofacial surgery clinics frequently. There are many treatment options as soft tissue flaps and hard tissue grafting. In this study our aim was to investigate the treatment options according to the size of oroantral communication.

Methods In this study the patients who has more than 5mm size oroantral communication. The communication sizes' measurements were calculated with CBCT and the treatment approach were decided. The patients' sex, age, medical history were recorded. The patients were controlled at 3. and 7. day after the surgery. Post-operative clinical findings, the healing of soft and hard tissue, vestibular depth and the precense of seconder oroantral communication were registered.

Results Total of 10 patients were included in this study and some of them treated by press- fit tecnique, the others treated by buccal fat pad. All patients healed and no second oroantral comminucation were seen. At one of the patient treated by press-fit tecnique, surgical field was bled on post-operative period. The patients treated by press-fit tecnique pain levels and edemas were higher than the patients treated by buccal fat pad.

Conclusions In the literature the both tecniques are successful for the treatment of oroantral communication as the presented study. However press-fit tecnique has some disadvantages because of the second surgical field compare to the buccal fat pad tecnique.



Objectives This clinical study was conducted to assess the efficacy of sugar-free tablets containing zinc lactate on oral volatile sulfurcontaining compounds (VSC) for 30 minutes versus placebo tablets

Methods To join this crossover trial, subjects had to have at least 24 teeth, no oral or systemic diseases, and no removable dentures. All eligible participants had to avoid professional oral hygiene and drugs for two weeks and to brush their teeth and tongue, to smoke, to assume alcohol, coffee or tea, onion, garlic, licorice for six hours before the test. Moreover, they had to score a level of VSC \geq 75 ppb at the basal measurement. The test tablet (1g) contained zinc lactate, delivering 0.51mg of zinc per tablet, the control tablet was identical without the zinc salt. The OralChroma2[®] device was utilized to score the levels of VSC at baseline, after sucking one tablet and after 30 minutes. The participants were requested to test both tablets after a minimum washout period of 72 hours. Data were analyzed with SPSS software and significance was set at α =0.05

Results 30 subjects completed the trial. None reported problems linked to the assumption of zinc lactate. The mean reduction from baseline at the end of the test tablets sucking was 78% (p<0.001), after 30 minutes, it was 44% (p<0.001), instead, the mean reductions from baseline at the end of the control tablets sucking was 46% (p<0.001) and it was 21% (p<0.001) after 30 minutes. The comparisons between the two groups showed a statistically significant difference for reductions in favor of the zinc lactate tablets both at the end of the sucking period (p<0.001) and after 30 minutes (p<0.01)

Conclusions Tablets containing zinc lactate can statistically significantly reduce the oral VSC levels immediately and after 30 minutes significatively better than a control tablet



Salivary Cortisol and Perceived Stress in COVID-19 Survivors With Periodontitis

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Objectives While it has been shown that chronic periodontitis represents risk for severe COVID-19, there are no data concerning overall impact of COVID-19 on periodontal health. Due to disruption of routine dental care, COVID-19 pandemic-induced chronic stress as well as virus-induced disturbed oral homeostasis, negative effects on oral health and host immunity in COVID-19 survivors could be assumed. Aims were to assess periodontal health, psychological stress scores and salivary cortisol in participants with and without history of COVID-19.

Methods A total of 80 participants, divided into four groups: I Periodontitis participants with history of COVID-19, II Periodontitis participants without history of COVID-19, III Participants with history of COVID-19 and without periodontitis, and IV Participants without history of COVID-19 and without periodontitis, were recruited and engaged methods were: 10-item Perceived stress scale questionnaire, periodontal examination and salivary cortisol measurement.

Results COVID-19 survivors with periodontitis showed no significantly different levels of salivary cortisol (39.2 ± 4.6 ng/ml) in comparison to periodontitis patients who did not have COVID-19 (44.8 ± 3.6 ng/ml). There were no differences among the groups in perceived stress score-all presented moderate stress levels. However, bleeding on probing was lower in COVID-19 survivors with periodontitis in comparison to periodontitis patients without history of COVID-19 (40.0 ± 6.1 vs 57.3 ± 5.1 , p= 0.03).

Conclusions Contrary to our hypothesis, COVID-19 survivors showed neither higher perceived stress nor salivary cortisol, however, they showed lower levels of inflammation in periodontitis. Present results may suggest psychological stress-unrelated modulation of inflammatory response in COVID-19 survivors with periodontitis.



VEGF-a, VEGFR-2 and PCNA Expression in Oral Vascular Anomalies in Childhood

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Objectives Vascular anomalies (VA) comprise a wide, heterogeneous group of entities, classified into neoplastic (vascular tumors) and dysplastic (vascular malformations) lesions, presenting most commonly in the head and neck area. VA may share similar clinical and histopathologic features, rendering specific diagnosis challenging. However, better understanding of their pathogenesis and accurate classification is mandatory, due to differences in biologic behavior. The aim of this study was to investigate the differential expression of the angiogenesis-related molecules VEGF-A and VEGFR-2 (Flk-1) and the proliferation marker PCNA in various oral VA. **Methods** Twenty-four surgically treated oral VA, including 12 hemangiomas (2 cavernous and 10 capillary), 7 lymphangiomas, 4 hemangiolymphangiomas and 1 Masson's tumor, were retrospectively collected; their demographic, clinical and microscopic features were reviewed. The immunohistochemical expression of VEGF-A, VEGFR-2 (Flk-1) and PCNA was assessed using routine immunohistochemistry and a semi-quantitative evaluation method.

Results The mean age of patients was 6.5 years (range: 2 months to 16 years), the male to female ratio was 1:1 and the most common location was the tongue (11/24 cases). VEGF-A was positive in 21/24 cases, of which 12/21 showed a low intensity, while VEGFR-2 (FIk-1) showed immunoreactivity in 10/24 cases (8/10 of low intensity). PCNA was positive in 22/24 cases demonstrating moderate or strong staining intensity in 12 and 6 cases, respectively; five out of the latter 6 cases were hemangiomas in patients older than 5 years old.

Conclusions Accurate classification of vascular tumors and malformations is important for determination of prognosis and appropriate management. The results of this study corroborate the notion that VEGF-A and VEGFR-2 (Flk-1) play a role in the pathogenesis of these lesions, while PCNA is a useful marker of the proliferating phase of hemangiomas in children and adolescents, possibly allowing, at least in some cases, their differentiation from vascular malformations.



Gingival Crevicular Fluid Biomarker Identification for Diagnosing Periodontitis by SWATH-MS

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Objectives To identify new molecular biomarkers with a high diagnostic capacity to detect untreated and treated periodontitis in gingival crevicular fluid (GCF).

Methods GCF samples were collected from 44 periodontally healthy subjects and 41 with periodontitis (stage III-IV). In the latter, 25 underwent non-surgical periodontal treatment and showed clinical improvement after two months. Samples were analysed using the sequential window acquisition of all theoretical mass spectra (SWATH-MS) and proteins were identified using UniProt human-specific database. The diagnostic capability of the proteins was determined with generalised additive models (GAM) to distinguish untreated periodontitis from periodontal health (first modelling), treated periodontitis from periodontal health (second), and untreated periodontitis from treated periodontitis (third). The area under the curve (AUC) and other classification measures were calculated. **Results** A total of 250 proteins were quantified. For distinguishing untreated periodontitis from periodontal health, 29 biomarkers had AUC values ≥ 0.850 , and for 48 dual combinations was ≥ 0.990 (sensitivity/specificity $\geq 95\%$). Glyceraldehyde-3-phosphate dehydrogenase (GAPDH) achieved the highest values (bias-corrected -bc- AUC=0.972; bc-accuracy=92.4%), followed by zymogen granule protein 16 homolog B (bc-AUC=0.962; bc-accuracy=89.4%). Their combination with matrix metalloproteinase-9 and cornulin, respectively, obtained a bc-AUC=0.999 and bc-accuracy=99.9%. For detecting treated periodontitis, 47 proteins had an AUC ≥ 0.850 and for 46 pairs was ≥ 0.995 (sensitivity/specificity $\geq 95\%$). Carbonic anhydrase 1 achieved a bc-AUC=0.930 and bc-accuracy=91.2%, while three combinations had a bc-AUC=1 and bc-accuracy=100% (haemoglobin subunit -Hb- delta with actin cytoplasmic 1, Hb alpha with GAPDH, and annexin A1 with peroxiredoxin-1). In the third modelling, no protein individually or combined achieved an accuracy of $\geq 60\%$.

Conclusions New single and dual-combination biomarkers in GCF were identified with outstanding capability to distinguish untreated and treated periodontitis from periodontal health using SWATH-MS. Pre-treatment and post-treatment periodontitis after two months were indistinguishable, even associating two proteins. However, these findings need to be validated using other techniques.



Ovariectomy-Induced Maxillary Trabecular Bone Microarchitecture and Marrow Cellularity Changes

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Objectives

Osteoporotic changes of alveolar bone microstructure can accelerate the rate and progression of inflammatory and destructive alveolar bone diseases such as periodontal diseases and apical periodontal diseases. The aim of this study was to identify the maxillary trabecular bone microarchitectural changes in the alveolar bone and cellularity changes in bone marrow over time after ovariectomy(OVX) in rats.

Methods Bilateral OVX was performed in test groups and a sham operation was performed in the control group on a scheduled day according to the assigned group. The groups were divided into three groups for the analysis of microarchitectural changes: 10, 12 and 14 weeks group according to the duration after OVX. Microarchitectural changes of trabecular bone in the alveolar interradicular septal area of the maxillary molars were analyzed using micro-CT and the histological observation of alveolar bone was performed. Real-time polymerase chain reaction was performed to measure mRNA expression levels of osteoclastic and osteogenic markers in the 12 weeks and 16 weeks groups

Results According to the micro-CT analysis, mean value of the percentage of mineralized bone volume per tissue volume, BMD and trabecular thickness gradually decrease as the time elapsed after OVX. Of note, although BMD failed to reach statistical significance among the OVX performed groups, the mean value showed a tendency to gradually decrease from the 10 weeks group to the 14 weeks group. The gene expression of osteoclastic markers markedly increased, whereas osteogenic gene expression markedly decreased over time after OVX.

Conclusions The microarchitectural deterioration of the maxillary alveolar bone was obviously observed at 10 weeks after OVX and progressed even further at 14 weeks. The sustained depletion of estrogen can lead to enhanced osteoclastogenesis and reduced osteogenesis in the bone marrow, which may disrupt bone mineralization and accelerate the rate and progression of destructive alveolar bone diseases like periodontal diseases and apical periodontal diseases.



0467 New Approach for Decontamination and Surgical Reconstruction of Peri-Implant Defects A. Friedmann, <u>H. Al Ghawi-Begovic</u>, D. Diehl, R. Jung, H. Bilhan Periodontology, Witten/Herdecke University, Witten, Germany

Objectives Periimplantitis therapy requires sufficient decontamination and depuration of exposed implant surface and sufficient modification of infrabony defect morphology. The common rationale suggests a combination between various materials according to the principle of Guided Bone Regeneration after mechanical/chemical debridement of implant surface. Present retrospective case series overlooks a 31 months follow-up of the outcomes reporting clinical and radiographic parameters.

Methods The surgical "Witten" approach uses Clean&Seal protocol, which includes application of hypochlorite-gel for implant surface decontamination and mechanical treatment by air abrasive after full-flap reflection. For the reconstructive part, cross-linked hyaluronic acid gel (xHyA) placed on defect walls and cleaned implant prior to grafting defect by xHyA hydrated sugar cross-linked collagen matrix (CLCM). The flap is than readapted and sutured around implant's neck, as the concept intentionally abstains from disconnecting the framework. Healing monitoring and control visits scheduled regularly for patients. At earliest after 12 months yet radiographically present defect area is compared to its baseline extension and change in Marginal Bone Level (MBL) calculated. **Results** The analysis included 12 patients contributing 14 treated implants and 78 peri-implantitis sites. All treated cases completed at least 12 months observation period with mean observation time of 31 months. Initial mean PPD equaled 6.9±1.9mm, and BoP was present in 59% of sites. The mean PPD at latest visit was 3.3±0.9mm. BoP frequency dropped to 7% for all sites. Newly formed mineralized peri-implant tissue occupied a 68.7±0.16% area of the former defect at mean. Mean MBL gain rendered 2.71±1.56 and 2.28±1.5mm at the mesial and distal aspect of the treated implants, respectively.

Conclusions Within the limits of the case series, we conclude that the reported outcome justifies the proposed approach representing a simplified and yet predictive technique, maintaining implant with the framework by sufficiently improving the biologic conditions.



"Mandibular Molar Causing Trigeminal Neuralgia Like Symptoms" a Case Report

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Objectives endodontic pathology either pulpal or periapical can mimic trigeminal pain

Methods A 30 year old female patient was referred to the University hospital of Düsseldorf after external root canal treatment. The patient presented with swelling in her left side of the face and acute pain. The patient was transferred to a neurologist who diagnosed the pain as trigeminal neuralgia. A Treatment with Carbamazepine was started up to 800 mg a day. The patient did not feel a better in symptoms rather experienced side effects such as weight gain over 10 kg and sleepiness.

The percussion of the tooth 37 was positive and triggered the described pain. There was a ledge in the mesiolingual canal and the inflamed vital tissue was removed under the ledge. The patient presented the next day she described that her pain was completely gone and that it cannot be triggered by chewing.

After one month, the patient had no pain since the removal of the vitality of 37. After Cleaning and shaping Calcium hydroxide was placed in the canals for 3 monthes. The canals were filled with Guttapercha R40 and Bioroot sealer. The Neurologist quit the carbamazepine as the patient had no pain after endodontic treatment of 37. 4 Monthes after the obturation the patient started feeling pressure under the tooth that triggered dull pain in tempral region and shooting pain in the lib. A periapical X-rax revealed that there was a periapical radiolucency under the tooth. Extraction extraoral episectomy and replantation of the tooth were preformed.

Results The pathology report revealed that there was a radicular cyst compressing the inferior alveolar nerve. The patient is symtomfree for 6 monthes now.

Conclusions thorough dental diagnosis must be performed to exclude dental cause before prescribing anticonvulsant drugs.



Objectives The aim of this study is to assess and evaluate the accuracy of third molar maturity index (I3m) and condylar cortication in relation to the real age in 14-23 year old individuals in Latvian population.

Methods Cross-sectional retrospective analysing of dental panoramic x-rays of 14-23 year old individuals was performed. **Results** For third molar maturity index a total of 126 panoramic radiographs were analysed, 77 radiographs met the inclusion criteria and were included, with 29 (37.6%) males and 48(62.3%) females. Third molar maturity index 0,08 or more was for 44 (57.1%) individuals, but below 0,08 or 0 was for 126 (42.8%) individuals. For condylar cortication a total of 126 pnoramic radiographs were analysed, 98 radiographs were included.

Conclusions I3m index value was accurate to the real age in 65 (84.4%) individuals. Condylar cortication was accurate to the real age in 46 (46.9%) individuals.



Discomfort/Pain Due to Periodontal Peri-Implant Probing in Titanium and Zirconium Implants

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Objectives To assess discomfort/pain following periodontal probing around teeth and peri-implant probing around titanium compared to zirconium implants

Methods One examiner recruited and examined 70 patients, each of them exhibiting a dental implant with a contralateral tooth. Thirty-five patients contributed one titanium implant of various types and 35 patients a zirconium implant each. Periodontal and periimplant probing depths (PPD) and clinical attachment level (CAL) were assessed. Whether implant or tooth was measured first was randomly assigned. Immediately after probing patients scored discomfort/pain using a visual analogue scale (VAS). The emergence profiles of implant crowns were assessed as transitional contour relative to the long axis on periapical radiographs of the implants. **Results** Seventy patients (age 70; 42/65 years [median; lower/upper quartile]; 43 females, 16 current smokers) were examined. Except for mean PPD and BOP (p < 0.001) clinical parameters (PPD, CAL, bleeding on probing, suppuration) were well balanced between implants and teeth. Peri-implant probing (VAS: 12.5; 4/22) caused significantly (p < 0.001) more discomfort/pain than periodontal probing (9; 2/15). Logistic regression analysis identified smaller differences of discomfort/pain between periodontal and peri-implant probing under analgesic medication (p = 0.135) and with many sites with BOP in corresponding teeth (p = 0.093). Comparing discomfort/pain between implants analgesic medication (p = 0.010), titanium (p = 0.031), emergence profile (p = 0.055) and smoking (p = 0.095) were negatively associated with discomfort/pain.

Conclusions Peri-implant probing caused significantly more discomfort/pain than periodontal probing. After analgesic medication (p = 0.010) and in titanium compared to zirconium implants (p = 0.031) probing caused less discomfort/pain.





Intraoral periapical radiograph of a titanium bone level implant replacing a right maxillary central incisor. The total angle describing the emergence profile is 39.56°.



Intraoral periapical radiograph of a zirconium implant replacing a right maxillary central incisor. The total angle describing the emergence profile is 65.98°.



Validation of Immunological and Microbiological Detection Methods in ORAMICAP Study

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Objectives The practice of sports can have repercussions on oral and general health. Elite athletes are more prone to upper respiratory tract infections and have an altered oral health. In addition, more than one third of adults have a high level of sedentary lifestyle, insufficient physical activity and have higher mortality and morbidity rates. This lifestyle is associated with an increased risk of oral diseases such as periodontitis. The aim of the cross-sectional ORAMICAP study is to compare the microbiological and immune oral changes in participants (n=200) performing physical activity at different levels (low, high, elite).

Methods Prior to the ORAMICAP trial, we set up two technological platforms designed for high throughput immune and microbial salivary profiling. A multiplexed ELISA (Meso Scale Discovery) was evaluated for the detection of 10 cytokines in saliva (IL-2,IL-4,IL-6,IL-8,IL-10,IL-12p70,IL-17,TNF-α,IFN-γ,IL-1β). Moreover, using nanofluidics-based qPCR (BioMark[™]HD System), we designed a cutting-edge microbial array dedicated to the simultaneous detection of 40 oral bacteria related to oral health and diseases, and 8 Herpesviridae (EBV,HSV-1,CMV,HSV-2,VZV,HHV6,-7,-8). Pre-runs of technological validation were performed using unstimulated saliva collected from donors aged 18-30 years, with various oral health conditions (periodontal disease, dental caries, good oral health).

Results All cytokines were found to be within the detection range in the saliva using a single dilution. Salivary concentrations of IL-1B, IL-2 and IL-17 were higher in patients with periodontal disease compared to controls. The proportions of commensal and periodontal bacteria were altered according to the disease. Higher concentrations of periodontal bacteria and Epstein-Barr virus (EBV) were found in patients with gingivitis and periodontitis compared to patients with good periodontal health.

Conclusions This work provides innovative new technological platforms dedicated to investigating the oral health. We particularly aim to provide global view of oral microbial and immune profiling for the identification of oral signatures associated with oral health and physical activity.



Patterns of Dental Antifungal Drug Prescribing in Croatia During 10-Years

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Objectives Oral candidiasis is the most common fungal infection in general dental practice, and therefore antifungal medications are among the commonly prescribed medications in dentistry. The aim of this study was to evaluate the prescription pattern for antifungal medications during the period of 10 years in Croatia.

Methods Data related to prescription practice used in this research were delivered by the Croatian Health Insurance Institute, a national insurance company for the years from 2013. - 2022. The number of dentists' prescriptions, the cost of medicines in national currency (Croatian Kuna; HRK), and the number of packages prescribed have been included in the analysis.

Results Local antifungals accounted for 99.5% of antifungal prescriptions. Among antifungal medications, the most popular choice was miconazolum for local application with an increase of 12,8% in 10 years. As for antifungal medication for systemic use, the most prescribed was terbinefrin. Nistatin and azoles showed a slow but continuous overall increase during the observed period. There was a small decrease in covid pandemic years due to the chronic nature of fungal infections and the avoidance of non-urgent dental treatments. Antifungal prescription represents on average 1,6% of all dental prescriptions.

Conclusions There has been an increase in the use of antifungal medicines over the last 10 years in Croatia. The present study indicates that azole antifungal agents (especially miconazole) are the most popular choice of antifungal agent. Local antifungals accounted for 99,5% of antifungal prescriptions.



0473 Patient Safety Standards in the U.S. Dental Schools

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Objectives Accreditation of the United States dental schools requires a formal system of quality assessment of clinical adverse events to ensure patient safety in school clinics. This study reviewed and assessed how patient safety standards are maintained in the U.S. dental schools and to determine students' attitudes and awareness of the malpractice consequences.

Methods Following PRISMA guideline, extensive literature search was conducted by using search engines like PubMed, Ovid Medline, Scopus, Embase, and google scholar. No language or time restrictions were used. The review was conducted from October 2022 to April 2023. Only full-text articles were selected that focused on malpractice litigations and patient safety in the U.S. dental schools. **Results** At the beginning of the study, 110 articles pertaining to malpractice and patient safety were selected. After excluding articles from countries other than the U.S., 45 relevant articles were used. An Inter-Rater Reliability (IRR) test was conducted for each article. The studies showed that patient safety was surveyed through committees like Medical Office Survey on Patient Safety by sending online questionnaires to dental schools through associations like the American Dental Association and the Commission on Dental Accreditation to analyze dental schools' attitudes to patient safety and risk management programs as well as through Agencies for Healthcare Research and Quality in dental schools. Electronic mail requests sent by study centers to receive adverse events reporting from schools have also been used.

Conclusions This study confirmed that patient safety cultures progressed over time. Ethics curriculum has been standardized in dental schools where students are given exposure to the adverse effects of malpractice and its prevention. However, schools still need to develop a standardized method of collecting and assessing adverse events data which will allow for quality improvement and increased patient safety in the U.S. dental schools



Teaching of Geriatric Dentistry in France: a Descriptive Study.

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Objectives Due to the ageing of the population, geriatric dentistry and its teaching have become indispensable. The purpose was to conduct a comprehensive study of the current teaching of geriatric dentistry in France.

Methods A questionnaire on this topic was proposed electronically to the 16 dental schools in the French Universities. This questionnaire was created by Dr. R. Ettinger and has been used on several occasions by his team in order to carry out an inventory of the undergraduate teaching of geriatric dentistry in the different American faculties. It was used with the kind permission of the author, and was translated using the translation-counter-translation process. We previously asked the universities to provide us with their teaching program and the associated knowledge control procedures.

Results Only one faculty did not have dedicated teaching. As far as theoretical pre-graduate courses were concerned, mostly were optional (69%) and 56% were taught as a specific independent module. The clinical part of the teaching was compulsory in only 44% of the faculties. Five faculties had no clinical module at all. 56% of the institutions were planning to develop their teaching. Half of the faculties accepted geriatric dentistry as an option in the first or second year of residency, but few residents were interested in this area. Only two universities proposed a postgraduate program in geriatric dentistry.

Conclusions This study revealed that the teaching methods for geriatric dentistry vary greatly from one faculty to another. We are far from being in line with the guidelines issued by the European College of Gerodontology in 2009 for predoctoral teaching in geriatric dentistry. New national strategies must be developped in France to meet the oral health challenges of an increasingly older population.



WORKSHOPS

0025

Artificial Intelligence Applications for Oral Health: a Hype or a Hope?

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Great achievements have been witnessed in the last half century pertaining to the fields of dentistry and oral and maxillofacial surgery: from the inception of 3-dimensional imaging (cone beam computed tomography) to the birth of Computer-Aided Design and Manufacturing (CAD-CAM); latest advancements in the field of machine learning (ML) and computer vision have allowed us to merge such complex technologies together, with the aim of accurately simulating, planning and analyzing clinical cases like never before.

But how accurate are such technologies in the 21st century? How do they work? And could they soon be assisting clinicians in their day-to-day clinical workflow, or is it still a far-fetched fantasy?

0211

Diversifying Your Skill Set as an Early Career Researcher

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An Early Career Researcher's (ECR) journey often revolves around intensive lab work and data analysis. However there is much more to a researcher's growth than theoretical and practical knowledge alone. This workshop aims to guide ECRs in diversifying their skill sets to cultivate a well-rounded skill-set.

The workshop will explore key strategies for skill diversification during the participants' ECR journey. The workshop will introduce the Vitae's Researcher Development Framework (RDF) and participants will learn how to identify and engage with the numerous courses and development opportunities that can contribute to widening their current skill-set. The speaker will provide examples of which activities she has found useful through her journey as an ECR and how these activities have contributed to her development and to her career pathway.

By diversifying their skill sets, ECRs enhance their research skills and broaden their networks, increasing their appeal in both the academic and the non-academic job market. This workshop will empower participants to make the most of their ECR phase by exploring new areas of interest and creating a solid foundation for their future careers.

0388

Managing Your Anxiety and Improving Your Eloquence to Give the Best

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Scientific conferences are an opportunity to promote research. However, oral presentations and posters can be stressful, especially for young researchers. Indeed, presenting your work in front of specialists is an impressive situation.

The objective of this workshop is to enable researchers to benefit from these presentations, to enjoy them and to enhance their work.



Tips and tricks will help you get ready in 3 steps:

Before the presentation - mental preparation and organization: manage your stress like a high-level athlete and prepare yourself for the communication: to write or not to write a text, to practice before, to master a foreign language and to understand the audience's expectations.

During the presentation - being eloquent: the keys to a good speech, non-verbal language, voice and oral expression.

Afterwards - enjoy the exchange: make corrections as necessary and take note of constructive comments immediately.

Giving your best allows you to take full advantage of these communications, which are great professional opportunities and allow you to leave with valuable advice and new ideas.

