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SUPPLEMENT ARTICLE

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# Oral Presentations

**RESEARCH SESSION | INSIGHTS INTO THE PATHOGENESIS OF PERIODONTITIS AND PERI-IMPLANTITIS**

## O001: Role of NLRP3 inflammasome in periodontitis: Friend or foe?

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**Background and Aim**: NLRP3 inflammasome is a major determinant of inflammation. Its activation leads to IL-1β maturation and initiates the programmed cell death, pyroptosis. NLRP3 inflammasome has been associated with various chronic inflammatory diseases. Recent findings showed that NLRP3 inflammasome components is over-expressed in gingival tissue of periodontitis patients suggesting its role in the pathogenesis of periodontitis. This study aims to characterize the role of NLRP3 inflammasome during *P. gingivalis*-induced periodontitis using transgenic NLRP3 KO mice.

**Methods**: Experimental periodontitis was induced on 4 groups of WT and NLRP3 KO mice using a ligature soaked with or without *P. gingivalis*. Ligature was placed into the palatal sulcus of first maxillary right molar. The intact left molar was used as control. We replaced the ligature twice a week during 4 weeks. Alveolar bone resorption was monitored by micro-CT on living animals before, during, at the end of the experiment. All mice were sacrificed for histological and immunostaining analysis.

**Results**: Micro-CT and histological analysis showed, without *P. gingivalis*, the absence of NLRP3 in KO mice increases alveolar bone resorption as compared to WT mice but *P. gingivalis* increases the bone resorption in WT mice. NLRP3 upregulation in WT mice augments mature IL-1β expression while a lower increase was detected in KO mice, probably due to AIM2 as we found its expression in connective tissue. We discovered a strong neutrophils recruitment at the periodontitis induction site while KO mice shows a recruitment defect. Strong NLRP3 expression was detected in neutrophils close to alveolar bone and weaker expression at the induction area. NLRP3 expression in alveolar bone crest neutrophils is significantly elevated when mice are treated with *P. gingivalis*.

**Conclusions**: NLRP3 inflammasome has a protective effect against periodontitis through neutrophils recruitment. However, this protective role is subverted by *P. gingivalis*. Further investigations of neutrophils subsets and role of NLRP3 inflammasome in neutrophils during periodontitis are needed.

## O002: Lipocalin-2 and semaphorin3a in periodontal health and disease

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**Background and Aim**: The purpose of this study was to examine gingival crevicular fluid (GCF) lipocalin-2 (LCN2), semaphorin3A (Sema3A), and tumour necrosis factor-α (TNF-α) levels in periodontal health and disease, and the effects of non-surgical periodontal therapy on these biomarker levels.

**Methods**: Three groups of systemically healthy non-smokers were recruited: periodontally healthy (group H; $n = 20$), gingivitis (group G; $n = 20$), and stage III grade C periodontitis (group P; $n = 20$). Clinical periodontal parameters were recorded and GCF samples were obtained at baseline from all groups and repeated (1 and 3 months after initial therapy) for group P. GCF LCN2, Sema3A, and TNF-α levels (total amounts) were determined using commercially available ELISA kits.

**Results**: For all three biomarkers, GCF levels were significantly higher in disease groups than group H ($p < 0.001$). TNF-α levels were significantly different between P and G groups ($p < 0.001$). All clinical parameters were significantly improved and LCN2 and TNF-α levels were significantly decreased after non-surgical periodontal therapy, compared to baseline ($p < 0.001$). Sema3A levels remained unchanged following treatment ($p > 0.05$). LCN2 and TNF-α levels were significantly positively correlated with periodontal clinical parameters and with each other.

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**Conclusions**: GCF LCN2 and TNF-α levels, which significantly declined following periodontal therapy, showed strong correlations with periodontal clinical parameters and with each other.

## O003: Activation of STAT3 in gingival tissues during periodontitis

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**Background and Aim**: The transcription factor signal transducer and activator of transcription 3 (STAT3) integrates and transduces the signaling of multiple pro-inflammatory cytokines associated with periodontitis. STAT3 is crucial for Th17 cell differentiation, a critical CD4 + T cell subset in periodontitis immunopathogenesis. Despite the importance of this protein, there is a gap in our knowledge regarding STAT3 activation (pSTAT3) during periodontitis. Hence, this study aimed to characterize pSTAT3 in gingival tissues during periodontitis.

**Methods**: To evaluate STAT3 activation by immune gingival cells, standardized gingival tissue biopsies were obtained from healthy and diseased subjects. Tissues were fixed, included in paraffin. pSTAT3 and immune cells were evaluated via immunofluorescence using an anti-pSTAT3(Y705), anti-CD45, anti-CD3, anti-CD4. Immuno-positive cells were counted in 40 tissues (18-CD45, 12-CD3, 12-CD4) using the CellProfiler™ software. To characterize pSTAT3 during progression of periodontal tissue destruction, we used an experimental periodontitis model. Murine gingival tissues were collected at 2 hr, 1, 3, 5 and 7 days after ligature placement. Total protein was extracted, quantified and pSTAT3 was detected by western blot. Bands were quantified using ImageJ software and β-actin were used as load control. Data are shown in mean ± SEM. P-values of <0.05 were considered statistically significant.

**Results**: Total percentages and numbers of CD45, CD3, CD4 and pSTAT3 immune-positive cells were higher in periodontitis tissues than healthy gingival tissues (24.9% ± 5.6% of CD45+, 13% ± 6.7% of CD3+ and 42% ± 10.2% of pSTAT3+). Furthermore pSTAT3-CD45, pSTAT3-CD3 and pSTAT3-CD4 immune-positive cells were significantly higher in periodontitis compared to health. In murine model, pSTAT3 was detected in all evaluated stages of periodontal tissue destruction. However, more dense bands of pSTAT3 were detected after 3 days of periodontitis induction.

**Conclusions**: Activation of STAT3 is higher in periodontitis compared to health. Immune cells, including T CD4 cells activate pSTAT3 during periodontitis. Activation of STAT3 is detected in early stages of tissue destruction.

## O004: Do neutrophils interfere with early oral biofilm formation?

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**Background and Aim**: Oral biofilms are complex multicellular structures composed of microorganisms and structural biofilm components such as extracellular matrix and extracellular DNA (eDNA), released by the resident bacteria. One of the first responders of the host immune system against oral biofilms are neutrophils. They migrate into the gingival crevice and employ antimicrobial mechanisms including production of neutrophil extracellular traps (NETs) and reactive oxygen species (ROS). In this investigation, we aimed to determine whether neutrophils affect the in vitro formation of early oral biofilms.

**Methods**: *Streptococcus oralis (S. oralis)* was used as a model organism of early colonizers. Neutrophils were isolated from peripheral blood and introduced to S. oralis biofilms at different stages of biofilm maturation in multi-well plates. Neutrophil extracellular trap (NET) and ROS production as well as neutrophil activation (CD11b expression) in response to S. oralis biofilms were analysed using fluorescent and luminescent assays and by microscopy. Biofilm mass was visualised by scanning electron and confocal microscopy and quantified using the crystal violet technique. DNAse activity of S. oralis was also investigated.

**Results**: *S. oralis* biofilms induced low NET production and high levels of intracellular ROS. At the same time, S. oralis biofilms alone produced high amounts extracellular DNA whilst showing no detectable DNAse enzymatic activity. A small but non-significant decrease in biofilm mass was observed when exposed to neutrophils. Microscopically, dead neutrophils were seen embedded in *S. oralis* biofilms.

**Conclusions**: Neutrophils, although activated, exert weak antimicrobial strategies in response to biofilms formed by the oral commensal *S. oralis*. Although high ROS production was observed, this was located intracellularly and may therefore be indicative of (frustrated) phagocytosis rather than affect the biofilm directly. Neutrophils appeared to become part of maturing biofilms without affecting these. Future studies will investigate whether NETs may contribute to the eDNA backbone of these biofilms.

## O005: Resolving E1 regulates inflammatory cell infiltration and cytokine production in diabetic periodontitis

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**Background and Aim**: Diabetic periodontitis involves a complex inflammatory process where periodontitis and diabetes aggravate the severity of the other. We hypothesized that Resolvin E1 (RvE1), a pro-resolution mediator of inflammation, decreases inflammatory cell infiltrate and pro-inflammatory cytokine expression in diabetic periodontitis through active ligand-receptor activation.

**Methods**: The db/db mouse (leptin receptor mutation) was crossbred with ERV1 transgenic mice (overexpresses receptor for RvE1) to generate double-mutant mice (db/db-ERV1).Wild-type (WT) and transgenic mice overexpressing ERV1 only were used as controls. Experimental periodontitis was induced with 7-0 silk ligatures tied around the maxillary second molars. Half of the animals received 10 mM RvE1 daily for 7 days. Gingival expression of IL-17+ and IL-2+ cells was evaluated by immunohistochemistry. Peripheral blood serum samples were tested for IL-17A, IL-17F, CCL20, IL-6, and IL-10 by multiplex immunoassay.

**Results**: Diabetic mice exhibited significantly more bone loss, with increased levels of IL-6, IL-17, CCL20, and IL-10 at baseline compared to the WT animals ($p < 0.001$). db/db-ERV1 mice were protected from the increased inflammatory phenotype and periodontal disease ($p < 0.001$ compared to db/db mice). Experimental periodontitis led to a significant increase in cytokine levels in all groups; however, it was significantly lower in the db/db-ERV1 mice compared to the diabetic and WT groups ($p < 0.05$). RvE1 treatment prevented experimental periodontitis-induced cytokine production in all groups; with a more significant impact on the db/db ERV1 group. Periodontitis increased the percentage of IL-$17^+$ cells in tissues in all groups; RvE1 treatment prevented this increase in ERV1, db/db, and db/ERV1 mice and decreased IL-$2^+$ cells in db/db and db/db ERV1 mice ($p < 0.05$).

**Conclusions**: RvE1 resolves inflammation and restores periodontal homeostasis through receptor-mediated activity and prevents excess inflammation induced by periodontitis in diabetic mice.

## O006: Bone microarchitecture and epigenetic markers in different periodontitis experimental models

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**Background and Aim**: Periodontitis is the results of a dysbiotic process possibly triggered by epigenetic mechanisms on the immune-inflammatory system. Systemic microbial challenge might provoke more or different epigenetic response when compared to a local challenge. The aim of this study was to understand which experimental model – gavage or ligature, would be more suitable to analyse the epigenetic alterations in the periodontium, accessing bone microarchitecture and epigenetic markers profile.

**Methods**: Periodontitis was induced in 6-8-week-old C57BL/6 mice allocated into the following groups: C: Control; GAV: gavage of *P. gingivalis* 3 times/week per 2 weeks, LIG7: animal euthanized 7 days after ligature placement; LIG42: ligatures was removed after 7 days of placement but animal were allowed to rest until complete 42 days after placement; and LIG42 + GAV: where ligature was placed for 7 days plus the gavage of *P. gingivalis*. Bone microarchitecture was measured by Micro-CT and acetyl histone 3 (H3) and 4 (H4) immunolabeling pattern by indirect immunofluorescence (IF) observed interproximally on the 2nd maxillary molar region. The data obtained were analyzed using ANOVA test, followed by Tukey's post-test.

**Results**: All groups exhibited bone loss comparing to control group – LIG7 showing the most evident bone loss ($p < 0.05$). However LIG42 and GAV did not exhibited any significant differences in any parameters of bone microarchitecture. Considering the whole periodontal tissue, all groups exhibited more labelling for H3 than C group but only GAV group was different than Control for H4 ($p < 0.05$). Interestingly, the immunolabeling in bone was higher for H3 and H4 in GAV than all the other groups, however, statistically significant just for H3 ($p < 0.05$).

**Conclusions**: While in ligature model, an acute local challenge, greater bone loss is observed, when ligature is removed, bone tends to recover. Systemic microbial challenge evidenced higher alterations of epigenetic markers for all the periodontal tissues, especially evidenced in crestal bone.

## O007: GenexGene Interaction analysis implies that combined polymorphisms at *SIGLEC5*, *PLG* and *CTD-2353F22.1* increase the risk for periodontitis and affect pathways of wound healing and angiogenesis

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**Background and Aim**: The basis of phenotypic variation of periodontitis is genetic variability. Disease relevant effects of risk alleles are considered to result from interacting genetic effects. We investigated gene x gene (GxG) interactions of periodontitis.

**Methods**: We used the case-only design to perform GxG interaction analysis and investigated SNPs that showed associations in our recent GWAS and GWAS-meta analysis with $p < 5 \times 10^{-6}$. CRISPR-dCas9 gene activation followed by RNA-Sequencing and gene-set enrichment analyses elucidated differentially expressed genes and gene networks. With the databases SNPInspector and Transfac professional, luciferase reporter gene assays and antibody electrophoretic mobility shift experiments, we analysed allele-specific effects on transcription factor (TF) binding.

**Results**: SNPs at the genes *SIGLEC5* and *PLG* showed GxG interactions with rs1122900 at the long noncoding RNA (lncRNA) *CTD-2353F22*. Associated chromatin cis-activated *CTD-2353F22.1* up to 6.5-fold ($p = 0.003$), indicating *CTD-2353F22.1* as target gene of this interaction. *CTD-2353F22.1* regulated *GADD45A* ($p_{adj} < 4.9 \times 10^{-11}$, $\log_2$ FC $= -0.55$), *THBS1*, *SERPINE1* and *Tissue Factor F3* ($p_{adj} < 5 \times 10^{-7}$, $\log_2$ FC $\geq -0.35$) and the gene set "angiogenesis" (area under the curve [AUC] $= 0.71$, $p_{adj} = 8.2 \times 10^{-5}$). rs1122900-C reduced reporter gene activity 5.5-fold ($p = 0.0003$) and reduced transcription factor binding of PRDM14 by 75%.

**Conclusions**: Our results indicate that the genetic risk of periodontitis relates, at least in parts, to mechanisms of angiogenesis and wound healing. We also suggest rs1122900-C as a putative causal variant of periodontitis that affects PRDM14 signaling.

## O008: Diagnostic and prognostic metabolic biomarkers in peri-implantitis

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**Background and Aim**: There are no methods to predict the initiation or progression of peri-implantitis (PI) around dental implants. Peri-implant crevicular fluid (PICF) metabolome may reveal host or microbial biomarkers with diagnostic and prognostic value while informing on PI pathophysiology. We aim to predict peri-implant bone loss using PICF metabolite levels.

**Methods**: Clinical and radiographic examinations and PICF samples were collected from 130 implants in 71 subjects at baseline, 6, 12, 18 and 24 months. At baseline, 59 implants were healthy (bone loss <2 mm; PD <4 mm), 33 implants had PI (bone loss ≥3 mm; PD ≥6 mm) and 38 other implants had bone loss ≥2 mm and <3 mm and PD 5 mm. Radiographic bone level changes of 112 implants and relative metabolites in PICF samples were measured at each 6 months interval using proton-nuclear magnetic resonance (H-NMR) 2D spectroscopy. MetaboAnalyst-5.0 software correlated metabolite levels with radiographic bone changes of ≥1 mm within a 6-month interval.

**Results**: The levels of *cadaverine* and *putrescine* in PICF are diagnostic of peri-implantitis with good accuracy (AUC = 0.755 and 0.709). Untreated diseased implants that demonstrated progressive radiographic bone loss of ≥1 mm within a 6-month interval (DP, n = 6) were compared to the metabolites of diseased-non-progressing (DNP, n = 8) and healthy-non-progressing implants (HNP, n = 26). *Proline* and *1-3-diaminopropane* levels could predict future bone loss of ≥1 mm with high accuracy (AUC = 0.917 and 0.854) whereas *glucose* and *arginine* levels could predict absence of bone loss in DNP and HNP respectively (AUC = 0.896 and 0.801) although statistical significance was not reached for all 4 metabolites. ANOVA revealed higher *biotin* and *propionate* levels in DNP compared DP and HNP ($p < 0.001$). *Valine* levels were higher in both DP and DNP compared to the HNP ($p = 0.002$).

**Conclusions**: PICF metabolites identified using H-NMR spectroscopy mapped a specific metabolomic profile able to identify diseased implants and implants with progressive disease versus non-progressing disease status and health.

**RESEARCH SESSION | LONG-TERM RESULTS IN IMPLANT DENTISTRY AND CONTROVERSIAL ISSUES IN ANTERIOR IMPLANTS**

## O009: 6-mm implants for the full-arch rehabilitation of edentulous mandibles: 5-year results from a multicenter randomized controlled trial

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**Background and Aim**: The use of short implants for the rehabilitation of atrophic sites compared to longer implants in augmented sites has been widely investigated. However, for a better evaluation, randomized clinical trials (RCT) comparing short and longer implants in intact bone sites without the need for vertical bone augmentation has been recommended (Jung et al. COIR 2018). In this multicenter parallel-group RCT we aimed to compare, in the same clinical scenario, 6-mm with 11-mm implants for the rehabilitation of edentulous mandibles.

**Methods**: 30 patients in three study centers received a fixed full-arch mandibular rehabilitation supported by five interforaminal implants (OsseoSpeed TX, Astra Tech Implant System, Dentsply Sirona Implants, Mölndal, Sweden) without any bone augmentation procedure. Patients were randomly allocated half to the test group (6-mm implants) and half to the control group (11-mm implants). Implants were loaded after 3 months (baseline). Peri-implant marginal bone level change (MBLc), as primary outcome, together with implant and prosthesis survival rate, as secondary outcomes, were evaluated up to 5 years. Data were analyzed with the patient as the statistical unit and the alpha level set at .025.

**Results**: One hundred and fifty implants in 30 patients were inserted. 27 patients were controlled at 5 years (3 drop-outs). No implant or prosthesis loss occurred. No statistically significant

intra-group and inter-group difference in the MBLc mean values was registered (P > .025, one-sided Mann–Whitney U test). The only significant difference (P < .01, Fisher Exact Test) was found for a higher rate of implants experiencing marginal bone loss >1.0 mm in the 11-mm group (9.0%, 6/70) compared to the 6-mm group (0.0%, 0/65).

**Conclusions**: 6-mm implants showed 5-year clinical and radiographic results comparable to 11-mm implants when used for the fixed rehabilitation of edentulous mandibles, in completely similar clinical conditions from both a surgical and prosthetic point of view.

## O010: Two-piece zirconia implants supporting all-ceramic single crowns in the posterior regions. A 9-year prospective cohort study

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**Background and Aim**: Two-piece zirconia implants were introduced to overcome the limitations of one-piece solutions. However, long-term studies investigating their clinical performance are still lacking. The aim of this prospective study was to determine the clinical outcomes of two-piece zirconia implants over a follow-up period of 9 years.

**Methods**: Fifty-two patients with at least one missing tooth in the posterior jaws were restored with two-piece zirconia implants supporting cemented fibreglass abutments and lithium disilicate crowns. After 2 years, 4 dropouts and 2 implant failures were recorded. After a mean observation period of 111.1 (SD 2.2) months, a total of 29 out of 46 patients were available for the assessment of implant survival, plaque index (PI), bleeding on probing (BOP), probing pocket depth (PD), mucosal recession (MR) as well as mechanical/technical complications. Comparisons with baseline- and 2-year data were accomplished using the Friedmann test, followed by post-hoc test when indicated ($p < 0.05$).

**Results**: Mean PI values at follow-ups were significantly higher than at baseline. Mean BOP and PD remained stable between 2 and 9 years. No additional case of peri-implantitis was registered. No significant difference in mean MR values was found over time and approximately two third of the implants exhibited no mucosal recession at 9 years. Three mechanical (10.3%) and 5 technical (13.8%) complications were detected in 7 patients between 2 and 9 years.

**Conclusions**: Within the limitations of this study, the investigated two-piece zirconia implants showed a high survival rate for single-tooth replacement in the posterior jaws. Despite the numerous mechanical and technical complications, clinical outcomes confirmed peri-implant tissue health and stability on the long-term.

## O011: Marginal bone maintenance and different prosthetic emergence angles

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**Background and Aim**: The aim of the present study was to assess marginal bone changes around implants restored with different prosthetic emergence profile angles.

**Methods**: Patients were treated with implants supported fixed prostheses and followed-up for 3 years. Marginal bone level (MBL) measured at prosthesis installation (t0) and at 3 years of follow-up visit (t1) were considered. MBL change from t0 to t1 was investigated. Two groups were considered: Group 1 for restorations with angle between implant axis and prosthetic emergence profile from >30°, and Group 2 for those with angle ≤30°, respectively. Seventy-four patients were included in the analysis and a total of 312 implants were examined. Moreover, peri-implant soft tissue parameters such as modified bleeding index (MBI) and plaque index (PI) were assessed.

**Results**: Mean EA in group 1 and 2 was 22 ± 7 and 45 ± 4 degrees, respectively. Mean marginal bone level change (MBL change) of 0.06 ± 0.09 mm and 0.06 ± 0.10 mm were, respectively in group 1 and 2. Difference of MBL change between the two groups was not statistically different ($p = 0.969$).

**Conclusions**: MBL change does not seem to be influenced by emergence angle, for implants with a stable internal conical connection and platform switching of the abutment diameter.

## O012: Comparative study of transcrestal sinus lift versus lateral approach sinus augmentation and simultaneous insertion of bioactive calcium–phosphate coated dental implants: 12 years of follow-up

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**Background and Aim**: In this prospective follow-up study, the cumulative survival and success rate of implants with bioactive calcium–phosphate coating after 12 years post-insertion via lateral sinus lift approach in comparison with transcrestal technique was documented. The second criteria were evaluation of bone remodelling in augmented sinuses.

**Methods**: Results of 90 conical implants with calcium–phosphate coating (Bioactive Alfa Gate, Israel) placed with simultaneous sinus lift procedure in 40 patients (2008) have been analysed. 20 patients were treated with lateral sinus lift and insertion of 50 implants (Group A). It was used following protocol: mixtures of platelet-rich fibrin and

deprotenized bovine bone covered by a collagen membrane (Bio-Oss/Bio-Gide, Geistlich AG, Switzerland). In rest, 40 implants were inserted via transcrestal sinus lift without grafting (Group B). ISQ analysis data were collected during surgery and after 4 months of healing. The Periotest data were obtained immediate, 4, 12 months and during 12 years post surgery.

**Results**: In group A ISQ values were 63.1 (4 months) versus 59.1 post-surgery. In group B the mean ISQ was 68.8 post-surgery versus 72.1–4 months. Post-surgery, Periotest value was −2.15(A) and −3.64 (B). After 4 months the value was −4.32 (A) versus −4.74 (B). The Periotest value in 1 year was −4.75 and −4.2 after 12 years. 4 months post-surgery; bone loss was −0.52 mm in transcrestal cases. After 1 year, a bone gain of +0.16 mm was observed with decreasing to −1.3 mm after 12 years. In augmented sinuses, it was observed bone formation after 4 months post-surgery (+0.46 mm). After 1 year, bone loss was −0.4 mm and −2.1 mm after 12 years.

**Conclusions**: Outcomes of study indicates a promising 12 years survival and success rate for bioactive calcium–phosphate coated implants. Transcrestal osteotomy has the advantage that allows for direct contact of the implant body with newly formed bone.

## O013: Tomographic and histological analysis of different socket sealing approaches for alveolar ridge preservation: A randomized controlled clinical study

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**Background and Aim**: Post-extraction volumetric changes on the alveolar ridge can be minimized with alveolar ridge preservation. Nevertheless, the effect of socket sealing on volume preservation and tissue formation remains unclear. This randomized clinical study compared different approaches for socket sealing in alveolar ridge preservation, assessing the tomographic dimensional change and histological characteristics of soft and hard tissues in a 4 to 6 months period.

**Methods**: Twenty-two patients with single tooth extraction indication in maxillary non-molar region were eligible for this study. After cone beam computed tomography (CBCT) and minimally traumatic tooth extraction, alveolar sockets were filled with xenografts, except for control group, which healed spontaneously (n = 6). Patients were divided into groups for socket sealing: collagen matrix (n = 5), collagen membrane exposed to the oral cavity (n = 5), and autogenous soft tissue graft from the palate (n = 6). A second CBCT was taken 4 to 6 months after extraction and a trephine biopsy of soft and hard tissues was collected during implant placement. Tomographic dimensional changes were compared between groups. Intra-group tomographic evaluation and descriptive histological analysis were also performed.

**Results**: Differences between socket sealing groups were not detected for dimensional change analysis ($p > .05$). Reduction on height of the buccal bone (−18.97 ± 23.73%) and cross-sectional area of the alveolar ridge (−19.28 ± 16.89%) were statistically significant 4 to 6 months after extraction for the spontaneous healing group in an intra-group evaluation ($p = .031$). Histological analysis revealed that the socket sealing approach had no impact on hard and soft tissues formation.

**Conclusions**: Our data suggest that socket sealing with collagen matrix, collagen membrane exposed to the oral cavity or autogenous soft tissue graft had no difference in terms of volumetric maintenance and tissue formation in a period of 4 to 6 months.

## O014: Anatomical predictors for successful ridge preservation associated with immediate implant placement on maxillary central incisors

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**Background and Aim**: Maxillary central incisors are crucial for aaesthetics and challenging to be replaced due to its anatomical features. These sites present a thin buccal wall, resulting in marked reduction following tooth extraction. Ridge preservation associated with immediate implant placement (IIP), that is, grafting the gap between the implant and the buccal wall has been suggested to limit marked volume loss. However, unpredictable outcomes and complications have been reported in the literature. Thus, the aim of the present study was to describe anatomical predictors for successful ridge preservation with IIP on maxillary central incisors.

**Methods**: Twenty-five patients who had a single failing maxillary central incisor with intact buccal wall and the contralateral tooth were included in this retrospective cohort study. Following minimally invasive tooth extraction and IIP, the resulting buccal gap wall was measured and filled with deproteinized bovine bone mineral (DBBM). After 5.6 ± 3.8 years in function, CBCT scans were obtained and assessed by a calibrated examiner. Implant sites were compared to the contralateral tooth sites. A linear regression model was built with the reduction of the alveolar process area as the dependent variable.

**Results**: The cross-sectional area of the alveolar process at tooth sites was 86.8 $mm^2$ (±20.3). At the implant sites, the cross-sectional area was 66.2 $mm^2$ (±26.8). Mean alveolar process remodeling was 24.4% (±23.8), with minimal reduction (≤15%) in 12 patients (48%) and advanced reduction (>15%) in 13 patients (52%). Predictors of reduction in the alveolar process area were the thickness of the buccal bone

at 3 mm from the crest (p = .031), width of the alveolar process at the same level (p = .037), tooth angulation in relation to the alveolar process (p = .011), and the size of the gap grafted with DBBM (p = .001).
**Conclusions**: Selection of the alveolar process with adequate anatomical features is fundamental for successful ridge preservation associated with IIP.

## O015: Vestibular socket therapy a novel protocol for immediate implant placement in compromised fresh extraction sockets: A 3 year follow up case series

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**Background**: The objective of this prospective study was to assess the radiographic, aesthetic and periodontal outcomes of immediate implant placement in compromised fresh extraction sockets in the aesthetic zone using vestibular socket therapy after 3 years.
**Description of the procedure**: Ten consecutive patients with type II sockets in the aesthetic zone were treated for single immediate implant placement. Hopeless teeth were atraumatically extracted, a vestibular access horizontal incision 3–4 mm apical to the mucogingival junction was made followed by a mucoperiosteal tunnel connecting it to the socket orifice. Implants were placed using a previously fabricated CAD/CAM surgical guide. Socket osseous defects were filled with particulate bone graft and covered with slowly resorbing cortical xenograft membrane that was stabilized to the apical bone, then the socket orifice was sealed with a customized healing abutment. The vestibular incision was closed with interrupted sutures. Post-restorative assessment included measuring labial plate thickness at three levels using CBCT scans at baseline and after 3 years. Changes in soft tissue levels were identified at three points by superimposing files obtained via an intraoral scanner at baseline with those after 3 years. Pink aesthetic score (PES) and peri-implant probing depth were measured after 3 years.
**Outcomes**: All 10 implants in this study survived. A significant gain in bone thickness was obtained at the crestal, middle and apical thirds, with a mean ± SD of 1.39 ± 0.89, 1.95 ± 0.75 and 0.78 ± 1.34 mm respectively (P ≤ 0.05). Mean ± SD mesial/distal papilla shrinkage and midfacial soft tissue recession after 3 years from baseline were − 0.23 ± 1.30, −0.93 ± 1.99 and-0.26 ± 1.40 mm respectively. The mean ± SD PES and peri-implant probing depth were 12.10 ± 0.88 and 2.20 ± 0.70 mm respectively.
**Conclusions**: The novel vestibular socket therapy might be a predictable treatment option for patients with compromised fresh extraction sockets on the long-term assessment, with adequate radiographic, esthetic and periodontal outcomes.

## O016: Socket shield technique for immediate implant placement - clinical, radiographic and volumetric data after 10 years

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**Background and Aim**: Since the first publication in 2009, the socket shield technique, as an immediate implant placement technique in the esthetic zone, has been gaining clinical acceptance. Although various cohort studies have been published, data about long-term performance has been missing. In this study, the 10 years data of the socket shield technique are presented.
**Methods**: The same patient cohort, in which the socket shield technique was evaluated over 5 years, was used in this protocol. Probing depths, bleeding on probing and height of keratinized tissue were recorded. Bone loss was evaluated on intra-oral radiographs. Digital impressions were taken to measure the mean oro-facial tissue change volumetrically on the implant and neighbouring teeth.
**Results**: The patients' follow-up time ranged between 119–127 months. All implants were clinically healthy at the time of examination. The mean oro-facial soft tissue change was −0.09 mm ± 0.24 mm from the baseline model to the 10-year model.
**Conclusions**: Within the constraints of this study containing only a limited number of patients, a virtually unchanged soft tissue contour was found after 10 years of implant placement with the socket shield technique. We can conclude that retaining the buccal dentine part of the failing tooth can prevent the otherwise expected soft and hard tissue alterations after tooth extraction.

**RESEARCH SESSION | PERIODONTAL DIAGNOSIS AND DISEASE PROGRESSION**

## O017: Evaluation of the success of a deep learning approach in determining periodontal bone loss on periapical radiographs

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**Background and Aim**: Deep learning systems, which are a sub-branch of machine learning, make models by imitating the learning processes in the human brain and can perform data analysis in these ways. These technologies are actively used in the medical field for purposes such as image processing and interpretation. The aim of the present study was to evaluate the success of a deep learning algorithm for determining periodontal bone loss types in periapical radiographs.

**Methods**: Five-hundred-fifty-seven digital periapical radiography images obtained from different jaw regions of individuals with periodontitis were included in this study. All radiography images were examined in detail by an experienced specialist, and 4 conditions (total alveolar bone loss, horizontal and vertical bone loss and furcation defect) thought to be signs of periodontal disease were labeled with the segmentation method. The images were sized and divided into data sets. In order to evaluate the success of the models created with the help of U-Net architecture, sensitivity, precision and F1 scores were calculated using statistical methods.

**Results**: In the current study, 561 labels were made for total alveolar bone loss. When the success of the artificial intelligence system for total alveolar bone loss was evaluated, it was found that the sensitivity was 1, the precision was 0.8, and the F1 score was 0.88. A total of 1224 and 517 labels were performed for horizontal and vertical bone loss (respectively), and the sensitivity, precision, and F1 scores were 0.76, 0.64, 0.69, and 0.66, 0.66, 0.66 for this parameters respectively. For the furcation defect, a total of 204 labels were made and it was determined that the sensitivity, precision and F1 score for this parameter were 1.

**Conclusions**: The success rates of artificial intelligence systems can be increased with more comprehensive studies to be carried out on this subject.

## O018: Detecting periodontal bone loss with an artificial intelligence approach on dental bitewing radiographs

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**Background and Aim**: Artificial intelligence is machine systems that imitate human intelligence and can improve itself. In the present study, it was aimed to evaluate the success of deep learning algorithms, which is an artificial intelligence system, in the determination of periodontal status on dental bitewing radiographs.

**Methods**: In the current study, a total of 434 dental bitewing radiograph images taken from patients with periodontitis were used. Total alveolar bone losses, horizontal bone losses, vertical bone losses, furcation defects and dental calculus around maxillary and mandibular teeth on all radiographs were labeled with the segmentation method. All images were sized and split into datasets. The development of artificial intelligence models was carried out with the U-Net architecture and the confusion matrix system was used for all statistical evaluations.

**Results**: In all radiographs, a total of 859 total alveolar bone loss, 2215 horizontal bone loss, 340 vertical bone loss, 108 furcation defects and 508 dental calculus labeling were performed. When the success of the developed models was evaluated (50% Intersection over Union value), the sensitivity, precision and F1 score results for total alveolar bone loss were found as 1, 0.94 and 0.96, respectively. In determining the type of bone destruction for each interdental space, it was observed that the sensitivity, precision and F1 score results for horizontal bone destruction were 1, 0.92 and 0.95, respectively, but the system could not determine the vertical bone destructions. Sensitivity, precision, and F1 score results for dental calculus were 1.0, 0.7, 0.82, and for furcation defect were 0.62, 0.71, and 0.66 (respectively).

**Conclusions**: It is seen that artificial intelligence systems are quite successful in radiographic image interpretation. The results of the present study show that these systems can be used for periodontal status determination in dental radiographs in the future.

## O019: Radiographical and clinical signs of periodontitis and associated bacterial species in a Swedish adolescent population

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**Background and Aim**: Periodontitis affecting adolescents is usually a rapidly progressing disease that ultimately leads to tooth loss if not treated early. In Northern Europe this has not, historically, caused any major issues due to the low prevalence (0–0.1%).

However, due to an increased migration globally, an increase in periodontitis among adolescents has been anticipated.

The aim was to study the presence of periodontal attachment loss and associated bacterial species in a population of adolescents in Västerbotten County, Sweden.

**Methods**: All adolescents born 2001 and who had a dental examination 2016 (n = 1655) were screened for proximal bone loss using bitewing radiographs taken during dental examinations (2014–2016). Individuals that exhibited proximal bone loss (≥2 mm) were invited to participate in a complete periodontal examination. Plaque, saliva and gingival crevicular fluid was also sampled. For each adolescent with bone loss, two healthy individuals were examined.

The microbiota in saliva and subgingival plaque was quantitatively examined by qPCR for selected bacterial species. The subgingival plaque samples were also analysed with cultivation technique.

**Results**: Proximal bone loss was identified in 24 individuals (1.5%) based on the radiographs. Thirteen of these individuals were periodontally examined, and 12 of those were diagnosed with periodontitis.

Preliminary results suggest that *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis* are found more frequently in cases exhibiting bone loss (cultivation and qPCR [plaque and saliva]) than in periodontally healthy controls. *Aggregatibacter aphrophilus* and *Filifactor alocis* were found more equally in both groups.

**Conclusions**: The present results suggest an increase of periodontitis among adolescents in Sweden. When comparing the microbiota from cases and controls clear differences were found.

## O020: Dietary patterns association with periodontitis and number of teeth. Data from the Tromsø study: Tromsø 7

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**Background and Aim**: We aimed to explore the association between dietary patterns and periodontitis grade B and C and number of teeth.

**Methods**: We used logistic regression to examine associations between dietary patterns and periodontitis and number of teeth controlling for age, sex, education, body mass index, smoking, and total energy intake with data from 1487 women and men aged 40–79 years, free of major chronic diseases, attending dental examinations in the seventh survey of the Tromsø Study (2015–2016). Periodontitis was defined by the AAP/EFP 2017 case definition and further by grade of progression based on % bone loss/age: no periodontitis/grade A (low rate of progression) and grade B/C (moderate-rapid rate of progression). Number of teeth were categorized as 28, 20–27 or <20 teeth. Dietary data were collected by an extensive food frequency questionnaire. Principal component analysis was applied to identify dietary patterns.

**Results**: Four dietary patterns were identified explaining 24% of the food intake variability: "Healthy", "Westernized", "Average" and "Refined grain and dessert." The "Healthy" dietary pattern with high loadings for vegetables, fruit, berries, nuts, fat fish, seafood, beans/lentils and vegetarian dishes was inversely associated with periodontitis grade B/C (OR tertile2vs1 = 0.75, 95% CI = 0.56–0.99, p = 0.044 and OR tertile 3 vs 1 = 0.73, 95% CI = 0.54–1.00, p = 0.048). The "Refined grain and dessert" pattern with high loadings for sweet spreads/sweeteners, desserts/cakes and other foods with refined grains and sugar such as bread, bun and cereals was positively associated with having <20 teeth compared with 28 teeth (OR tertile 2 vs 1 = 2.63, 95% CI = 1.44–4.82, p = 0.002 and OR tertile 3 vs 1 = 3.87, 95% CI = 1.96–7.65, p < 0.001).

**Conclusions**: A "Healthy" dietary pattern was associated with 25% lower odds of periodontitis grade B/C. Higher intake of sweet foods and refined grains was associated with having <20 teeth. Prospective studies are needed to confirm whether dietary patterns have an impact on the development of periodontitis.

## O021: The relation of external locus of control with depression, education level and periodontitis severity

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**Background and Aim**: External Locus-of-control (ExtLOC), i.e. the belief that outcome of our actions mainly do not depend on our personal control has been previously associated with an increased susceptibility to depression, low socio-economic status and periodontitis severity. We aimed at determining which of those characteristics are associated with ExtLOC in patients suffering from periodontitis.

**Methods**: 79 patients (mean age = 46.19 years; SD = 12.35), were recruited from the Department of Periodontology of a University Hospital. Education level, income and marital status, the Number of Standing Teeth (NST), and Plaque Control Record (PCR) were recorded. Patients completed Beck Depression Inventory (BDI), Cohen Perceived Stress Scale (PSS) and Levenson LOC scale. After dental prophylaxis, Bleeding On Probing (BOP), Probing Pocket Depth, mean and maximal Clinical Attachment Loss (CAL and CALmax) were measured.

**Results**: 20 participants presented a dominant ExtLOC. (external chance or external powerful others beliefs, rather than internal). They were characterized by a higher BDI (median[IQR] 15.00 [10.75, 22.50] vs 7.50[3.25, 14.00], P = 0.008), a higher CALmax (mean(SD), 9.95(2.82) vs 8.38(2.94), P = 0.041), a lower NST (24.00 [22.00, 26.25] vs 27.00[26.00, 28.00], P < 0.001), and a lower education level (OR = 0.18 [0.03–0.65], P = 0.004) in univariate analyses. No significant difference was found according to smoking status and PCR.

After 2000 bootstrap sample backward selections, NST (98.25%), education level (83.30%), CALmax (76.45%), PSS (64.25%), living alone (63.75%), BDI (60.5%) and age (58.40%) were retained in most multivariate logistic models predicting dominant ExtLOC, with still a significant association with CALmax (OR = 1.31,P = 0.02), NST (OR = 0.67,P = 0.002), BDI (OR = 1.21,P = 0.004) and education level (OR = 0.6,P = 0.011).

**Conclusions**: Findings suggest that ExtLOC is independently associated with more severe periodontitis, depressive mood, and lower education level. For clinicians, they underline the interest of taking externality into account in both disease management and therapeutic education. For researchers, it emphasizes the need to explore the role of externality in the psychosocial pathways between educational level, depression and periodontitis severity.

## O022: Changes in food intake, masticatory function, tooth mobility, loss of posterior support and diminished quality of life are associated with more advanced periodontitis stage diagnosis

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**Background and Aim**: Periodontitis, a chronic disease involving host-mediated, microbially-associated inflammation, causes destruction of the periodontal apparatus, and potentially tooth loss. Mastication is a complex function involving multiple structures; dysfunction occurs when the components in this process are impaired, such as tooth loss. The recent classification highlights masticatory dysfunction as a distinguishing factor between stage III and stage IV periodontitis. This study aims to describe periodontal and functional characteristics of subjects with different stages of periodontitis and to associate measures of masticatory function and quality of life with periodontitis stage.

**Methods**: This was a cross-sectional study on a convenience sample of 214 subjects with periodontitis seeking oral care in a hospital setting. A comprehensive periodontal examination was conducted by a single calibrated examiner who determined the diagnosis. Subjects were assessed using the OHIP-14, a validated masticatory dysfunction questionnaire and a quantitative test based on the ability to mix a dual color chewing gum. Mixing was quantified based on variance of hue (VOH) with a colorimetric software. Descriptive, univariate and multivariate analyses were performed.

**Results**: Stage IV periodontitis subjects reported greater impairment of oral health related quality of life, reduced food intake or altered food type intake attributed to difficulties in chewing, objective measures of masticatory dysfunction, tooth loss as well as more advanced periodontal breakdown compared with subjects with a milder diagnosis. Quantitative assessment of masticatory function was associated in a multivariate analysis with loss of functional tooth units in the premolar/molar region, presence of hypermobile teeth and severity of periodontal attachment loss.

**Conclusions**: Stage IV periodontitis subjects are characterized by a specific set of signs and symptoms of advanced periodontal breakdown and functional impairment which affect quality of life and masticatory function/food intake choices. Stage IV periodontitis captures a clinical entity with distinct features and may warrant particular treatment needs.

## O023: Are periodontal disease levels correlated to tooth-specific extraction patterns in the general population?

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**Background and Aim**: There is limited information about whether periodontal disease levels affect the general dentists' decision to extract teeth in persons with severe periodontitis and whether forceps levels have changed over the last decades. Therefore, we assessed tooth-specific distributions of probing depths (PD) and clinical attachment levels (CAL) in relation to tooth loss.

**Methods**: The Studies of Health in Pomerania (SHIP-START; SHIP-TREND) are two German population-based cohort studies. Only participants with severe periodontitis according to CDC/AAP criteria were included, totalling in 522 SHIP-START participants with 11-year follow-ups and 478 SHIP-TREND participants with 7-year follow-ups. On tooth level, maxPD and maxCAL were assessed together with information on tooth loss. Self-reported periodontal treatment was recorded. We graphically assessed distributions of maxPD and maxCAL for retained and extracted teeth and compared distributions between SHIP-START and SHIP-TREND. Linear mixed-effects models were applied to test for distributional differences between both studies. Finally, areas under the receiver operating characteristic (AUROC) were estimated to assess the ability of maxPD/maxCAL to differentiate with regard to incident tooth loss.

**Results**: On tooth level, distributional patterns of maxPD for retained and extracted teeth differed significantly between SHIP-START and SHIP-TREND in all participants as well as in participants without (only for retained teeth) and with periodontal treatment: in SHIP-TREND the distribution of maxPD values was shifted to the right compared to SHIP-START. However, no distributional differences were detected for maxCAL. Finally, differentiation with regard to tooth loss was slightly better for maxCAL (AUROC 0.809) than for maxPD (AUROC 0.723) in the total sample of SHIP-TREND.

**Conclusions**: In participants with severe periodontitis, teeth were already extracted at low levels of PD/CAL. This tendency was still detectable 10 years after, indicating a high potential to improve periodontal diagnosis and treatment in order to achieve higher tooth retention rates in general dental practices.

## O024: Periodontitis in young individuals - important factors for disease progression

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**Background and Aim**: To investigate how periodontitis in young individuals develops over 10 years and to identify factors that contribute to disease recurrence.

**Methods**: This is a retrospective cohort study based on all patients at age <36 years referred to two periodontal clinics in Public Dental Service, Stockholm, during the years 2003–2009. In total 471 patients fulfilled the inclusion criteria. At least 10 years after periodontal diagnosis all individuals were invited to a clinical and radiographic examination. The response rate was 46% and the final sample included 215 subjects. Stepwise logistic regression at individual level, using Periodontitis grade C at follow-up as dependent variable and using healthy/gingivitis and Periodontitis grade A as references, was adopted in order to investigate the influence of potential risk indicators on periodontitis progression. Results were considered statistically significant at $p < 0.05$.

**Results**: A majority (83%) of the subjects were classified as Periodontitis Stage III at baseline. At follow-up 69% of these subjects remained in Stage III and 11% were classified as Clinical gingival health or Gingivitis on a reduced periodontium. The frequency of subjects with Periodontitis Grade C was reduced from 79% at baseline to 17% at follow-up while subjects classified as Grade A increased to 42% at follow-up compare to one individual (0.5%) at baseline. Three variables had a significant influence on periodontitis progression rate; subjects classified as Grade C at follow-up had significantly higher bleeding on probing scores at baseline, were smokers and did not follow a regular supportive care program.

**Conclusions**: A majority of the young individuals with periodontitis showed stable periodontal conditions at follow-up. However, high bleeding index at baseline, smoking, interruption of ongoing periodontal treatment and lack of regular supportive care increased the risk for being classified as Grade C at follow-up.

**RESEARCH SESSION | RESEARCH IN THE MANAGEMENT OF PERI-IMPLANT DISEASES**

## O025: Case–control study on the correlation of $TiO_2$ sensibility-related parameters and peri-implantitis

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**Background and Aim**: Peri-implantitis is a biofilm-induced inflammatory disease around dental implants. Its progression depends on risk factors, of which many are still issue of controversial discussion, like tissue macrophage sensibility on $TiO_2$. The latter can be assessed by testing macrophage cytokine polymorphism (MCPM) and related surrogate parameters. The aim of this pilot study was to test the hypothesis of a positive correlation of such sensibility-related parameters and peri-implantitis.

**Methods**: In this case–control study, patients without and with peri-implantitis defined as progressive marginal bone loss, bleeding-on probing (BOP) and peri-implant probing pocket depths (PPD) ≥5 mm were recruited. MCPM, IgA, mannose-binding lectine (MBL), aMMP-8, TNF-α and IL-1ß from heparinized and full blood samples were assessed. Furthermore, the presence of specific bacterial species (*A. actinomycetemcomitans*, *P. gingivalis*, *T. forsythia*, *T. denticola*, *P. intermedia*, *P. micros*, *Fusobacterium spp*., *C. rectus spp*., *E. nodatum*, *E. corrodens* and *C. gingivalis/cochracea*) was determined semi-quantitatively. Implants were the statistical unit. One implant per patient was tested. Sample-size analysis revealed a minimum of 19 per group to be sufficient to show differences regarding MCPM. Fisher's exact test was used for inter-group comparison of ordinal parameters and Mann–Whitney-*U*-test for continuous parameters. The level of significance was set at 0.05.

**Results**: In both groups 24 patients were included. Clinical and patient-related parameters showed no significant inter-group differences except for the higher number of deep PPD and BOP around test implants (both $p < 0.001$). Regarding surrogate parameters indicating sensibility on $TiO_2$, MCPM ($p = 0.867$), IgA ($p = 0.781$), MBL ($p = 0.217$), aMMP-8 ($p = 0.113$), TNF-α ($p = 0.322$) and IL-1ß ($p = 0.367$) showed no significant intergroup difference. As to bacterial species, *T. forsythia* ($p < 0.001$), *T. denticola* ($p = 0.016$) *and Fusobacterium* spp. ($p = 0.010$) were significantly elevated in peri-implantitis. Therefore, the study hypothesis was rejected.

**Conclusions**: Within the present study design and its limitations, no correlation between parameters related to $TiO_2$ sensibility and the clinical finding of peri-implantitis was found.

## O026: Long-term clinical outcomes of short implants (6 mm) in relation to implant disease risk assessment (IDRA)

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**Background and Aim**: To investigate the association of the Implant Disease Risk Assessment (IDRA) with the occurrence of biological complications among short implants with a minimum follow-up of 7 years after loading.

**Methods**: This study was designed as a retrospective cohort study with a median follow-up time of 10.05 years. Patients who had received 6-mm short implants were reviewed and assigned into three groups based on the IDRA tool: low-risk group (Group L), moderate-risk group (Group M), and high-risk group (Group H). The following parameters were collected and analyzed at follow-up: survival rate, peri-implant soft tissue condition, biological complications, hardware

complications, and radiological assessment. The occurrence of biological complications in association with the IDRA model was evaluated.

**Results**: A hundred and ten patients, each contributing one implant, were assigned to three groups (L:17, M: 60, and H: 33). 12 biological complications were observed, 1 (7.7%) occurred in Group L, 4 (30.8%) occurred in Group M and 8 (61.5%) occurred in Group H. The cumulative rate of biological complication-free survival was 88.9% in Group L, 62.5% in Group M, and 41.7% in Group H ($p < 0.05$). A higher risk profile of IDRA (hazard ratio: 3.90, $p < 0.05$) and splinted crowns (hazard ratio: 9.35, $p < 0.01$) were risk factors of the prevalence of biological complications. The cumulative implant survival rate of Group H was significantly lower than that of Group L (80.8% vs 100%, $p < 0.05$). A multivariable Cox regression showed a higher risk profile of IDRA was a risk factor for short implants survival (hazard ratio: 4.08, $p < 0.05$). A significant difference of bleeding index was found ($p < 0.01$). No significant differences were found in modified plaque index, periodontal probing depth, hardware complication rates, and marginal bone loss.

**Conclusions**: For short implants, patients with a higher risk profile of IDRA seem to be at greater risk of implant loss and biological complications.

## O027: Evaluation of the outcomes of mechanical non-surgical treatment of peri-implant mucositis in combination with modification of the implant-supported prosthesis 30 motnhs after treatment

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**Background and Aim**: To determine outcomes at 30 months following mechanical non-surgical treatment of peri-implant mucositis in combination with prosthesis modification in order to improve access to biofilm, and also to determine other factors that may influence the long-term stability of treatment results.

**Methods**: Patients were evaluated 30 months after mechanical non-surgical therapy in combination with modification of the implant-supported prosthesis, either at the outset or at 6 months. All clinical variables were recorded using an electronic pressure-calibrated periodontal probe. Furthermore, at the patient level, previous history of periodontitis, total number of implants, attendance for supportive periodontal treatment (SPT),smoking habit, new medication, and new-onset systemic disease were registered. At the implant level, presence or absence of intermediate abutment, type of implant connection, implant position, and regular use of inter proximal brushes were assessed.

**Results**: 34 patients were evaluated and 108 implants were included in the analysis. Bleeding on probing (BOP) was present in 32.35% of the patients and 26.85% of the implants evaluated, with a mean modified bleeding index (mBI) of 0.13 (SD 0.23). Values of modified plaque index (mPi) reached 0.31 (SD 0.42) and mean probing pocket depth was 2.97 (SD 0.46) mm. No patient reported suppuration at this evaluation. Multivariate analysis at the patient level showed a statistical relationship between mBI and higher values of mPI and irregular use of interproximal brushes ($p < 0.001$ and $p = 0.0292$, respectively), while at the implant level, mPI locally and compliance with the SPT were shown to affect the final mBI ($p < 0.001$ and $p = 0.0261$, respectively).

**Conclusions**: Prosthesis modification to allow proper access for oral hygiene seems to be crucial in promoting a good outcome and stable results at 30 months after initial mechanical treatment of peri-implant mucositis. However, it is mandatory that this is accompanied by compliance with the stipulated SPT protocol and regular use of interproximal brushes.

## O028: Autogenous strip graft in combination with acellular dermal matrix versus free gingival graft alone to treat insufficient keratinised mucosa width. A randomised controlled trial

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**Background and Aim**: Several investigators have demonstrated that insufficient peri-implant keratinised mucosa width (KMW) is associated with increased plaque accumulation, soft tissue inflammation and attachment loss. Free gingival graft (FGG) is the gold standard for KMW augmentation, however, harvesting is associated with pain and donor site morbidity. To overcome these disadvantages and the limited volume available, acellular dermal matrix (ADM) were commonly utilised recently. Nevertheless, ADM was associated with enormous post-operative contraction. To minimise these disadvantages, we aimed to compare ADM plus autogenous strip graft (ASG) to FGG alone.

**Methods**: Thirty-four patients with insufficient KMW (<2 mm) at mandibular sites were enrolled. Subjects were randomly assigned to the test (ADM[mucoderm®] + ASG) or control (FGG) groups. Surgical intervention consisted of apically positioned split-thickness flap (APF) with apically secured ASG combined with a rehydrated and coronally sutured ADM in the test group, while APF with FGG alone were implemented in the controls. Grafts were immobilised with single interrupted and deep periosteal sutures. KMW, thickness (KMT) and shrinkage of the newly developed keratinised mucosa was determined at baseline, 6- and 12 months.

**Results**: 9 men and 25 women (56.4 ± 8.5 years) completed the study. Mean KMW were increased from 0.4 ± 0.5 mm to 4.3 ± 1.2 mm and 4.1 ± 1.2 mm @6 M (shrinkage:33.1% ± 23.0%) and 12 M (shrinkage:30.1% ± 20.9%) in control, while from 0.5 ± 0.6 mm to 5.1 ± 1.1 mm (shrinkage:42.1% ± 19.3%) and 4.7 ± 1.2 mm (shrinkage:43.7% ± 14.6%)

in the test groups, respectively. KMT increased from 1.6 ± 0.8 mm to 2.6 ± 0.7 mm and 3.1 ± 0.9 mm in controls vs from 1.5 ± 0.7 mm to 2.8 ± 0.7 mm and 2.7 ± 0.7 mm in tests. Improvement of all parameters showed significance ($p < 0.001$). Intergroup differences did not reach significance apart from the greater shrinkage in the test group @12 M ($p = 0.03$).

**Conclusions**: Within the constraints of this study, the combination of ADM + ASG could be a suitable alternative to the gold standard FGG for peri-implant keratinised mucosa widening.

## O029: Epigenetic regulation of gene expression through DNA methylation in peri-implantitis

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**Background and Aim**: Peri-implantitis lesions feature high progression rates, unpredictable responses to current treatment approaches and a lack of tools for patient stratification. The underlying pathomechanisms and determinants of host susceptibility are not fully understood.

Herein, we aimed to identify DNA methylation and linked gene expression patterns associated with disease severity as possible new epigenetic markers of peri-implantitis.

**Methods**: 43 'diseased' peri-implant tissue samples of 29 systemically healthy, previously untreated non-smokers (66.49 ± 9.05 years; mean maximum probing depth of 8.07 ± 1.94 mm [range: 5–11 mm]) were harvested. Genome-wide DNA methylation was assessed using the Illumina EPIC (850 K) platform, transcriptomes using total RNA Illumina sequencing. We identified differentially methylated CpG sites and regions associated with maximum probing depth as measure of disease severity using mixed regression models. Further, differentially expressed genes with concomitant differentially methylated promoter regions were identified using serial regression analyses. All results were FDR corrected.

**Results**: We observed a total of 80,373 differentially methylated CpG sites: methylation of 39,895 sites was negatively and 40,478 was positively associated with disease severity. These differentially methylated sites conglomerated to 14,476 differentially methylated regions. Further, we identified 8774 genes whose expression patterns were statistically significantly associated with disease severity. Lastly, we identified epigenetic networks with negative correlations between methylation and gene expression.

**Conclusions**: We were able to identify gene expression signatures and concurrent epigenetic regulation patterns via DNA methylation which were significantly associated with disease severity. This approach may be able to identify genes and their epigenetic regulation relevant in the pathophysiology of peri-implantitis and relevant host response. The identified epigenetic regulatory networks could furthermore be useful as diagnostic markers of disease.

## O030: Treatment of peri-implant mucositis: Combination of ultrasonic debridement and air abrasive device vs. ultrasonic debridement alone. A randomized clinical trial

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**Background and Aim**: The aim of this randomized clinical trial is to assess the adjunctive effect of a glycine powder air abrasive procedure (GPAP) to the ultrasonic debridement (UD) for the treatment of peri-implant mucositis.

**Methods**: Individuals diagnosed with peri-implant mucositis were consecutively enrolled. Full-mouth periodontal evaluation together with intraoral radiographs were recorded at baseline by a single calibrated examiner. All subjects were treated by the same operator with a full-mouth ultrasonic debridement, approaching dental implant with a ultrasonic plastic tip; at the end of this session the treatment allocation was assigned: test group implants were additionally treated with GPAP, whereas in control group no adjunctive treatment was delivered. Oral hygiene instruction were delivered before the intervention and every month until the end of the experimental period (3 months follow-up). Clinical variables were recorded at the last follow-up in order to assess periodontal and peri-implant status.

**Results**: Fifty subjects successfully completed the examination period. Both baseline status and treatment result for periodontal treatment were comparable between the two groups. At patient level, residual bleeding sites around implants were compared among groups and no significant difference was detected (34.0% vs 36.9%) ($p > 0.05$). At implant level, 3 months after treatment, 1.9 residual bleeding sites were present at test implants, whereas 2,1 sites bled at control implants without any significant difference ($p > 0.05$). Predictive model based on a multiple logistic regression showed that implant healing (Bop sites <2) after treatment is correlated with the radiographic emergency angle ($p < 0.05$), implant location ($p < 0.05$) and with the type of prosthetic manufacture (cement vs screw retained) ($p = 0.051$).

**Conclusions**: According to the present study, both peri-implant mucositis treatment protocols improve the clinical inflammatory condition after 3 months of follow-up. No adjunctive clinical effect was detected for the combination of GPAP plus UD over UD alone.

## O031: Systemic antibiotics in the surgical treatment of peri-implantitis–a randomized controlled trial

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**Background and Aim**: The aim of this ongoing randomized controlled trial was to evaluate the clinical and microbiological outcome of adjunctive systemic antibiotics in the surgical treatment of peri-implantitis.

**Methods**: Patients referred for peri-implantitis were randomized to three treatment groups (A = amoxicillin and metronidazole, B = phenoxymethylpenicillin and metronidazole, and C = placebo). All patients received resective surgical treatment and implant surface decontamination. DNA-samples were collected for polymerase chain reaction (PCR) analysis of four types of pathogenic bacteria and clinical treatment outcomes were assessed at 6 and 12 months after surgery.

**Results**: A total of 55 patients with 79 implants has to date completed the 12-month follow-up. A difference in implants presenting with inflammation was observed in the antibiotic groups compared to the placebo group (55% and 65% vs. 79%) at 6 months, however not significant. A significant reduction in peri-implant probing depth and bacterial load was observed within all groups ($p < 0.05$). These parameters continued to decrease throughout the study.

**Conclusions**: The adjunctive use of systemic antibiotics in the surgical treatment of peri-implantitis may improve the clinical and microbiological outcome when compared to placebo, however the results are preliminary.

## O032: Surgical treatment of peri-implantitis using a bone substitute with or without a resorbable membrane: A 10-year follow up

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**Background and Aim**: To evaluate the long term outcome of two regenerative surgical techniques.

**Methods**: 16 out of originally 38 individuals treated with reconstructive surgery for peri-implantitis remained at a 10-year follow up examination. In Group 1 (8 individuals with 13 implants), the intraosseous defects had been treated with a bone substitute covered with resorbable membrane whereas in Group 2 (8 individuals with 13 implants) only the bone substitute was used. All study individuals were kept on a strict maintenance programme during the follow-up.

**Results**: At the 10-year follow-up clinical and radiographic improvements in both groups were demonstrated. No implants were lost due to progression of peri-implantitis. In both groups, radiographic evidence of bone gain was maintained over the 10 years. At year 10, the average defect fill was 1,6 mm (SD ± 2.2 mm) in Group 1 and 1,3 mm (SD ± 2,5 mm) in Group 2. Bleeding on probing decreased in both groups. Baseline and year 10 plaque scores did not differ between groups and was reduced from 47.8% at baseline to 6.7% at 10 years.

**Conclusions**: Both treatments resulted in stable conditions long term in most of the patients and implants. Additional use of a membrane did not to improve the outcome.

**RESEARCH SESSION | RESEARCH IN PREVENTION AND SUPPORTIVE PERIODONTAL CARE**

## O033: The interest and the development of a digital tool for prevention and supportive periodontal care. Example of diabetic patients

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**Background and Aim**: Periodontal diseases represent a major public health issue. They are considered as the 6th diabetes' complication, and are connected to other systemic diseases. Up to now, the main treatment guidelines were focused on the curative techniques, more than the preventive ones (particularly in France).

In a context of increases of both periodontal diseases and diabetes (chronic diseases generally speaking), we seriously have to take into account the preventive approach. E-health has evolved in different medical specialities, especially to help diabetics to manage their disease (connected to their doctor). Those patients are confident in using digital tools in many ways. They are informed on different diabetes' complications but not enough on periodontal diseases. Although efforts are being made to improve the situation, it is not enough given the overall data.

In that context, the work of my exercise thesis intended to prove the need of a digital tool to optimize the periodontal diseases' treatment especially for diabetics. The goal is to help dentists and patients in the prevention and supportive periodontal care for better results in both short and long terms, especially in a context of a pandemic.

**Methods**: An investigation showed the need of a digital tool for the dentist as well as the patient.

With the help of engineers and designers, we have developed an application. This one has two sides: one for the dentist to help him in his practice (particularly for all the preventive and supportive cares), and the other one for the patient to involve him/her the best way possible into the treatment of his/her chronic disease.

**Results**: The prototype of the tool is almost finished, and will be for use at the beginning of 2022.

**Conclusions**: Considering the overall context, there is an urgent need for that kind of tool helping in the management of periodontal diseases.

## O034: The impact of a "successfully treated stable periodontitis patient status" on patient-related outcome parameters during long-term supportive periodontal care

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**Background and Aim**: The 2018 Classification of periodontal and peri-implant diseases and conditions included a definition for a successfully treated stable periodontitis patient status (PPS). However, there is no information on the possible long-term impact on the periodontal conditions, of achieving such a stable PPS after active periodontal therapy.

To assess the importance of achieving a successfully treated stable PPS during long-term supportive periodontal care (SPC).

**Methods**: This retrospective cohort study included 100 periodontitis patients, who continued for ≥7.5 years after active periodontal treatment with SPC and were judged as overall adherent. The effect of various predictors on the number of

1. diseased teeth at last SPC,
2. teeth lost due to periodontitis, and
3. teeth lost due to any reason was assessed.

**Results**: Twenty percent of the patients were classified as stable after active periodontal treatment. After a mean follow-up of 10.77 years, 24 patients lost 38 teeth due to periodontitis; only one out of these teeth was in a patient with stable PPS. An unstable PPS and a higher number of diseased teeth at first SPC, and inadequate oral hygiene levels over time significantly increased the risk for a higher number of diseased teeth per patient at last SPC and for more lost teeth due to periodontitis. However, high adherence to SPC appeared to mitigate the negative effect of an unstable PPS, especially regarding tooth loss due to periodontitis. Further, tooth loss due to any reason was about 3-times higher than tooth loss due to periodontitis and was affected by a larger number of predictors.

**Conclusions**: Successfully treated patients with a stable PPS maintained a low number of diseased teeth and barely lost teeth during long-term SPC, compared to patients not achieving a stable PPS after active periodontal therapy.

## O035: Stability of periodontal parameters during 10 years of supportive periodontal therapy in patients with and without previous orthodontic treatment: A cross-sectional evaluation and long-term comparison

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**Background and Aim**: To evaluate and retrospectively compare the periodontal parameters of patients during 10 years of supportive periodontal therapy (SPT) with or without previous orthodontic treatment.

**Methods**: During a follow-up visit (T1), the dental data, including periodontal parameters, of a total of 64 patients with at least 10 years of SPT were collected (27 with completed orthodontic treatment; 37 without orthodontic treatment in the past) and intraoral scans (IOS) were performed (PrimeScan AC, DentsplySirona). Furthermore, data of the patients 10 years before T1 were used (T0). Staging and grading was determined for T0. Using IOS, the index of treatment need (IOTN) was performed remotely.

**Results**: Both groups showed highly stable values for the parameters probing depth (PD) and clinical attachment loss (CAL) (change in mean: PD 0.01 ± 0.31 mm (with orthodontic treatment) vs. 0.05 ± 0.50 mm (without previous orthodontic treatment); CAL 0.16 ± 0.54 mm vs. 0.07 ± 0.66 mm), as well as for bleeding on probing (change in mean: 3.1 ± 7.8% vs. 0.5 ± 15.5%), plaque control record (change in mean: 4.2 ± 16.6% vs. 2 ± 14.6%) and gingival bleeding index (change in mean: 0.6 ± 2.6% vs. 3.2 ± 7.2%). In both groups, patients had lost less than one tooth in 10 years (tooth loss in mean 0.89 ± 1.67 vs. 0.62 ± 0.89). At T0 the distribution of staging and grading was comparable (stage II: 2 vs. 4; stage III: 23 vs. 31; stage IV: 2 vs. 2; grade B: 7 vs. 10; grade C: 20 vs. 27). The aesthetic (AC) and dental component (DHC) of the index of treatment need were on the same level at T1 (mean AC: 3.48 ± 1.63 vs. 3.03 ± 1.19; DHC: 3.37 ± 0.63 vs. 3.24 ± 0.68).

**Conclusions**: Periodontitis patients with previous orthodontic treatment as well as patients without previous orthodontic therapy had high grades of stability in periodontal parameters during long-term SPT and showed similar scores in the IOTN.

## O036: Change in periodontal parameters of splinted posterior teeth during 10 years of supportive periodontal therapy – A retrospective evaluation

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**Background and Aim**: A common symptom of periodontitis is increased mobility, which may persist after treatment. An often-used strategy to reduce increased mobility is splinting. The aim of the study is to compare periodontal parameters of splinted posterior teeth versus non-splinted control teeth over a period of 10 years of supportive periodontal therapy (SPT) and to assess the survival rate of splints.
**Methods**: Retrospective data of 372 SPT-patients were screened for the presence of composite and fiberglass-reinforced composite splints in the posterior region (molars/premolars). Splints were only included if patients had attended SPT ≥10 years, if the splints had been inserted due to increased mobility of the test tooth, and if a non-splinted control tooth was present. Data (patient-level/splint-level/test-control tooth-level) were assessed at the first SPT-session after splint insertion (T1) and 10 years later (T2). Possible influencing covariates for splint survival (mobility degree, Eichner class) were tested by Cox regression.
**Results**: 24 patients (32 splints, 58 splinted teeth) were included. Seven patients experienced no splint fracture over 10 years of SPT. Ten test and two control teeth were lost. No differences were observed between the changes in CAL and PPD of test teeth compared to controls (CAL_T1: 5.37 ± 1.62 vs. 4.26 ± 1.59 mm; CAL_T2: 5.52 ± 1.69 vs. 4.38 ± 1.66 mm; CAL_change: −0.38 ± 1.90 vs. 0.20 ± 1.27; PPD_T1: 3.04 ± 0.89 vs. 2.57 ± 0.68 mm; PPD_T2: 2.92 ± 1.01 vs. 2.63 ± 1.0 mm; PPD_change: −0.17 ± 1.18 vs. 0.10 ± 1.05 mm). After 10 years of SPT, survival rate of splints was 31%. Cox regression was not able to show that the maximum mobility degree prior to splinting and the number of supporting zones had influence on time to fracture or debonding ($p = 0.212$; $p = 0.703$).
**Conclusions**: Splinting of periodontally compromised and mobile posterior teeth does not have any disadvantage regarding the clinical periodontal situation. However, splint fractures occur very often.

## O037: Skill begins with knowledge and understanding - why daily tooth brushing fails to keep gums healthy

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**Background and Aim**: Oral health behaviours such as daily tooth brushing often appear to be a habit rather than purposeful behaviour aimed at a specific goal like the maintenance of gum integrity. Instead, research and epidemiological data suggest that even those who brush their teeth twice a day may not be able to prevent periodontitis. One of the reasons may be that people do not have thorough knowledge and understanding of the causes and consequences of gingivitis and periodontitis. The current study thus aimed to assess the knowledge and understanding regarding periodontal diseases in adolescents, adults and senior citizens.
**Methods**: Former participants of the 5th German Oral Health Study (n = 333 16-year-olds, n = 307 39–48-year-olds, n = 332 69–78-year-olds) participated in a telephone survey about periodontal diseases and oral hygiene behaviour. Open-ended questions were followed by single- and multiple-choice questions regarding the same topic.
**Results**: The results showed considerable deficits in knowledge and understanding. More than half of the participants could not mention any causes or consequences of periodontitis when asked with open questions. In addition, less than 10% and less than 25% mentioned the gingival margin and proximal sites respectively as areas that should be given special importance. Instead, more than 70% of the adolescents and senior citizens and nearly 50% of the adults considered the statement to be correct that brushing the occlusal surfaces would be of particular importance to avoid periodontitis.
**Conclusions**: Tooth brushing has become an integral part of most people's daily lives. Nevertheless, the prevalence of gingivitis and periodontitis remain high. The results of this study suggest that this may be due to deficits regarding knowledge and understanding of periodontitis and its prevention. People lack important information that could help them brush the teeth more efficiently. Addressing these deficits can be an important step in achieving better periodontal health at the population level.

## O038: Sugar, oral/general health, obesity associations awareness and weight stigma

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**Background and Aim**: The WHO states dental practitioners should provide dietary advice to patients to help improve their general health and prevent noncommunicable diseases. Pilot studies show that patients are happy to receive this advice, however dental professionals are hesitant to discuss obesity related topics. Weight stigma and discrimination can lead to numerous adverse health consequences less trust of healthcare providers. The project aim was to investigate awareness of associations between sugar, oral/general health and

obesity and to assess levels of weight stigma amongst the general public compared to dental professionals.

**Methods**: This multicentre cross-sectional survey was conducted by six post-graduate students across various locations in the UK. Each student recruited a minimum of 60 participants. All participants completed an online questionnaire including demographic information and rating their level of agreement with 36 statements (6 statements within 6 domains) using a 1–5 value Likert Scale (strongly disagree-strongly agree). Domains 1–5 contained statements related to sugar and general health, sugar and oral health, obesity as a disease, obesity and caries, obesity and periodontitis, while domain 6 statements were to assess weight stigma.

**Results**: The survey was completed by 1976 participants (1268 non-dental individuals, 708 dental professionals). Linear regression analysis adjusting for age, gender and university degree indicated that dental professionals' mean Likert scale score was statistically significantly greater than non-dental individuals for domain totals 1–5 individually and for their overall total ($p < 0.01$). However, there was no evidence of a difference in Likert scale scores between the two groups for domain 6 (weight stigma) ($p = 0.43$). Pearson correlation coefficient indicated a highly significant negative association between awareness (D1-5 total) and weight stigma (D6) ($p < 0.001$).

**Conclusions**: Based on this UK sample, dental professionals compared to non-dental individuals demonstrated similar levels of weight stigma in spite of dental professionals being significantly more aware of sugar, oral/general health, and obesity associations.

## O039: One-year clinical, microbiological and immunological results of local doxycycline or antimicrobial photodynamic therapy for recurrent/persisting periodontal pockets: A randomized clinical trial

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**Background and Aim**: To evaluate after 1 year the clinical, microbiological and immunological effects of local drug delivery (LDD) or photodynamic therapy (PDT) adjunctive to subgingival instrumentation (SI) in persistent/recurrent periodontal pockets in patients enrolled in supportive periodontal therapy(SPT).

**Methods**: Persistent/recurrent pockets (PD ≥4 mm, bleeding on probing-BOP+) of 105 patients enrolled in SPT were randomly treated with SI + PDT or SI + LDD or SI + NaCl (control). The following parameters were recorded at baseline, and at 3, 6 and 12 months after therapy: number (N) of treated sites with BOP, probing pocket depths (PPD) and clinical attachment levels (CAL) along with full-mouth plaque scores (FMPS). Microbiological and immunological samples were also analysed. The main outcome variable was the N of sites with BOP at 12 months (m).

**Results**: At all follow-ups, all three treatments resulted in statistically significant clinical improvements ($p < 0.05$) compared to baseline, without significant intergroup differences for PPD- and CAL-values ($p > 0.05$). Notably, the presence of both bleeding and plaque at treated sites showed altogether (i.e. in all patients) a reduction of such sites at 3 m, but a continuous increase at the later follow-ups; on the other hand, absence of bleeding and plaque at treated sites resulted in a reduction of these sites, which was sustained up to 12 m. Most important, in all three treatment groups, signs of bleeding were associated with a PPD-increase up to 12 m. Over the 12 m evaluation period, several bacterial species (*A. actinomycetemcomitans*, *P. gingivalis*, *T. denticola*, *T. forsythia*, *F. allocis*) were reduced in the LDD- and control-group, whereas *P. intermedia* and *F. nucleatum* increased in all treatment groups. No major changes were observed for the inflammatory markers IL-1b and MMP-8.

**Conclusions**: The present data indicate that in periodontal patients enrolled in SPT, treatment of persistent/recurrent pockets with SI alone or combined with either PDT or LDD may lead to comparable clinical improvements.

## O040: Third-party toothbrushing among patients with periodontitis is associated with a positive patient experience: Randomized, single-blind, patient-centered analysis

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**Background and Aim**: As the need for care increases with higher age, so does the need for assistance with oral hygiene. A recent study analyzed the clinical effectiveness of oral hygiene assistance provided by caregivers, but patient perception has not yet been addressed – including whether perceptions would differ between assistance provided by laypeople vs. dental professionals or the type of toothbrush used (manual vs. powered).

**Methods**: First, a qualitative study was conducted. This aimed at developing a standardized questionnaire which assesses pleasant and unpleasant perceptions of patients while being brushed. Items were extracted on the basis of qualitative interviews with a sample of persons not otherwise involved in the study. A delphi process ensured the content validity of the final instrument. The main study comprised 39 patients randomized to one of four groups: brushing carried out by trained laypeople or dental professionals, each using

a manual or powered toothbrush at three different time points during anti-infective periodontal therapy. Patient perceptions of the third-party toothbrushing were assessed immediately after brushing.

**Results**: Patients reported mainly positive feelings regarding being brushed by a third person and the interaction with this person during brushing. Neither the professional background of the brushing person nor the type of brush had a significant influence (all $F < 3.30$, all $p > 0.07$, all $\eta^2 < 0.10$).

**Conclusions**: Patient perceptions of third-party toothbrushing are mainly positive regarding wellbeing and interactions with the tooth brushing person, with no differences between laypeople versus dental professionals or the toothbrush used (manual versus powered). Since a positive perception of such measures is a decisive factor in determining whether they will work in everyday clinical practice, this is an important aspect when planning oral hygiene measures.

**RESEARCH SESSION | CLINICAL CHALLENGES IN IMPLANT THERAPY**

## O041: Peri-implant bone augmentation by the sub-periosteal peri-implant augmented layer technique and a bovine-derived bone block: A case report

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**Background**: The Sub-periosteal peri-implant augmented layer (SPAL) technique combined with particulate deproteinized bovine bone mineral (DBBM) was effective in completely correcting up to 92% of peri-implant buccal bone dehiscence's (BD). The use of a DBBM block (bDBBM), however, may result in an improvement of the peri-implant bone dehiscence as well as a relevant lateral bone augmentation, since its mechanical properties may ensure a better dimensional stability than particulate DBBM. The aim of the present case report was to investigate if bone augmentation may be performed successfully at BD with a combination of SPAL and bDBBM.

**Description of the procedure**: At the buccal aspect of an edentulous ridge, a split-thickness flap, namely the "mucosal layer", was raised, leaving the periosteum on the edentulous ridge intact. Then, the periosteal layer was elevated from the bone crest. A full-thickness flap was elevated on the lingual aspect.

Two tissue-level implants were positioned, in position 3.5 and 3.6, using a computer-aided surgical guide. Both implants presented a BD of 3 mm at 3.5 and 2 mm at 3.6. Cortical perforations were performed. Block DBBM was adapted beneath the periosteal layer to completely cover the BDs.

The periosteal layer was sutured to the lingual and the mucosal layer was coronally advanced to achieve primary closure of the wound. At 6-months re-entry, a free gingival graft was used to augment the peri-implant soft tissue phenotype.

**Outcomes**: At 6 months, previously exposed implant surfaces were completely covered by newly formed hard tissue up to the most coronal portion of both implants and a bone-like tissue ≥3 mm thick mm was found.

**Conclusions**: The combination of SPAL and bDBBM can be successfully used to increase buccal tissue thickness at the most coronal portion of an exposed implant. The histological nature of the newly formed tissue has to be determined yet.

## O042: The tunneled sandwich technique for preserving the buccal tissue volume after immediate implantation: A retrospective report of 11 cases

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**Background**: The loss of volume of the alveolar ridge following tooth extraction especially in the anterior regions of the jaws is a commonly accepted problem. This case series presents a technique of combined immediate implant placement with the enhancement of the buccal tissue by an ossifying cross-linked collagen matrix combined with cross-linked hyaluronic acid. The method, which has been very efficient in 11 cases for prevention of volume loss is presented.

**Description of the procedure**: In the enclosed cases, an intact extraction socket presented with a narrow buccal wall, yet justifying an immediate implantation. The tunneled sandwich technique helped to build a subperiosteal pouch for insertion of the collagen matrix buccal to the alveolar bone. The implants either healed transmucosally by receiving a gingiva former, or were immediately restored. During the follow-up sessions, the pocket probing depth (PPD) and bleeding on probing (BOP) were measured, and the buccal tissue contour evaluated.

**Outcomes**: 11 sites in 11 patients with a follow-up between 6 and 20 months after implant placement demonstrated stable non-inflamed peri-implant conditions and suitable ridge volume at the implant's neck. The pink esthetic score was calculated with a mean of 12.2 from 14 and a range from 7 to 14 points.

**Conclusions**: The tunneled sandwich technique appears a feasible method to preserve the buccal volume and to contribute to biologic as well as esthetic long-term results. To be able to draw reliable conclusions more cases with a longer follow-up period are necessary.

## O043: 3D Driven hard tissue augmentation based on reverse planning: Reconstruction of advanced, horizontovertical alveolar ridge defects. Case series

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**Background**: This case series presents a novel, 3D driven reverse planning for surgical rehabilitation of advanced alveolar ridge defects. Utilizing a completely digital workflow, alveolar ridge augmentation could be virtually simulated thus the surgical procedure is simplified.

**Description of the procedure**: Three patients with periodontitis (Stage III, Grade B) presented posterior partial edentulism with class C alveolar defects according to the horizontal, vertical, and combination (HVC) classification.

In all three cases, the digitally planned treatment of a severe horizontovertical alveolar ridge defect is presented.

Preoperative Cone-Beam Computed Tomography (CBCT) scans were segmented using a semi-automatic segmentation technique in an open-source medical image processing software (3D Slicer) to acquire virtual 3D models of dental and alveolar structures. Intraoral scans, bite registrations were also acquired to generate digital wax-ups. Consequently, prosthetically ideal implant positions could be planned in 3D. Based on future implant positions adequate amount of hard tissue augmentations could be planned virtually. Individualized form of the barrier membranes could be determined, allowing the additive manufacturing of membrane cutting templates for shaping the barrier membrane during surgery.

The combination of a non-resorbable barrier membrane, tenting screws and composite graft (50% xenograft, 50% autogenous bone) was utilized.

Follow-up CBCT scans were taken after 9 months to determine volumetric and 3D morphological changes.

**Outcomes**: Moderate postoperative swelling was observed, membrane exposition occurred in two of the three cases however in these scenarios no superinfection of the augmented area and no differences in the clinical outcome were observed. After 9 months with superimposition of the preoperative and postoperative CBCT scans a hard tissue gain of 0.9 ± 0.2 $cm^3$ was detected.

**Conclusions**: Virtual planning and subsequent surgical simulation on 3D models is a novel method in "prosthetically driven" augmentation potentially reducing duration of surgery and postoperative complications. However, further studies are necessary to drive any more conclusions.

## O044: Preserving the emergence profile - a digital copy abutment technique

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**Background**: Digital Copy Abutment Concepts seem to have a positive impact on hard and soft tissue integration of dental implants. The immediate placement and provisionalization of single tooth implants, with an digital individualized definitive zirconia abutment could have positive impact on hard tissue integration and the aesthetic outcome.

**Description of the procedure**: By copying the emergence profile of the natural tooth digitally and using a one abutment - one time technique, repeated abutment disconnections and re-connections during prosthetic rehabilitation can be avoided. Therefore definitive, individualized zirconia abutments, copying the emergence profile of the natural tooth were fabricated within 3 hours after immediate implant placement, using a complete digital workflow. The provisional crown was replaced by a definitive crown after a healing period of 12 months. Soft tissue aesthetics were evaluated pre- and postoperatively using the Pink Esthetic Score.

**Outcomes**: The Pink Esthetic Score improved from 12 to 14. The Marginal and horizontal bone and tissue loss were digitalized measured after a mean observation period of 2 years. The patient claimed that she was very satisfied with the result and would choose the same treatment protocol again, if tooth replacement were necessary.

**Conclusions**: The immediate placement and provisionalization of single tooth implants in the esthetic zone, using a digital Copy Abutment Concept, is an efficient treatment method, which leads to high patient satisfaction, good esthetic results as well as limited marginal and horizontal bone loss.

## O045: Simplified transcrestal sinus floor elevation procedure: 2 year results, intra-oral and endonasal recordings

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**Background**: Several translaveolar sinus floor elevation techniques avoid the use of an osteotome or a mallet: the Balloon procedure, the Piezotome procedure, the Reamer procedure, and the Gel Pressure Technique. Those procedures are efficient but require the use of multiple drills and/or instruments. The simplified translaveolar procedure drastically reduces the number of drills and/or instruments used as only one drill achieves the osteotomy and begins to unstick sinus membrane.

**Description of the procedure**: The sinus floor elevation procedure used a specially designed drill (Sinusjet®) to achieve the osteotomy and start hydraulic sinus-membrane unsticking. A nanohydrxylapatite paste (Osslift®) is used for further sinus-membrane elevation and bone augmentation instead of hydroxyapatite granules because of its suitability for injection by syringe into the 3.3-mm diameter osteotomy. It was performed as a 1-step procedure with immediate implant placement. Implant survival rate, sinus membrane perforation, post-operative complications were analysed retrospectively. The whole procedure was registered using two endoscopes (30° - 4k sinus endoscope – Olympus) in one patient, to get both sinusal and buccal recordings.

**Outcomes**: 105 sinus floor elevation were performed in 90 patients using Sinusjet® and Osslift® with a mean follow-up period of 2 years. Sinusal 4 K recordings showed the progressive membrane unsticking and elevation in one patient. The mean membrane elevation was 8.1

± 2.5 mm. 120 implants were placed. Sinus-membrane perforation was observed in less than 1% (n = 1/105). Two late membrane perforations (2%) were registered without post-operative complications. Two years implant survival rate was 99.2% with one early implant loss (n = 1/120).

**Conclusions**: This transcrestal sinus floor elevation procedure that combines an hydraulic device and nanohydrxylapatite paste appears safe and predictable. It is both patient friendly as it avoids the use of an osteotome or a mallet and practitioner friendly as it drastically reduces the number of drills and/or instruments used.

## O046: A novel application of dynamic navigation system in dental implant placement with simultaneous sinus lifting by lateral window approach: A case series

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**Background**: In sinus augmentation, if the remaining crestal bone height is under 5 mm, a lateral window approach is recommended. However, the maxillary sinus has an anatomical limit that results in lateral window sinus lifting being more complicated and challenging. How to choose the appropriate surgical site in advance or in real-time is the key to improve the surgical outcome.The aim of this case series was to evaluate the effect of sinus lifting by lateral window approach and the accuracy of dental implant placement under dynamic navigation.

**Description of the procedure**: Eight patients with partial edentulism over maxillary molars area and initial vertical bone height under 5 mm. Periodontal status was stable before implant surgery in all cases. Then, took cone-beam computerized tomography (CBCT) and completed the pre-operation evaluation. All surgeries were performed by one surgeon (T.-Y. Lin) under dynamic navigation (Navident®, ClaroNav Inc., Canada). Area of antrostomy, time of antrostomy and implant primary stability were measured. Used superimposed CBCT for evaluation of accuracy outcomes and sinus lifting.

**Outcomes**: Eight implants were placed on eight patients. All surgeries were done uneventfully. The mean of implant linear deviations of entry point (2D) was 0.56 mm, apex (3D) was 0.74 mm. The mean of implant angular deviations was 2.04°. The mean of bone augmented height was 12 mm, time of antrostomy and membrane reflection was 775 seconds and the area of the antrostomy was 43.7 $mm^2$. Surgeon could use navigation to detect the location of septa, arteries, and sinus floor. Hence, precisely prepare small antrostomy to skip the anatomical limit and follow the sinus floor to efficiently make Schneiderian membrane elevation and achieve sufficient bone height.

**Conclusions**: The data showed excellent accuracy of implant placement and it was precise, safe, and minimal-invasive for sinus lifting by lateral window approach using the dynamic navigation system.

**RESEARCH SESSION | NEW INSIGHTS IN PERIODONTAL STEP 2 NON-SURGICAL TREATMENT**

## O047: Acute systemic inflammation in obese patients following full-mouth versus quadrant non-surgical treatment of periodontitis

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**Background and Aim**: The study aimed to evaluate acute perturbations of systemic inflammation after non-surgical periodontal treatment by comparing two different protocols, Quadrant Scaling and Root Planning (Q-SRP) versus Full-Mouth Scaling and Root Planning (FM-SRP) in patients affected by obesity.

**Methods**: A total of 40 obese patients affected by periodontitis, were randomly allocated to either FM-SRP or Q-SRP, respectively. Periodontal parameters were collected at baseline and after 3-months. Vital signs, endothelial function exam, and blood collection were performed at baseline, 24-hours after the first session of treatment and at 3-months control. High sensitivity assays of inflammatory biomarkers, glucose-related biomarkers and lipids were performed on all samples.

**Results**: Periodontal treatment was successful in terms of periodontal parameters independently of the technique used. A significantly higher increase in hs-CRP levels was observed 1 day after the FM-SRP treatment approach compared to the Q-SRP approach ($p < 0.05$). Reduction in HbA1c and insulin levels were observed at 3-months ($p < 0.05$ and $p < 0.01$, respectively) in the Q-SRP group, whereas in the FM-SRP group a reduction in insulin level was observed at 3-months ($p < 0.01$). Multivariate regression model revealed that high body mass index (BMI), FM-SRP approach, age >60 years, smoking, and high systolic blood pressure levels are negative predictive factors for HbA1c increase 3-months after treatment in obese patients. Moreover, intragroup reduction in total OHIP-14 score was observed for both treatment groups.

**Conclusions**: In conclusion, to avoid acute systemic perturbations, it is recommended to perform non-surgical periodontal treatment according to a conventional treatment protocol in patients with comorbidities, such obesity, to minimize potential risk for cardiovascular events and/or metabolic disruptions.

## O048: Impact of periodontal treatment on GCF miRNAs expression changes associated with cardiovascular risk in patients with periodontitis

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**Background and Aim**: This study aimed to assess the effects of periodontal treatment of microRNAs (miRNA) expression in gingival crevicular fluid (GCF) in patients with periodontitis (PT) and cardiovascular disease (CVD) as a measure of CVD risk reduction.
**Methods**: For this 6-months prospective controlled clinical trial, were recruited healthy subjects (n = 16) and patients with PT (n = 16), CVD (n = 17) and PT + CVD (n = 17). Patients were assigned to receive full-mouth Scaling and Root Planing (FM-SRP) protocol and were regularly monitored for clinical and GCF miRNA-7a,-21,-100,-125b and − 200 changes at baseline, 60 and 180 days follow-up. Clinical and GCF data changes were statistically evaluated. The primary outcome was the evaluation of GCF miRNA changes that was evaluated by real-time PCR. A multivariate generalized linear model was applied to identify the significant predictors at baseline that influenced miRNA variation changes after 6-months of FM-SRP.
**Results**: Compared with healthy subjects, patients with PT, CVD and PT + CVD presented significant dysregulated miRNAs GCF expression. At 3 and 6 months after therapy, FM-SRP treatment significantly reduced each analyzed periodontal parameter in all groups. FM-SRP produced, at −3 and at 6-months after therapy, a significant reduction of the miRNA 7a-5p, 21-3p, 21-5p, 200b-3p, and 200b-5p, and a significant increase in the miRNA 100-5p and 125-5p ($p < 0.001$). The multivariate analysis evidenced that periodontitis at baseline was a significant predictor of the decrease of miRNA 7a-5p ($p = 0.016$) and miRNA 21-3p ($p < 0.001$). Moreover, presence of periodontitis (miRNA 100-5p, $p = 0.002$;miRNA 200-5p, $p = 0.009$) and CVD at baseline were significant predictors of the increase of miRNA 100-5p ($p < 0.001$) and the decrease of miRNA 200-5p ($p = 0.015$) at 6-months.
**Conclusions**: Periodontal treatment determined, at 6-months follow-up after FM-SRP, a significant reduction of miRNA 7,-21,-200 and the upregulation of miRNA-100 and -125. Moreover, periodontitis at baseline was a significant predictor, after 6-months of therapy, of some GCF miRNA expression changes associated with augmented CVD risk.

## O049: Factors affecting patients' choice of pain control during subgingival instrumentation

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**Background and Aim**: To determine clinical and psychological factors influencing patients' choice of pain control for subgingival instrumentation (SI) during either antiinfective (AIT) or supportive periodontal therapy (SPT).
**Methods**: Patients with the need of subgingival instrumentation used a decision board for shared-decision-making to opt for:

a. no pain control,
b. intrapocket anesthesia gel (Oraqix) or
c. infiltration anesthesia (Articaine).

Clinical parameters (maximum probing-pocket-depth, number of teeth treated, treatment phase) and patient-reported parameters (procedural pain via visual-analogue-scale (VAS), dental anxiety (mDAS), decision-regret (DRS), current and future-choice) were recorded.
**Results**: Out of 231 participants (age 64 ± 12 years, female: 50%), 62% opted for no pain control, 36% for intrapocket gel and 2% for infiltration anesthesia. Current choice was influenced by all clinical parameters recorded ($p < 0.05$, ANOVA, Pearson-Chi-Square). Procedural pain during subgingival instrumentation and decision-regret had an influence on future choice. DRS values were generally low and not statistically different between the groups of current choice ($p > 0.05$). Current choice had the highest impact on the future option; 95% would stick to their previous choice ($p = 0.000$, Pearson-Chi-Square).
**Conclusions**: The extent of periodontal inflammation was positively correlated with the invasiveness of pain control chosen by patients undergoing subgingival instrumentation. AIT patients tend to use pain control while most SPT patients preferred no pain control. The future change of choice is related to the pain experience during subgingival instrumentation and the decision regret. Shared-decision-making using a decision board for pain control during subgingival instrumentation yielded in high levels of patient satisfaction irrespective of the option chosen.

## O050: Effect of probiotic *Lactobacillus reuteri* as an adjunct to nonsurgical treatment on halitosis of patients with periodontitis - a preliminary randomised controlled trial

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**Background and Aim**: Intraoral halitosis is caused by microbial degradation of oral organic substrates, resulting in volatile compounds. Periodontitis may present as one of the oral conditions causative to halitosis. The aim of this randomised controlled trial was to assess the effect of probiotic *Lactobacillus reuteri* as an adjunct to nonsurgical periodontal treatment on halitosis of patients with periodontitis.
**Methods**: 30 systemically healthy patients with generalised periodontitis stage II - IV and halitosis (OLS ≥1 and VSC >160 ppb) were

included in this trial. All patients were treated with nonsurgical periodontal treatment, after which they were randomly assigned to a test group, using probiotic lozenges for 28 days/twice per day (ProDentis®, BioGaia AB, Lund, Sweden) or a control group using placebo lozenges. Halitosis was assessed by organoleptic judgement and with a device (Halimeter®, Interscan Corporation Chatsworth, CA, USA) at baseline, after 1 month and 3 months. Tongue coating (WTCI) was assessed at baseline, after 1 month and 3 months. Clinical periodontal parameters, PPD, CAL, REC, FMBS and FMPS, were recorded at baseline and 3 months.

**Results**: Both groups showed significant halitosis reduction, tongue coating reduction and improvements in periodontal parameters at 3 months. No significant inter-group differences could be detected for halitosis parameters at 1 and 3 months. A composite outcome for residual halitosis, defined as OLS ≥1 and VSC >160 ppb present at 3 months, showed a marginally significant difference between the probiotic and control group (0% vs 20%, respectively, $p = 0.068$) with greater nullification of halitosis in the probiotic group. The probiotic group showed small but significantly greater PPD reduction and CAL gain ($p < 0.0001$).

**Conclusions**: Within the limitations of this study, it can be concluded that causative periodontal treatment is effective in halitosis reduction, and probiotics could provide additional benefit.

## O051: Effectiveness of adjunctive use of proanthocyanidins in non-surgical periodontal treatment

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**Background and Aim**: Preclinical studies with proanthocyanidins (PACN) have shown high antibacterial and anti-inflammatory capacities, that could reduce periodontal inflammation. Recently, preclinical studies of our research group have shown a specific antibacterial characteristic of PACN to attack periodontal pathogens but save the oral commensal bacteria. The aim of current clinical study was to evaluate the effectiveness of subgingivally placed collagen hydrogels with PACN as an adjunct to subgingival instrumentation in patients with periodontitis.

**Methods**: Patients with stage III grade B periodontitis were included in this study. Healthy individuals were enrolled as no-treatment control. Patients with periodontitis received two different treatment strategies: subgingival instrumentation and subgingival application of collagen hydrogels with PACN (SP group) compared with subgingival instrumentation (S) alone. Clinical periodontal parameters (PPD, BI, PI) were evaluated before treatment and after 6 weeks. The relationship of clinical periodontal parameters and immunological markers (MMP-3 and TIMP-1 levels) were analyzed to assess the efficacy of PACN in periodontal therapy. This study is approved by the Regional Biomedical Research Ethics Committee (No. BE-2-38). Trial Registration in ClinicalTrials.gov: NCT05015387.

**Results**: Totally, 70 systemically healthy individuals were enrolled in this study (23 patients in S group, 23 patients in SP group, 24 patients in no-treatment control group). Proanthocyanidins combined with subgingival instrumentation resulted in additional statistically significant PPD reduction in moderate periodontal pockets 0,5 mm ($P < 0.05$) on average compared to the subgingival instrumentation alone. Immunological investigation showed that healthy individuals had lower MMP-3 concentration in saliva compared to the patients with periodontitis ($P < 0.05$). Application of PACN showed significant reduction of MMP-3 levels in saliva after 6 weeks ($P < 0.05$).

**Conclusions**: Adjunctive use of proanthocyanidins in subgingival instrumentation resulted in better clinical outcomes for moderate pockets. Additional use of proanthocyanidins improved MMP-3 concentration in saliva more than subgingival instrumentation alone. Biochemical analysis revealed that MMP-3 concentration in saliva reflected the periodontal health state.

## O052: Minimally invasive non-surgical therapy (MINST) in patients with advanced periodontitis: A 6-month results of a split-mouth, randomized controlled clinical trial. Part 1: Clinical outcomes

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**Background and Aim**: During initial periodontitis treatment, the mechanical disruption of subgingival biofilm is challenging in deep periodontal pockets and furcations, often resulting in residual pockets. Nevertheless, thin ultrasonic tips, Gracey mini-curettes and magnification devices in minimally invasive non-surgical periodontal therapy (MINST) appear to overcome such hurdles due to improved access, diminished tissue trauma, enhanced blood clot stability and better marginal gingival tissue integrity. Therefore, the present study aimed to estimate if MINST has a higher capacity to reduce residual pocket's number than standard debridement when treating advanced periodontitis with predominantly supra-alveolar bone defects.

**Methods**: In a split-mouth, randomized controlled trial, dental arches in 20 stage III/IV, grade B/C periodontitis patients were randomly allocated to two treatment modalities. In the test quadrants, therapy consisted of MINST, while the control quadrants received conventional subgingival mechanical debridement. The primary outcome variable was the number of diseased sites (DS: PPD ≥5 mm + BOP). A multivariate multilevel logistic regression model evaluated the effects of gender, smoking, treatment modality and tooth type.

**Results**: The number of DS after 6 months was similar in the test (Me = 6.5; IQR = 3.0–10.5) and control (Me = 7.0; IQR = 2.5–10.0) groups. Percentage of pocket closure was comparable (MINST = 75.5%; control group = 74.1%). Both groups showed substantial but equivalent improvements in periodontal parameters. In deep pockets of molars,

recession progression between the 3rd and 6th month was lower in the MINST group (p = 0.037). The logistic regression showed lower odds for the healing of DS in men (OR = 0.52, $p = 0.014$) and higher in non-molars (OR = 3.84; $p < 0.001$).

**Conclusions**: For treatment of advanced periodontitis with predominately supra-alveolar defects, MINST yields results similar to conventional mechanical debridement. Men gender and molar teeth are associated with a higher number of residual diseased sites.

## O053: Resolving D1n-3 DPA induces host protective effects in oral epithelial cells

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**Background and Aim**: Apart from shaping a passive physical barrier, oral epithelial cells (OECs) serve as a direct line of communication between the immune system and the external environment by generating and secreting cytokines, chemokines and other proteins. Specialized pro-resolving mediators (SPMs) promote resolution of inflammation via receptor-mediated actions.

**Aim**: The aim of this study was to examine whether oral epithelial cells (OECs) express the inflammation resolution receptors FPR2/ALX and DRV1/GPR32 which bind the recently described n-3 DPA-derived SPM namely resolvin D1 ($RvD1_{n-3\ DPA}$). In addition, we aimed to evaluate the regulatory effect of $RvD1_{n-3\ DPA}$ on the transcriptomic profile of primary OECs stimulated with the pro-inflammatory mediator TNF-α.

**Methods**: Gingival biopsies were subjected to immunohistochemistry using antibodies to FPR2/ALX and DRV1/GPR32. Primary OECs were isolated from gingival biopsies and the expression of the $RvD1_{n-3\ DPA}$ receptors FPR2/ALX and DRV1/GPR32 was examined by flow cytometry and immunofluorescence. In addition, primary OECs were stimulated with TNF-α and/or $RvD1_{n-3\ DPA}$. Total RNA was extracted and subjected to 150-bp paired-end RNA-sequencing. Gene-level differential expression analysis was conducted using the R statistical programming software.

**Results**: FPR2/ALX and DRV1/GPR32 receptors were expressed by gingival epithelial cells in situ. Primary OECs in culture also expressed both receptors and exposure to $RvD1_{n-3\ DPA}$ mobilized intracellular calcium. Incubation of these cells with $RvD1_{n-3\ DPA}$ upon pre-stimulation with TNF-α significantly decreased the mRNA expression of pro-inflammatory genes. Pathway enrichment analysis identified the NF-κB singling pathway among the top significantly enriched pathways.

**Conclusions**: The present data show that the signal constituted by resolvin $RvD1_{n-3\ DPA}$ is recognized by gingival epithelial cells and indicate that this SPM can down-regulate the TNF-α-induced pro-inflammatory effects in the oral epithelium. This suggests that the recently identified pro-resolving agonist $RvD1_{n-3\ DPA}$ may be a new promising host modulatory therapeutic candidate for the treatment of periodontal inflammation.

## O054: Full-mouth ultrasonic debridement: Impact of type of device and operator's experience. A factorial randomized clinical trial

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**Background and Aim**: Efficacy of professional mechanical plaque removal and subgingival instrumentation, performed to control periodontal diseases, is widely documented in literature. The main aim of the current investigation is to compare the performance of FmUD executed either with piezoelectric or magnetostrictive devices in terms of clinical and Patient Centered Outcomes. A secondary aim is to assess the impact of operator's experience on the results.

**Methods**: Patients with a diagnosis of Periodontitis, considered eligible for the protocol, were consecutively enrolled. After a full mouth clinical diagnosis, they were allocated according to a first randomization 1:1 either to receive a FmUD performed with a piezoelectric ultrasound (Test 1 group) or with a magnetostrictive ultrasound (Test 2 group) by an experienced (Operator A) or inexperienced operator (Operator B). Final follow-up was set at 3 months after therapy. The main outcome was considered the percentage of closed pocket (PPD ≤ 4 mm without bleeding) before and after treatment. Patient centered outcomes comprises discomfort, pain, dental hypersensitivity (VAS-Scale) and quality of life (OHIP-14) were also assessed. One single calibrated examiner unaware to the clinical procedures performed the clinical examinations.

**Results**: A total of 52 patients were included without drop-outs. FMPS and FMBS were significantly reduced 3 months after baseline, without differences detected amongst the 4 groups (Test 1A: 54.5% to 24.4%; Test 1B: 61% to 23.6%; Test 2A: 58.5% to 23.4%; Test 2B: 59% to 24.1%), and with a comparable proportion of closed pockets (Test 1A: 67.5%; Test 1B: 65.4%; Test 2A: 68.3%; Test 2B: 66.6%). More discomfort was perceived for ultrasonic devices in comparison to Test 2 (4.04 vs 2.73,VAS-Scale).

**Conclusions**: The clinical efficacy of FmUD is independent to the type of device employed. Operator experience can reduce the patient discomfort.

**RESEARCH SESSION | RESEARCH IN IMPLANT DENTISTRY - BASIC CONCEPTS, DIAGNOSIS AND RISK FACTORS**

## O055: Evaluation of diagnostic accuracy of cone-beam computed tomography and intraoral radiography in peri-implant bone defects

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**Background and Aim**: Intraoral radiographs (IR) and cone-beam computed tomography (CBCT) are widely used methods to detect peri-implant bone defects. Both techniques may present advantages and disadvantages for the clinician in the diagnosis of defects with different configurations. Therefore, current study aims to compare the diagnostic accuracy of IR and CBCT in the diagnosis of peri-implant bone defects.

**Methods**: Four groups (n = 15 in each group) of peri-implant bone defects (1-, 2-, 3-wall, circumferential) were prepared around implants inserted in bovine ribs. Defect depth and width were measured by a periodontist and used as reference. IR with long cone technique and CBCT images were taken, analyzed, and recorded for each implant by a calibrated radiologist who is blinded for defect types.

**Results**: In 1-wall and 2-wall defects, true defect depth was significantly higher compared to CBCT ($p < 0.05$) and was found to be similar to IR measurements ($p > 0.05$). In 2-wall defects, both IR and CBCT measurements were higher compared to true defect width ($p < 0.05$). In 3-wall defects, true defect depth measurements were higher than CBCT and IR ($p < 005$), while IR measurements were also higher than CBCT ($p < 0.05$). Defect width measurements were similar in both groups in 3-wall defects ($p > 0.05$). In the circumferential defects, the consistency of true defect measurements and CBCT were higher than IR measurements ($p < 0.05$).

**Conclusions**: Within the limits of current study, IR showed more accuracy in the detection of all peri-implant defect types except circumferential ones. CBCT may provide higher diagnostic accuracy in the diagnosis of circumferential peri-implant bone defects. Therefore, employment of CBCT combined with IR may serve better for the diagnosis of angular bone defects.

## O056: The mental foramen segmentation and location detection on digital orthopantomogram radiographs by using deep learning

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**Background and Aim**: Orthopantomogram (OPG) radiographs are frequently used in the implantology. Correct determination of the boundary of anatomic structures at these radiographs are very crucial to avoid surgery complications like, nerve injury, paresthesia, etc.

Deep learning models based on convolutional neural networks (CNNs) have been successfully used for computer vision applications in recent years. These models can be used on different datasets and provide high success rates in applications such as image classification, object detection, and segmentation.

The aim of this study was determined the validation rate of deep learning-based CNN in the detection and further segmentation of mental foramen at digital OPGs.

**Methods**: In this study, we used a dataset obtained from the archive of radiology clinic in the Faculty of Dentistry Nuh Naci Yazgan University (NNYU). The dataset contained randomly selected and anonymized 200 digital OPG images. As a method, coevolutionary neural networks are used based on U-NET architecture. The U-Net backbone uses Resnet34 foundational model, which is pre-trained on the Image-Net dataset. Eighty percent of the dataset were randomly selected by using random number table for training, 10% of it for validation and accuracy was tested on the remaining 10%. In order to calculate overlapping segmentation areas; a Multi Class Dice metric method was used to compare target and predicted locations of mental foramen. The model was trained using NVIDIA Quadro P5000 GPU.

The study protocol was approved by the Ethical Committee of NNYU.

**Results**: The model training and validation loss were 0.100 and 0.115, respectively. The Dice metric in the dataset was 0.400.

**Conclusions**: Within the limits of our study, deep learning models based on CNNs showed high accuracy in learning the predetermined location of mental foramen at OPG.

## O057: Evaluation of buccal bone thickness accuracy with different cone-beam computed tomography settings

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**Background and Aim**: Cone-beam computed tomography (CBCT) has been widely used for treatment planning in dentistry. The detection of thin objects with CBCT is still challenging. The aim of this study was to investigate the accuracy of CBCT measurements with three different voxel sizes to histological sections in maxillary anterior teeth.

**Methods**: Five human cadavers with maxillary canine to canine were used. The specimens were scanned with the CBCT at 3 different settings: Group 1: Voxel size 0.25 mm with FOV 16 × 10 cm, Group 2: Voxel size 0.3 mm with FOV 27 × 17 cm, Group 3: Voxel size 0.4 mm, FOV 16 × 10 cm. The buccal bone at 3, 5, and 7 mm from the reference notches was measured on CBCT and histomorphometric images. The agreement of measurements between CBCT and histomorphometric images was assessed by Bland–Altman plots and ICC. The specificity and sensitivity of buccal bone detections were calculated.

**Results**:

| CBCT method | ICC | Sensitivity | Specificity | Accuracy |
|---|---|---|---|---|
| Group 1 (voxel size: 0 .25, FOV: 16 × 10) | 0.71 | 0.754 | 0.655 | 0.722 |
| Group 2 (voxel size: 0.30, FOV: 27 × 17) | 0.72 | 0.590 | 0.724 | 0.633 |
| Group 3 (voxel size: 0.40, FOV: 16 × 10) | 0.60 | 0.393 | 0.793 | 0.522 |

A total of 30 teeth with 90 sites were included in this study. ICC values between the CBCT and histology of Group 1, 2, and 3 demonstrated 0.71, 0.72, and 0.6 respectively. The mean buccal bone thickness with histology was 0.40 ± 0.05 mm, (Group1: 0.52 ± 0.05 mm, Group2: 0.39 ± 0.05 mm, Group3: 0.36 ± 0.06 mm). The sensitivity and specificity of the detection with Group 1 was 75.4% and 65.5%, Group 2 was 59.0% and 72.4%, and Group 3 showed 39.3% and 79.3%. The accuracy of the detection decreased from 72.2% to 52.2%.

**Conclusions**: Lower voxel sizes showed higher accuracy of buccal bone thickness measurements and an increase in sensitivity and accuracy of buccal bone detections.

## O058: Reliability of probing depth assessments at dental implants and natural teeth

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**Background and Aim**: To evaluate the intra- and inter-examiner reliability in the assessment of probing depth (PD) measurements at dental implants and natural teeth presenting with gingival/mucosal health.

**Methods**: Five periodontally maintained patients exhibiting 21 healthy dental implants were enrolled in the study. Eight experienced examiners from four different German university centers performed duplicate PD measurements at six aspects of all implants and of preselected natural teeth according to a prespecified scheme. The interval between repeated measurements was at least 30 min. Intra-examiner accuracy was estimated using intra-examiner correlation coefficients (ICCs) with 95% confidence intervals (CI). A gold standard (GS) examiner was set. Inter-examiner accuracy compared to the GS examiner was assessed using pairwise inter-examiner ICCs.

**Results**: The intra-examiner ICC ranged from 0.759 (95% CI 0.692–0.812) to 0.863 (95% CI 0.826–0.892) for the tooth measurements and from 0.712 (95% CI 0.580–0.800) to 0.841 (95% CI 0.774–0.888) for the PDs assessed at implants. Compared to the GS examiner, the inter-examiner ICCs for the tooth measurements varied from 0.197 (95% CI −0.280–0.511) to 0.797 (95% CI 0.629–0.879) at first examination and from 0.675 (95% CI 0.525–0.777) to 0.791 (95% CI 0.560–0.892) at second examination. The corresponding values for the assessments at implants varied from 0.622 (95% CI 0.400–0.753) to 0.794 (95% CI 0.708–0.855) at first examination and from 0.576 (95% CI 0.286–0.734) to 0.759 (95% CI 0.658–0.831) at second examination. The estimated inter-examiner ICC across all eight examiners was 0.901 (95% CI 0.873–0.925).

**Conclusions**: The intra- and inter-examiner reliability of repeated PD measurements tended to be higher for the measurements at teeth compared to implants.

## O059: A new murine model of dental implant integrating clinical issues

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**Background and Aim**: Osseointegration of dental implants has been usually studied in rodent long bones providing an easier access compared to jaw bones. Over the past decade, several mouse models have been developed at the maxillary site but without considering major clinical issues (tooth loss, positioning in a three-dimensional bone corridor, compact/spongy bone tissue duality). Here, we aim to set up an original preclinical murine model of dental implant osseointegration integrating these clinical issues.

**Methods**: Morphometric analyses of maxillae and mandibles from C57BL6/J mice (n = 6) were performed using a micro-Computed Tomography (μCT) to define the most suitable implantation site. Implants were designed after characterization of the alveolar bone architecture and manufactured using medical titanium. Dental extraction stage of the first mandibular molar (M1) was determined according to dental development and alveolar bone

density, and complete bone healing identified in order to place 1 implant/site/mouse. In vivo longitudinal follow-up of bone/implant contact surfaces was performed with μCT every week for 5 weeks to evaluate osseointegration. Mice were sacrificed at day 35 and mandibles were harvested for histological analyses.

**Results**: Bone site surrounding M1 presented the largest volume with bone characteristics similar to humans (compact/spongy bone, crown/root ratio). M1 extractions were performed in 5-week-old mice. At this stage, roots of M1 are formed and surgery without root fractures is facilitated by a lower bone density. Five weeks after extraction, the surgical site showed a bone volume-to-total volume (BV/TV) ratio similar to native bone. At day 35 post-implantation, μCT analyses indicated intimate contact between bone/implant confirmed through histological analyses.

**Conclusions**: Our model allows the study of osseointegration of dental implants integrating major clinical criteria. Application of our model in transgenic mice might be relevant to study dental osseointegration process in genetic disorders or implant-related pathologies.

## O060: Growth of oral epithelial cells on zirconia and titanium implant surfaces of different roughness

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**Background and Aim**: Formation of tight contacts between oral soft tissue and dental implants is one of the major challenges in contemporary implantology. An important role in this process is played by oral epithelial cells. In the present study we investigated how titanium and zirconia surfaces with different roughness influence cell proliferation/viability and the expression of various factors involved in the barrier and immunological functions of oral epithelial cells.

**Methods**: We used the commercially available human oral squamous carcinoma cell line Ca9-22 as a model of oral epithelium cells. Cells were cultured on following surfaces: machined titanium (TiM) and zirconia (ZrM) surfaces as well as sandblasted and acid-etched titanium (SLA) and zirconia (ZLA) surfaces. Cell proliferation/viability was measured by CCK-8 assay after 48 and 168 h of culture. The expression of interleukin (IL)-8, intercellular adhesion molecule (ICAM)-1, E-cadherin, integrin (ITG)-α6 and ITG-β4 were measured by qPCR.

**Results**: There was no difference in cell proliferation/viability between various surfaces after both 48 and 168 h of culture. Gene expression analysis showed that the expression of functional proteins in Ca9-22 cells is influenced by surface roughness and not by the material. The expression of IL-8 tended to be lower on moderately rough surfaces compared to smooth surfaces. A significant difference was observed between ZrM and ZLA surfaces. The expression of ICAM-1 tended to be higher on moderately rough surfaces; a significant difference was detected between ZrM and ZLA surfaces. The expression of ITG-α6 and ITG-β4 was significantly higher in cells grown on ZrM and TiM surfaces compared to ZLA and SLA, respectively.

**Conclusions**: The expression of functional proteins in gingival epithelial cells is substantially modified by surface roughness but not by material. Hence, the roughness of the implant surface might influence both immunological and barrier function of peri-implant epithelium.

## O061: Reduced bone dimensions in oligodontia: A case–control study

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**Background and Aim**: Oligodontia (OD) is a rare developmental disease characterized by agenesis of at least six permanent teeth. Once diagnosed, patients require complex oral rehabilitation. Difficulties in dental implants treatment have been reported. We aim to determine whether the bone volume of the maxilla and mandible are altered in OD patients compared to non-OD patients, in a retrospective case control study.

**Methods**: CBCTs of 53 adult OD patients (40 maxillary, 32 mandibular) were analyzed and compared with those of 82 (51 maxillary, 31 mandibular) age- and sex-matched controls. Alveolar bone dimensions were evaluated at every tooth position site.

**Results**: In OD patients, upper maxilla bone width was decreased in sites with permanent teeth, while bone height was only decreased in the anterior area (17.1 ± 3.0 mm vs 19.2 ± 3.9 mm, $p < 0.001$). Edentulous sites (compared with control patients' edentulous sites) showed a reduced height in the anterior sites ((15.0 ± 4.1 mm vs 19.4 ± 4.4 mm, $p < 0.001$)

and a decreased thickness in the premolar at 3 mm ($p = 0.05$) and molar areas at 3 ($p < 0.001$) and 6 mm ($p = 0.05$).

In the mandible, the permanent teeth were associated with a decreased bone height in premolar and anterior areas, while bone thickness was significantly reduced in the incisive-canine area at 3 ($p < 0.001$), 6 ($p < 0.01$), and 12 mm ($p < 0.001$) depth in OD patients. In mandibular edentulous sites, bone thickness diminished at every site. Of interest, bone thickness increased in the sites with permanent or temporary teeth compared to edentulous ones. This morphology modification was associated with changes in alveolar nerve position in case of molars agenesis.

**Conclusions**: Maxillary and mandibular bone volume is decreased in OD patients compared to controls. Since the absence of teeth in OD patients is associated with volume deficit, it may be beneficial to keep temporary teeth functional to limit alveolar bone resorption.

## O062: Effect of titanium and zirconia nanoparticles on human gingival mesenchymal stromal cells in the presence and absence of lipopolysaccharide

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**Background and Aim**: Nano- and microparticles could be released during implant placement, corrosion, and during therapeutic procedures like implantoplasty. These particles are currently discussed as a potential risk factor of peri-implant disease. Resident gingival mesenchymal stromal cells (MSCs) play an essential role in soft tissue homeostasis and inflammatory reactions. In the present study, we compared the response of human gingival MSCs on titanium and zirconia nanoparticles in the presence and absence of *Porphyromonas gingivalis* lipopolysaccharide (LPS).

**Methods**: Primary human gingival MSCs were isolated from 6 healthy individuals. Cells were treated with commercially available titanium and zirconia nanoparticles (< 100 nm) in concentrations up to 2.000 μg/mL for 24, 72, and 168 h. Cell viability/proliferation was measured by the MTT method, and the expression of interleukin (IL)-6, IL-8, and monocyte chemoattractant protein (MCP)-1 were measured. In another series of experiments, cells were treated with different nanoparticles (25–100 μg/mL) in the presence or in the absence of *P. gingivalis* LPS for 24 h, and the production of inflammatory mediators was evaluated.

**Results**: Cell proliferation/viability was inhibited by titanium (>1000 μg/mL) but not zirconia nanoparticles. Both types of nanoparticles (>25 μg/mL) induced a significant expression of IL-8 in gingival MSCs. Slightly higher expression levels were observed for titanium compared to zirconia nanoparticles. Both nanoparticles (>250 μg/mL) enhanced IL-6 gene expression, but no effect on protein production was observed. The expression of MCP-1 was not affected by nanoparticles. In the presence of *P. gingivalis* LPS, both nanoparticles substantially enhanced IL-8 production; a higher effect was observed for zirconia nanoparticles. Both nanoparticles inhibited LPS-induced gene expression of IL-6 and MCP-1, but the protein production was not affected.

**Conclusions**: The production of inflammatory mediators by gingival MSCs is affected by nanoparticles. This effect depends on the nanoparticles' material and the presence of inflammatory stimuli.

**RESEARCH SESSION | PERIODONTITIS AND SYSTEMIC DISEASES - LUNGS, DEMENTIA, RHEUMATOID ARTHRITIS AND FITNESS**

## O063: The association between periodontitis and pulmonary function based on the Malmö offspring dental study (MODS)

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**Background and Aim**: The aim of this study is to investigate the association between periodontitis and lung function in a population-based study.

**Methods**: Participants in Malmö Offspring Study (MOS) were invited to a dental examination in the dental arm, Malmö Offspring Dental Study (MODS). Periodontal disease was assessed by a full mouth periodontal charting, recording periodontal pockets >2 mm at six surfaces per tooth and clinical attachment loss. Periodontitis was diagnosed according to the American Academy of Periodontology and Centre for Disease Control definitions. To assess pulmonary function, spirometry (Jaeger Masterscope) was performed for all participants. The lung function measures (primary outcomes), forced expiratory volume in 1 second ($FEV_1$), forced vital capacity (FVC) and the ratio $FEV_1$/FVC, were modelled as continuous dependent variables in linear regression models. Percent predicted values of FVC and $FEV_1$ were based on the Global Lung Function Initiative Equations, 2012. Periodontitis severity was used as a categorical variable (moderate, severe) in comparison with healthy/mild periodontitis as reference.

**Results**: 513 males and 508 females were included in the analysis. The mean age was 44.5 years. Moderate periodontitis was found in

28.31% and severe periodontitis in 6.95% of the population. Higher prevalence of severe periodontitis was observed in males (59.15%), and older individuals (mean age ≈ 55 years). Moderate and severe periodontitis were associated with smoke ($p < 0.05$).

$FEV_1$ and FVC (expressed as %-predicted) and $FEV_1$/FVC (%) declined gradually with an increasing severity of periodontitis. Significant inverse associations were observed between pulmonary function and severe periodontitis, with 4.7% lower $FEV_1$ and 2.2 lower $FEV_1$/FVC ratio compared to healthy/mild periodontitis ($p$-values<0.05) in models adjusted for age, sex, smoking, BMI, diabetes, and educational level.

**Conclusions**: Severe periodontitis was associated with impaired pulmonary function in the MODS-population. Further long-term cohort- and intervention studies are needed to evaluate causality, and if pulmonary function can be improved by periodontal therapy.

## O064: Bacterial communities of gingival samples – Is there an association with lung health?

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**Background and Aim**: We investigate whether bacterial community composition (microbiota) in gingival samples is associated with an increase or decrease in lung function in the community-based RHINESSA study population (rhinessa.net).

**Methods**: 208 participants from the RHINESSA study population in Bergen, Norway (mean age: 29.3 years; 43% women), were chosen based on availability of (i) lung function data measured at two time points – baseline (2013–15) and follow-up (2020–21) and (ii) gingival samples collected at baseline. The change in lung function was calculated as the mean annual decline in $FEV_1$ (mL/year). Bacterial community profiling of gingival samples was performed by amplicon-based sequencing of the bacterial 16S rRNA gene region V1-V2 on an Illumina MiSeq. Bioinformatics processing was performed in QIIME2.

**Results**: Participants were stratified into two groups: either decrease ($n = 150$) or increase ($n = 58$) in the calculated mean annual change in $FEV_1$ (mL/year).

Bacterial community profiling yielded a total number of 19,075,419 sequences and 6886 amplicon sequence variants (ASVs). When sequences were collapsed at genus level, a total of 196 bacterial genera were identified. Gingival samples from participants with a decline in $FEV_1$ from baseline to follow-up, were dominated by genera: Fusobacterium (15%), Streptococcus (11%), Prevotella (8%), Capnocytophaga (6%), Neisseria (4%), Veillonella (3%), Porphyromonas (3%), Actinomyces (3%), Leptotrichia (3%), Campylobacter (3%). Gingival samples from participants with an increase in $FEV_1$ were dominated by the same genera and similar relative abundances: Fusobacterium (16%), Streptococcus (9%), Prevotella (8%), Capnocytophaga (7%), Neisseria (5%), Veillonella (4%), Leptotrichia (4%), Campylobacter (3%), Porphyromonas (3%), Actinomyces (3%).

**Conclusions**: In the community-based RHINESSA study population, bacterial community profiles determined from gingiva samples collected at baseline did not appear to be associated with change in lung function.

## O065: Association between periodontitis and chronic obstructive pulmonary disease

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**Background and Aim**: A relation between Periodontitis and Chronic Obstructive pulmonary Disease (COPD) has been suggested by recent study. The aim of this study is to explore the association between Periodontitis and COPD and the relation between severity of periodontitis and the severity of COPD.

**Methods**: We conducted a case–control study at the Military Hospital of Tunis for a period of 6 month. One hundred twenty patients were enrolled in this study (60 cases and 60 Controls). These patients meted the inclusion criteria with control of the confounding factors (Gender, Age, Tobacco). The diagnosis of COPD was made according to the International Recommendation of the Global Initiative for Chronic Obstructive Lung Disease 2017.

Periodontal examination included Pocket Depth (PD), Attachment Loss (AL), Bleeding on Probing (BOP), number of teeth lost due to Periodontal disease. The diagnosis of periodontitis was made according to the last classification of periodontal and peri-implant diseases and conditions 2017.

**Results**: Cases and controls were comparable for demographic characteristics. There was a significant association between Periodontitis and COPD with OR = 7 and 95% CI [2.22–22.05]. BOP, AL, PD, and tooth loss were significantly associated to COPD.

A significant Association between the severity of periodontitis and the severity of COPD with P < 0,004 was also detected.

The Tiffeneau Index was also associated to periodontitis stages with P < 0,002. The more severe the periodontitis stage, the more severe the pulmonary obstruction.

**Conclusions**: Our study found a strong association between Periodontitis and COPD. The results showed that individuals with higher COPD scores had significantly higher BI, PI, AL, ABL, and less number of teeth. These findings indicate the potential importance of promoting oral hygiene in the prevention and treatment of COPD.

## O066: Molecular pathways in a combined model of experimental periodontitis and depression in rats

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**Background and Aim**: Previous studies from our group reported significant neuroinflammation in a combined model of periodontitis and depression in rats. *Fusobacterium nucleatum* was identified in brain tissues, as a plausible hypothesis on periodontal bacteria linking both diseases. The aim of this study was to explore the interplay between the innate and adaptative immune system controlled by sphingosine-1-phosphate (S1P), the direct pathway analyzing the permeability of the blood–brain-barrier (BBB), and indirect mechanisms through which systemic inflammation could mediate these processes.

**Methods**: This is an in vivo preclinical model with Wistar rats. Periodontitis (P) was induced by oral gavages with *Porphyromonas gingivalis* and *F. nucleatum* followed by a chronic mild stress model as a depression model (CMS). Four groups of 10 rats each were obtained: periodontitis with CMS (P + CMS+), or without CMS (P + CMS-), CMS without periodontitis (P-CMS+), and control (P-CMS-). After sacrifice, samples of blood, mandible, and brain were harvested. Protein/mRNA expression analyses and fluorescence immunohistochemistry were performed in frontal cortex. Gingiva and plasma were analyzed by Luminex® to determine the concentration of inflammatory cytokines. ANOVA tests were applied.

**Results**: In frontal cortex, the combined model (P + CMS+) modified the expression of enzymes and receptors of the S1P pathways compared to the other groups. The expression of structural proteins of tight junctions (ZO-1, occludin), cell and leukocyte adhesion molecules (ICAM-1, VCAM-1), and matrix metalloproteinase 9 increased after exposure to P + CMS+. The exposure to CMS also increased the number of microglia cells (an indicator of neuroinflammation).In gingival tissues, there were no statistically significant differences in levels of inflammatory cytokines, but the combined model (P + CMS+) showed the highest levels.

**Conclusions**: The combined model (P + CMS+) model presented changes in S1P pathway, molecules related to BBB permeability, and microglial activation that could be relevant to the pathophysiology and comorbidity of both diseases.

## O067: Analyzing the relationship between periodontal health status and Alzheimer's disease (a preliminary study)

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**Background and Aim**: Although much is known about its pathogenesis, Alzheimer's disease is still a terminal disease. For this reason, the correct evaluation and treatment of the risk factors of the disease gains importance in the prevention of the disease. Chronic inflammation, such as periodontal disease, can speed up the onset and progression of AD. The study aimed to investigate the relationship between periodontal status and the rate of progression of dementia in individuals diagnosed with Alzheimer's disease.

**Methods**: According to the Clinical Dementia Rating Scale (CDR), Alzheimer's patients, who were divided into groups as mild dementia, moderate dementia, and severe dementia, were evaluated in terms of systemic status and periodontal health status. Plaque index (PI), probing depth (PD), clinical attachment level (CAL), percentage of bleeding sites (%BOP), eichner index (EI), and tooth/denture status were evaluated.

**Results**: The sample was constituted of mild dementia AD (n = 30, mean age = 75.13 years), moderate dementia (n = 20, mean age = 75.40 years) and severe dementia AD (n = 15 mean age = 80.50 years). There were statistically significant differences between the groups in the evaluated parameters ($p < 0.05$). As the disease level progressed from mild to severe, it was observed higher BOP% and higher loss of attachment was observed.

**Conclusions**: Alzheimer's Disease patients with severe periodontal status have higher rate of disease progression. Periodontal status worsened as the level of AD progressed from mild to severe.

## O068: Periodontitis contributes to cognitive decline and its progression in elderly patients with hypertension

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**Background and Aim**: In the last decade, a bulk of evidence has suggested an association between periodontitis and dementia. However, the contribution of periodontitis to cognitive decline in an aging population at high risk of dementia due to established hypertension is still unknown.To assess whether periodontitis is associated with cognitive decline and its progression as well as with certain markers of neurodegeneration in elderly hypertensive subjects.

**Methods**: Data from cross-sectional US survey [National Health and Nutrition Examination Survey (NHANES) 2011–14, n = 1424] and a 2-year follow-up prospective cohort study (SANTIAGO study, n = 101) was analysed. Participants included were aged ≥60 years and diagnosed with hypertension. All of them received a full-mouth periodontal examination and cognitive function assessments [NHANES: Consortium to Establish a Registry for Alzheimer's Disease word learning test (CERAD-WLT), CERAD delayed recall test (CERAD-DRT), animal fluency test (AFT) and digit symbol substitution test (DSST); SANTIAGO: Addenbrooke's Cognitive Examination (ACE) and Mini-Mental State Examination (MMSE)]. Plasma levels of amyloid beta $(A\beta)_{1-40}$, $A\beta_{1-42}$, phosphorylated Tau (p-Tau) and total Tau (t-Tau) were determined at baseline, 12 and 24 months (SANTIAGO study).

**Results**: Periodontitis was associated with poor cognitive performance [NHANES: a) CERAD-WLT: $\beta = -0.9$ (0.4), b) CERAD-DRT: $\beta = -0.4$ (0.1), c) AFT: $\beta = -1.4$ (0.4), d) DSST: $\beta = -5.9$ (1.2); SANTIAGO: MMSE: $\beta = -1.5$ (0.6)] as well as progression of cognitive impairment (HR = 1.8; 95% CI: 1.0–3.1). Periodontitis subjects showed greater baseline levels of p-Tau [1.6 (0.7) vs 1.2 (0.2) pg/mL), $p < 0.001$] and $A\beta_{1-40}$ [242.1 (77.3) vs 208.2 (73.8) pg/mL, $p = 0.036$] compared to those without periodontitis. Concentrations of the latter protein also increased over time only in the periodontitis group ($p = 0.005$).

**Conclusions**: Periodontitis is associated with cognitive decline and its progression in elderly patients with hypertension. Overexpression of p-Tau and $A\beta_{1-40}$ may play a role in this association.

## O069: Treatment of periodontits enhancea the treatment of rheumatoid arthritis: A randomized clinical trial

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**Background and Aim**: The aim of the present study was to assess the effect of periodontal treatment on the clinical and biochemical parameters, and the Oral Health Related Quality of Life (OHRQoL) in patients with rheumatoid arthritis (RA) who were diagnosed with periodontitis.

**Methods**: 30 patients affected by RA and periodontitis were randomly allocated to receive either immediate (test group) or "delayed" (performed after 90 days form baseline evaluation, i.e. control untreated group) periodontal treatment. Periodontal treatment consisted of full-mouth non-surgical scaling and root planning, and oral hygiene instructions. A periodontal clinical evaluation and a rheumatological examination, consisting also of Disease Activity Score 28 (DAS28), were performed at baseline and 3 months after treatment (Day 90). Serum samples for the assessment of high-sensitivity assays were collected at baseline and Day 90.

**Results**: Periodontal treatment led to significantly improved periodontal parameters in the immediate treatment group ($p < 0.05$). No between-group differences were found in the DAS28 score at Day 90; the number of subjects in remission from RA significantly increased in the test group ($p = 0.04$). Significant increases in Erythrocyte Sedimentation Rate and C-Reactive Protein were found from baseline to Day 90 in the non-treatment group (delayed). A significantly higher interleukin 6 concentration was found at Day 90 in the delayed vs immediate group. Moreover, periodontal treatment led to a significant improvement in the OHRQoL ($p < 0.05$).

**Conclusions**: Although no linear improvement in DAS28 score was demonstrated following periodontal treatment, there was an increased number of subjects with RA in remission. The presence of untreated periodontitis led to increased systemic inflammation. Performing periodontal treatment significantly increased the OHRQoL in RA subjects. Further studies are needed to better elucidate these preliminary findings.

## O070: Association between periodontitis and physical fitness in law enforcement workers: The Op-Chiron study

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**Background and Aim**: Consistent evidence supports the link between oral and systemic health, including cardiovascular disease. The aim of this study was to evaluate the association between oral and

periodontal health status and physical fitness in British law enforcement workers.

**Methods**: Cross-sectional study of 89 British law enforcement workers recruited between November and December 2019. Anthropometric measurements, including cardiopulmonary fitness (Bruce incremental treadmill test to exhaustion), muscular strength and power tests (Countermovement Jump) were conducted. The primary outcome measures were Maximal Oxygen Uptake ($VO2_{max}$) (ml/kg/min), Maximum Load ($Load_{Max}$) (W) generated at the end of the Bruce incremental treadmill test, and Countermovement Jump (CMJ) power average (W). Oral and periodontal variables included percentage of sites with PPD >4 mm (% PPD >4), full-mouth bleeding score (FMBS) and Decayed, Missing, and Filled Teeth (DMFT) index recorded within 1 week from the fitness assessment. Linear regression models were adjusted for age, sex, time in service and shift patterns.

**Results**: Mean age was 41.5 years (range 23–61; 71.9% male). The mean time in service was 14.3 ± 5.7 years. Forty-one (47.7%) participants had a rota including night shift patterns, while 45 (52.3%) had only day shifts. The % PPD >4 was statistically significantly associated with lower $Load_{Max}$ (−6.24 ± 2.95 W; $P = 0.038$) and CMJ power average (−15.31 ± 7.56 W; $P = 0.047$), while no association was found for $VO2_{Max}$. DMFT and FMBS were not associated with $Load_{Max}$, $VO2_{Max}$ and CMJ power average.

**Conclusions**: The present study suggests that periodontitis may be negatively associated with certain aspects of physical performance. Further studies with larger sample sizes, and longitudinal effects, are required to further explore this relationship and investigate potential mechanisms.

**RESEARCH SESSION | RESEARCH IN BONE REGENERATION - PRECLINICAL & CLINICAL STUDIES.**

## O071: L-PRF Plus DBBM enhance bone regeneration and accelerate bone healing in maxillary sinus. A randomized clinical trial

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**Background and Aim**: The association of growth factors with bone grafts is commonly used to increase new bone formation and accelerate bone healing. Leukocyte-Platelet Rich Fibrin (L-PRF) is an autogenous platelet derivate which contains cytokines and growth factors. Thus, this study aimed to evaluate whether the use of L-PRF may increase bone formation and accelerate bone graft healing when combined with a deproteinized bovine mineral bone (DBBM) in maxillary sinus augmentation (MSA).

**Methods**: 36 maxillary sinuses, were randomly divided into 3 groups: G1(DBBM - 8 months of healing), G2 (L-PRF + DBBM - 4 months of healing) and G3 (L-PRF + DBBM - 8 months of healing). All the groups received dental implants following the proposed healing time. During the implant placement surgery, biopsies were obtained from the grafted region for histomorphometric and immunohistochemical analysis. The stability of the implants was assessed by resonance frequency. Furthermore, to evaluate the bone graft volume maintenance, all patients underwent cone beam computed tomography in 3 moments: before the MSA, 1 week after the surgery and after the healing time.

**Results**: L-PRF associated with DBBM resulted in a higher bone neoformation (G1: 32.34 ± 9.49%; G2: 44.58 ± 13.09% and G3: 46.56 ± 12.25%). Besides that, G1 presented the highest percentage of residual graft (G1: 12.58 ± 9.19%; G2: 3.59 ± 4.22%; G3: 7.01 ± 8.49%) and there was no statistically difference respecting fibrous tissue among groups. Regarding VEGF, the intensity of staining marks was higher in G2 and G3. The osteocalcin and osteopointin expression was also higher in G2. Primary stability of the implants was achieved in all groups. However, the ISQ values were significantly lower in the G2. The bone graft volume decreased in all groups, also without significant difference.

**Conclusions**: The use of L-PRF in addition to DBBM increased and accelerated the new bone formation, thus allowing the placement of dental implants after 4 months of healing.

## O072: Leukocyte and platelet-rich fibrin (L-PRF) effects on alveolar ridge preservation at 4 months. A randomized controlled clinical trial

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**Background and Aim**: Alveolar ridge preservation is indicated in determining cases to attenuate bone reduction after tooth extraction and allow proper implant placement. Thus, Leukocyte and platelet-rich fibrin (L-PRF) could deem candidate as socket filling material for this purpose. This study aims to find out if L-PRF use as socket filling material after tooth extraction has an effect on minimizing ridge dimensional changes as compared to spontaneous healing at 4 months.

**Methods**: Twenty-eight patients with hopeless non-molar teeth needing extraction were included. Treatments were randomized (preservation with L-PRF versus spontaneous healing). CBCTs and intraoral scans (STLs) were obtained immediately after extraction and 4 months

later. Files were superimposed to assess horizontal ridge width, height, buccal volume, and ridge contour changes. A guided bone biopsy was taken at implant surgery for histomorphometric analysis. Patient-reported outcomes were also assessed.

**Results**: Ridge contour reduced concomitantly with bone in both groups. Less reduction was seen in the test group only at 1 mm from the bone crest ($p > 0.05$). L-PRF use did not prevent major reductions of ridge contour, neither in the linear vertical aspect nor in volumetric change. There were no differences in needs of bone regeneration previous to implant placement among groups. Biopsies demonstrated mineralized and well-structured bone in both groups. PROMs reported a lower level of postoperative inflammation in favor of the test group at 7 days. ($p > 0.05$).

**Conclusions**: Alveolar preservation with L-PRF does not minimize bone resorption occurring after tooth extraction in non-molar sites in a significant manner; showing a similar behavior as spontaneous healing. Even so, no differences in bone regeneration needs were found previous to implant placement between groups. In terms of healing, patients perceived less inflammation and spontaneous bleeding when treated with L-PRF. Moreover, the histologic analysis showed appropriate bone quality after this intervention.

## O073: Cell conditioned media-functionalized collagen membranes promote in vivo guided bone regeneration

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**Background and Aim**: Cell-free strategies using conditioned media (CM) from adult mesenchymal stromal cells (MSC) are emerging as cost-effective alternatives to cell therapies for regeneration of advanced periodontal and bone defects. Collagen membranes (MEM; e.g. Bio-Gide®) absorb bioactive factors from CM; thus, functionalization of MEM with CM (MEM-CM) represents a promising strategy to enhance guided bone regeneration (GBR). The objectives herein were to test (a) the in-vitro paracrine effects of CM on cells, and (b) the in-vivo potential of MEM-CM for GBR in rat calvaria.

**Methods**: In-vitro paracrine effects of CM on human MSC and macrophages were studied via gene expression and/or differentiation assays. MEM-CM were produced via soaking (MEM-CM-soak) or lyophilization (MEM-CM-lyo) and applied on 5-mm calvarial defects of Lewis rats; control defects were treated using native MEM, MEM with allogeneic rat-MSC (MEM-rMSC) or left untreated. New bone formation (NBF) was evaluated via in-vivo computed tomography (CT) at 2-weeks, and ex-vivo micro-CT and histology at 4-weeks; data were statistically analyzed.

**Results**: Exposure to CM for 24-hours revealed upregulation of osteogenic gene-markers in MSC (RUNX2/BMP2/COL1A/BGLAP/SPP1; $p < 0.05$) and downregulation of pro-inflammatory gene-markers in macrophages (IL1β/IL6/IL12/TNFα; $p < 0.05$). In calvarial defects, significantly greater mean NBF was observed after 2-weeks in MEM-CM-lyo (85.5 ± 15.4%) vs. MEM-CM-soak (21.6 ± 21.1%), MEM-rMSC (18.8 ± 20%), MEM (18.5 ± 20.8%) and untreated groups (11.6 ± 12%; $p < 0.05$). After 4-weeks, only MEM-CM-lyo (78.9 ± 13%) revealed significantly greater NBF than the untreated group (28.9 ± 18.6%; $p < 0.05$), while MEM-CM-soak (46.9 ± 37.1%), MEM-rMSC (56 ± 29.2%) and MEM (57.8 ± 30.9%) were comparable ($p > 0.05$). Histologically, a hybrid-pattern of NBF (MEM-fibres embedded in woven bone) was observed in central defect-regions in most groups, while MEM-CM-lyo revealed more mature bone in the centre and mineralized MEM-fibres only in the peripheral regions.

**Conclusions**: MEM-CM-lyo promoted earlier and greater NBF in rat calvarial defects compared to other treatments, including cell-delivery. MSC CM-functionalized collagen membranes represent a novel 'off-the-shelf' strategy to enhance GBR in advanced bone defects.

## O074: The effect of autogenous dentin block for horizontal alveolar ridge augmentation and staged implant placement: A randomized controlled clinical trial with histological assessment

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**Background and Aim**: Dentin is considered a mineralized connective tissue and its composition is nearly analogous to that of bone. Dentin and bone had similar percentages of hydroxyapatite and collagen type I that serve as the main component of the dentin organic matrix. This study aimed to compare the dentin block harvested from impacted wisdom teeth with autogenous ramus bone block for horizontal alveolar ridge augmentation.

**Methods**: Thirty patients with anterior missing teeth and horizontal ridge defect were randomly assigned to two groups ($n = 15$ per group) to receive either dentin or autogenous bone blocks. Six months after the augmentation, dental implants were placed in all patients, and a core biopsy was performed for histological evaluation in addition to clinical and radiographic evaluation using cone beam computed tomography.

**Results**: All sites healed uneventfully, and the mean overall clinical bone gain 6 months after augmentation was 3.29 ± 1.03 mm and 2.27 ± 0.75 mm in the dentin and bone blocks respectively with

statistically significant difference between them ($P = 0.004$). The overall mean gain in the radiographic bone width was 3.4 ± 0.98 mm and 3.2 ± 1.06 mm in dentin and bone blocks respectively without any statistically significant difference between the two values. The histomorphometric analysis of the bone area fraction was 41% and 40.8% in dentin and bone blocks respectively without any statistically significant difference between the two values. Histological evaluation of the dentin block revealed new bone formation, viable cells, and matrix formation on the dentin block periphery, in addition to well-organized woven bone that suggests dentin block remodeling and supports new bone deposition.

**Conclusions**: Clinical and radiographic assessment of dentin block revealed an increase in the buccolingual width that was confirmed by histological analysis. Dentin blocks are a reliable method for horizontal bone augmentation and showed less resorption than autogenous bone blocks.

## O075: 4-mm-supershort compared to longer implants placed in augmented bone in the posterior atrophic jaw: 5-year RCT results

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**Background and Aim**: Clinicians have routinely to deal with the rehabilitation of severely atrophic bone atrophy. The aim of this study is to evaluate if 4-mm-supershort implants could be an alternative to bone augmentation and standard-length implant placement in the extremely atrophic posterior jaws.

**Methods**: Eighty partially edentulous patients with posterior atrophic jaws were included. They were randomised to receive one to three 4-mm-supershort implants or one to three implants at least 10-mm-long in augmented bone. Posterior mandibles (40) were treated with the interpositional block bone technique, while a lateral sinus lift approach was performed in the maxillae (40). After 4 months provisional restorations were delivered and replaced 4 months later by definitive ones. Results are reported 5 years after loading evaluating implant and prosthetic failures, complications, and peri-implant marginal bone level changes.

**Results**: Ten patients from the short implant group were affected by 13 complications versus 18 patients with 32 complications in the control group, however the difference was not statistically significant ($P = 0.103$). In mandibles, two augmented patients lost 2 implants versus 2 short implants in 2 patients ($P = 1.000$). In the maxilla, 4 sinus-lifted patients lost 10 long implants while 4 patients lost 5 short implants ($P = 1.000$). Nine prostheses failed at augmented sites, while 4 prosthesis failures on short implants occurred ($P = 0.363$). The differences regarding implant and prosthetic failures were not statistically significant. Five years after loading short implants lost on average 0.58 ± 0.40 mm of peri-implant marginal bone and long implants 0.99 ± 0.58 mm, the difference was statistically significant ($P = 0.006$).

**Conclusions**: Four mm supershort implants showed similar if not better results when compared to longer implants in reconstructed jaws 5 years after loading. For this reason, 4-mm-short implants could be preferable since the treatment is less invasive, faster, cheaper and associated with less morbidity.

## O076: Surgical and healing complications in vertical ridge augmentation using titanium-reinforced PTFE meshes versus custom-made titanium meshes: Preliminary results of RCT

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**Background and Aim**: Titanium-reinforced PTFE meshes and custom-made titanium meshes are innovative devices used in vertical ridge augmentation (VRA).

The aim of this RCT was to compare VRA performed with those devices in terms of surgical and healing complications, intra-operative difficulties, treatment times.

**Methods**: The study included 37 patients randomly assigned: 16 received titanium-reinforced PTFE mesh (control); 21 received customized titanium mesh (test). All VRA procedures were performed by the same surgeon. During surgery, all intra-operative difficulties were recorded. Surgical (flap damage, neurological damage, and vascular damage) and healing complications (exposure≤3 mm, exposure>3 mm without infection, exposure with infection, abscess without exposure) were evaluated the day of the surgery and 2, 4, 12, 24 months after surgery. Treatment times were measured in terms of site preparation, bone harvesting, device fixation, membrane fixation, flap passivation, primary closure.

**Results**: Surgical and healing complications showed rates of 10.8% and 8.1%, respectively. In control group, the surgical complication rate was of 6.3%, while the healing complication rate was of 12.5% consisting of one flap perforation, one exposure without infection, and one abscess without exposure. In test group, the rates of surgical and healing complications were of 14.3% and 4.8% respectively, with two paresthesia, one flap perforation, one exposure with infection. No significant differences were observed ($P < 0.05$). Regarding intra-operative difficulties, achieving sedation per os, flap mobilization, easy free tension primary closure, device adaptation and fixation were reported in less than 25% of patients. Mean duration of VRA procedure was 108 min in control group and 115 min in test group. No significant differences were observed in terms of site preparation, bone harvesting, device fixation, membrane fixation and closure.

**Conclusions**: The control group showed a slightly lower rate of surgical complication and a slightly higher healing complication rate. The

two groups showed similar intra-operative difficulties. Both techniques could be successfully used for VRA.

## O077: Immunohistochemical analysis following bone regeneration with a $TiO_2$ scaffold

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**Background and Aim**: Histology and immunohistochemistry (IHC) are essential to analyse bone augmentation success. Sample decalcification can be damaging to mineral containing bone biomaterials. Innovative implants, which consist of different materials and new approaches, that depend on materials compounding are hard to investigate in decalcified tissue and paraffin embedding, and often sectioning is impracticable. This study aimed to evaluate the feasibility of hard embedding to process bone samples with a porous ceramic $TiO_2$ scaffold for histology and immunohistochemistry.
**Methods**: Guided bone regeneration (GBR) was performed in chronic defects in dogs. Three buccal defects were made in each hemimandible and left to heal for 8 weeks prior to GBR procedure with following materials: 1) $TiO_2$ scaffold and BioGide® membrane, 2) BioOss® and BioGide® and 3) BioGide® only. After 4 or 12 weeks healing time the samples were embedded in methyl methacrylate (MMA) and sectioned by microtome prior to deplastifying, decalcifying and staining. Samples were stained for von Kossa, Masson Goldner trichrome and Movat while IHC staining was done for Alpha smooth muscle-actin (ASMA), collagen I, osteocalcin, osteopontin and tartrate-resistant acid phosphatase. Samples were semi-automated quantified with ImageJ.
**Results**: Both histology and IHC with the applied method was feasible. It was possible to retrieve a higher number of slides compared to conventional cutting and grinding method, which allowed for statistical comparisons between the groups. The cutting procedure also provided better details as thickness was 5 microns. The decalcifying of microtome-sectioned slides saved time over decalcifying whole bone blocks. IHC measurements showed in general no differences in markers for ASMA, collagen I, osteocalcin and osteopontin from 4 to 12 week healing, except for ASMA in the empty control group and collagen in the BioOss® group.
**Conclusions**: MMA embedding was achievable for both histological and IHC staining. IHC demonstrated similar marker intensity comparing BioOss® and $TiO_2$ blocks.

## O078: Osteoconductivity of a bone graft substitute is enhanced by a WNT protein therapeutic: Preclinical data from a sinus augmentation model

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**Background and Aim**: Autologous bone grafts consolidate faster than bone graft substitutes (BGS) but resorb over time, which compromises implant support. We evaluated how differences in consolidation rates affected the mechanical properties of grafts and implant stability; and tested whether a pro-osteogenic protein, L-WNT3A, could accelerate BGS graft consolidation.
**Methods**: Transgenic mouse models of sinus augmentation and sub-renal capsule transplantation with immunohistochemistry, enzymatic assays, and histology were used to quantitatively evaluate the osteogenic properties of autografts and BGS. Composite and finite element modeling compared changes in mechanical properties of grafts during healing until consolidation, and secondary implant stability following remodeling activities. BGS was combined with either L-WNT3A or placebo and tested for its osteogenic potential.
**Results**: Compared to autografts, BGS lacked osteoprogenitor cells and were bioinert in a sub-renal capsule assay. When transplanted into the maxillary sinus, new bone around BGS solely initiated at the internal maxillary periosteum. WNT treatment of BGS resulted in significantly higher expression levels of pro-osteogenic proteins and lower levels of bone-resorbing activity. Together, these features of a WNT-treated BGS culminated in faster new bone formation, comparable to that of an autograft.
**Conclusions**: WNT-treated BGS supported faster consolidation, and because BGS typically resists resorption, their use may be superior to autografts for sinus augmentation.

**RESEARCH SESSION | RESEARCH IN IMPLANT DENTISTRY & PERI-IMPLANT DISEASES**

## O079: Influence of bioinspired lithium-doped titanium implants on gingival fibroblast bioactivity and biofilm adhesion

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**Background and Aim**: Soft tissue integration (STI) at the transmucosal level around dental implants is crucial for the long-term success of dental implants. Surface modification of titanium dental implants

could be an effective way to enhance peri-implant STI. The present study aimed to investigate the effect of bioinspired lithium (Li)-doped Ti surface on the behaviour of human gingival fibroblasts (HGFs) and oral biofilm in vitro.

**Methods**: HGFs were cultured on various Ti surfaces—Li-doped Ti (Li_Ti), NaOH_Ti and micro-rough Ti (Control_Ti)—and were evaluated for viability, adhesion, extracellular matrix protein expression and cytokine secretion. Furthermore, single species bacteria (*Staphylococcus aureus*) and multi-species oral biofilms from saliva were cultured on each surface and assessed for viability and metabolic activity.

**Results**: The results show that both Li_Ti and NaOH_Ti significantly increased the proliferation of HGFs compared to the control. Fibroblast growth factor-2 (FGF-2) mRNA levels were significantly increased on Li_Ti and NaOH_Ti at day 7. Moreover, Li_Ti upregulated COL-I and fibronectin gene expression compared to the NaOH_Ti. A significant decrease in bacterial metabolic activity was detected for both the Li_Ti and NaOH_Ti surfaces.

**Conclusions**: Together, these results suggest that bioinspired Li-doped Ti promotes HGF bioactivity while suppressing bacterial adhesion and growth. This is of clinical importance regarding STI improvement during the maintenance phase of the dental implant treatment .

## O080: Digital pathology image analysis vs traditional morphometric analysis for histological evaluation of periodontal and peri-implant tissues

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**Background and Aim**: Digital pathology image analysis (DPIA) is a time-saving procedure for histological analysis as it relies on a software to identify and quantify, for example, tissue components, while traditional morphometric analysis (TMA) requires a researcher to do it. We tested the hypothesis that both methods provide comparable results by comparing the analysis concerning the histological and histochemical features of human gingival samples of healthy tissues and tissues with periodontitis or peri-implantitis.

**Methods**: Four healthy gingival samples (H), 12 samples of tissue from patients with periodontitis (PD), and 11 with peri-implantitis (PI) were collected during oral surgical procedures and prepared for paraffin sectioning. The slides were partly stained with hematoxylin–eosin and partly processed for immunohistochemistry (CD3+, CD4+, CD8+, CD15 +, CD20+, CD138+, and PGM+). Slides for DPIA were acquired by a high-resolution scanner while those for TMA by optic microscopy. Qualitative and quantitative histological evaluation was obtained by analyzing 4 images per slide (400X). DPIA was carried out using an image analysis program set to compute the area of the inflammatory infiltrate and the pixels corresponding to antibodies labelling. TMA was achieved through stereological principles using a 100-test points grid superimposed over the target area that allowed for manual identification of antibodies expression and inflammatory infiltrate.

**Results**: A well-defined inflammatory lesion was identified in both PD and PI samples. In the PI group the inflammatory infiltrate occupied a larger portion of the connective tissue with apical extension and was more than twice larger than in PD lesions, using both methods. The percentage of inflammatory cells in the connective tissue was significantly larger in PI than in PD and H sections, with similar trends for both DPIA and TMA.

**Conclusions**: These results suggest that DPIA can be used as a reliable and time-saving method for the quantitative histological evaluation of periodontal and peri-implant tissues.

## O081: Patient-based outcomes following peri-implant keratinised mucosa widening with epithelised connective tissue grafts versus xenogenic dermal matrix combined with autogenous strip graft. Randomized clinical trial

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**Background and Aim**: The use of epithelised connective tissue grafts (ECTG) to augment the width of peri-implant keratinised mucosa (PIKM-W) has become widespread. However, areas enhanced with ECTG presents different texture and colour than adjacent mucosa. Additionally, a considerable size of ECTG must be harvested from palate that results in significant post-operative discomfort and morbidity. Recently a xenogenic dermal matrix (XDM) has been utilised as a successful alternative. The purpose of this RCT was to compare patient-reported outcomes following augmentation either with XDM plus autologous strip graft (ASG) or with ECTG alone.

**Methods**: Thirty-four patients (17/group) presenting with PIKM-W <2 mm in the lower jawbone were enrolled and randomly allocated to either the XDM (mucoderm®) + ASG (test) or ECTG (control) groups. During vestibuloplasty, ASG was secured tightly at the deepest part of the prepared split-thickness periosteal bed and the XDM was immobilised coronally to them, while ECTG were fixed alone onto the recipient bed with periosteal sling sutures. Operation times were recorded and the post-operative pain was assessed using visual analogue scale alongside the number of painkillers taken. Plaque index (PI), pocket probing depth (PPD) and bleeding on probing (BoP) were also assessed at baseline, 3, 6, 9 and 12 months as secondary outcomes.

**Results**: 25 females and 9 males finished the study. Test group subjects reported lower pain and took fewer painkillers versus controls (7.9 ± 6.6 vs 22.4 ± 23.6, $p < 0.05$ and 5.6 ± 5.3 vs 9.2 ± 9.5, $p = 0.18$) respectively. However, the surgical time (min) was shorter in the control vs test groups (85.2 ± 28.1 vs 104.7 ± 29.7, $p = 0.05$). Differences in BoP and PI were not significant between the two groups, apart from greater PPD reduction in the control group ($p = 0.014$).

**Conclusions**: The novel technique of the combination of XDM and ASG is associated with lower patient morbidity in comparison with ECTG according to the present investigation.

## O082: Clinical and radiographic assessment of circular versus triangular cross-section neck implants in the posterior maxilla: Five year follow-up of a randomized controlled trial

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**Background and Aim**: Dental implants undergo design changes continuously in order to improve their life span. A triangular cross-section neck design had been developed in order to limit peri-implant bone loss. The aim of this study was to evaluate the clinical behavior of the surrounding hard and soft tissues in triangular versus classical circular neck design implants for a period up to 5 years.

**Methods**: A group 34 patients enrolled in a randomized controlled trial comparing a classical circular-neck (control group) and a triangular cross-section neck implant (test group) were followed for a period of 5 years. Patients were seen after 1, 3 and finally 5 years to assess osteointegration, peri-implant bone remodeling, probing pocket depth (PD), bleeding on probing (BoP), plaque index (PI), full mouth plaque score (FMPS). Pink Esthetic score (PES) and patient reported outcome measures (PROM) were also evaluated.

**Results**: Although 9 patients dropped out at the 5 year follow-up, no implant loss was observed. The proximal bone loss reached 0.36 ± 0.868 mm for the circular design and 0.37 ± 0.347 mm for the triangular design ($p = 0.49$). Peri- implant soft tissue health (PD, BoP, PI), and PROMs were similar in both groups. A small but still statistically significant decrease of the PES was observed in the test group when compared to the control group.

**Conclusions**: Mid-term evaluation of triangular cross-section neck implants shows that this design can be used in an effective way in partially edentulous patients, showing similar results when compared with circular neck design implants in terms of peri-implant bone loss, surrounding soft tissue and patient satisfaction.

## O083: A retrospective analysis of biological complications of implant-supported fixed dental prostheses

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**Background and Aim**: In the past few decades implant supported fixed dental protheses has become widely accepted treatment option for replacing missing teeth. Despite their high survival rate, complications such as peri-implant diseases are common.

To evaluate patient-, implant- surgical- and prosthetic-related risk factors that are associated with peri-implant diseases, identify prevalence and predictors of peri-implant diseases.

**Methods**: A retrospective study of 162 patients who received 301 dental implants was conducted to evaluate the prevalences and risk indicators for peri-implant mucositis and peri-implantitis. The data were analyzed using the binary logistic regression to evaluate different risk indicators peri-implantitis.

**Results**: The prevalence of peri-implant mucositis at the patients and implant levels were 44.4% and 38.2%, respectively. For peri-implantitis, the prevalence at the patient level was 5.6%, while the prevalence at the implant level was 4.0%.Patients diagnosed with peri-implant mucositis were more likely to be irregular attenders of peri-implant maintenance while those diagnosed with peri-implantitis were likely to be smokers, had history of treated periodontitis or did not attend of regular peri-implant maintenance visits.

**Conclusions**: Within the limitations of this retrospective study, the analysis identified plausible risk indicators, namely smoking, history of treated periodontitis and irregular peri-implant maintenance visits, that would allow clinicians to identify those at risk and ensure continuous peri-implant supportive care.

## O084: Influence of implant component materials towards peri-implant soft tissue host-response: A randomized clinical trial

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**Background and Aim**: Recently, the importance of durable peri-implant soft tissue integration has been recognized as an essential factor in the long-term success of implant restorations. The aim of this study is to assess the effects of 3 materials commonly used transmucosally, namely titanium (Ti), dental adhesive resin (Resin) and polyetheretherketone (PEEK), on the peri-implant tissues.

**Methods**: In this randomized controlled trial, 37 bone level implants were placed and the experimental transmucosal healing abutments made of the above-mentioned materials were randomly assigned to each implant on the day of surgery. The abutments were removed together with the surrounding soft tissues after 8 weeks of healing. The harvested peri-implant soft tissues underwent immunohistochemical analyses in order to assess the presence of the different immune cell populations. In addition, clinical and radiological data were collected and peri-implant bone loss was assessed.

**Results**: Compared to the other groups, the resin group revealed a higher infiltration of macrophages ($p = 0.036$) and neutrophils ($p = 0.032$) in the adjacent soft tissues. Peri-implant radiographic bone loss was also significantly higher around the resin abutments in comparison with the other groups ($p = 0.042$).

**Conclusions**: Within the limitations of the present study, the use of resin transmucosally showed the presence of inflammatory cells at

8 weeks of healing. In addition, bone loss appeared to be more significant around resin than around PEEK and Ti abutments.

## O085: Influence of abutment height on clinical peri-implant parameters: A 3-year prospective clinical study

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**Background and Aim**: Peri-implant bone level maintenance is a key factor for long-term success and optimal aesthetic results in implant therapy. The study of factors affecting marginal bone level around implants has gained importance in recent years.

The aim of the present study was to assess the effect of intermediate abutment height on clinical parameters and peri-implant marginal bone level at screw-retained fixed partial implant dentures with a 3 year follow-up.

**Methods**: This is a 3-year prospective study of a previously published 6-month randomized clinical trial (Blanco et al. 2017). Twenty-two patients were rehabilitated with screw-retained fixed partial implant dentures (FPIDs) supported by two implants to replace at least two missing adjacent teeth (39 implants). The patients were randomized before receiving a 1 mm intermediate abutment (control) or a 3 mm abutment (test). Clinical and radiological measurements were made at 6 and 36 months after surgery. Changes at the interproximal bone level between treatment groups were compared by mixed-design ANOVA. Probing depth, bleeding on probing, prevalence of mucositis and peri-implantitis were also analyzed.

**Results**: Significant differences ($p < 0.01$) were observed between groups at each follow up when the changes in interproximal marginal bone level were compared. Peri-implantitis was found in 21% of implants with 1 mm abutments, while none was found in the 3 mm abutment group ($p < 0.05$).

**Conclusions**: The results of the present prospective study show that platform switching implants placed with a long abutment present greater preservation of interproximal peri-implant bone at 36 months. Furthermore, the prevalence of peri-implantitis was significantly higher in the short abutment group (1 mm).

## O086: The association between peri-implantitis and its treatment on systemic inflammation. A systematic review and meta-analysis

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**Background and Aim**: Peri-implantitis is characterized by a mucosal inflammatory response resulting in destruction of soft and hard peri-implant tissue. Peri-implantitis and periodontitis show many similar features. Evidence suggests that periodontitis triggers a systemic inflammatory response. The aim of this study was to appraise the evidence linking peri-implantitis to biomarkers of systemic inflammation.

**Methods**: The review was completed according to PRISMA guidelines. Eight electronic databases (Cochrane Central Register for Controlled Trials, MEDLINE, EMBASE, Web of Science, Dentistry & Oral Sciences Source, Scopus, LILACS and China Online were searched up to 8th, July 2021. Human studies of all designs other than case series were eligible for inclusion. Titles and abstracts were screened in duplicate followed by retrieval and screening of full text articles. Following risk of bias assessment, both qualitative and quantitative analyses were performed using random effects models.

**Results**: After removal of duplicates, 821 abstracts and titles were screened with retrieval of 25 full text articles. Nine studies were included in the final analyses; 7 case–control and 2 cross-sectional studies. No intervention studies were identified. All of the included studies demonstrated an association between peri-implantitis and higher systemic inflammation. Patients with peri-implantitis exhibited a higher level of C-Reactive Protein (CRP), Interleukin(IL)-6 and white cell counts compared to healthy controls.

| | Number of studies | Sample size (control) | Sample size (peri-implantitis) | Mean difference | 95% CI | Overall p value | $I^2$ |
|---|---|---|---|---|---|---|---|
| CRP | 5 | 175 | 108 | 4.7 | 2.13, 7.27 | $p = 0.0003$ | 97% |
| White cell counts | 3 | 99 | 91 | 1.56 | 0.83,2.29 | $p < 0.00001$ | 52% |
| IL-6 | 2 | 45 | 52 | 6.26 | 4.99, 7.53 | $p < 0.00001$ | 0% |

**Conclusions**: Peri-implantitis is associated with higher systemic inflammation as assessed by serum CRP and white cell counts. Further research is needed to explore the impact of effective treatment of peri-implantitis on biomarkers of systemic inflammation.

**RESEARCH SESSION | MULTIDISCIPLINARY APPROACHES, FROM AUTOTRANSPLANTATION TO ORTHO-PERIO THERAPY**

## O088: State of the art in digital tooth autotransplantation

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**Background**: Digital technologies have arrived in the dental field to provide significant improvements over conventional treatments.

They highly contribute to optimize a correct diagnosis and treatment planning which results in better clinical outcomes.

Along these lines, the advent of digital technologies on tooth autotransplantation has radically changed the acceptance of this technique. Even though it has been largely discounted as a plausible treatment option to restore edentulous areas, the incorporation of a fully digital workflow has enabled a better understanding of its biological principles resulting in a more attractive technique because of its easier performance and more predictable results.

**Description of the procedure**: Precisely description of every step required to perform a fully digital workflow on tooth autotransplantation will be depicted using video material. Certain steps include; linear measurements and CBCT segmentation to obtain a printable file (STL), 3D printing of a tooth replica and stereolithographic model, virtual surgery on a CAD program, design of a multiaxis surgical guided and production of a stent to drive the ideal allocation of the future donor tooth.

**Outcomes**: All the material presented corresponds to the digital plan of 10 patients from a prospective case series carried out at the University Complutense of Madrid. Digital and clinical videos will be included to show how to obtain the same ideal successful results corresponding to a 12 months follow-up.

**Conclusions**: Digital planning workflows together with 3D printing technologies allow a correct donor tooth selection, creation of an adequate recipient socket or reduction of the extraoral time of the donor tooth among other. In other words, they improve success and survival rates in the short and long term leading to this treatment option equivalent to other alternatives such as dental implants.

## O089: Use of adjunctive enamel matrix derivatives combined with digitally guided tooth autotransplantation: A series of 10 cases

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**Background**: Tooth autotransplantation has shown survival rates higher tan 90% with follow ups as long as 20 years. Success of this therapy depends directly on the vitality of the donor tooth's periodontal ligament and its regenerative and reparative potential. During the last years, protocols have been modified and improved to increase the predictability of this technique, with the aim of reducing the extraoral time of the donor tooth and to increase or preserve the potential of its periodontal ligament, like the adjunctive use of enamel matrix derivatives.

**Description of the procedure**: Ten cases will be presented, of systemically healthy and non smoking patients with ages ranging from 26 to 57 years, that came to our service presenting a molar with a hopeless prognosis due to different reasons (tooth fracture, fissure or radicular carious lesion) and an available healthy donor tooth. After proper digital planning, autotransplantation surgeries (which will be presented in video format) were performed. A completely digitally guided protocol was used for surgery planning and execution, creating an STL file from the patient CT Scan; and then creating an stereolithographic model of the donor tooth and a guided surgery splint to prepare the recipient site. Lastly, enamel matrix derivatives were applied on the root surface of the donor tooth before being placed in the recipient site. Root canal therapy was performed 4 weeks afterwards and final restorations 3 to 6 months later based on individual need.

**Outcomes**: Twelve month follow up of the 10 cases will be presented, in which treatment success was achieved in all cases based on clinical, radiographic and patient related outcomes.

**Conclusions**: It can be concluded that tooth autotransplantation with adjunctive use of enamel matrix derivatives, and supported by a digital protocol can be an adequate treatment to substitute teeth with a hopeless prognosis and has a good perception by patients.

## O090: Successful treatment of periodontitis stage III generalized grade C periodontitis trough resective, access flap and regenerative periodontal surgeries

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**Background**: A 65 years old, ASA II woman came for treatment to the Periodontology Postgraduate degree at University Complutense. She was diagnosed as a periodontitis Stage III generalized grade C, together with endo-periodontal lesions without root damage in a periodontitis patient grade 1 (4.1 and 3.1) and grade 3 (1.4). Periodontal treatment consisted in Step 1, 2 and 3, in accordance with the EFP clinical practice guideline, followed by an interdisciplinary treatment. The aim of the treatment was to achieve pocket closure in all sites.

**Description of the procedure**: In order to obtain the periodontal treatment endpoints, the step 3 was necessary, and included a resective periodontal surgery (tunneling surgery of 3.6 and 3.7) and an access periodontal surgery (third sextant). Regenerative periodontal surgeries were also performed, consisting on the connective tissue wall technique and the minimally invasive surgery concept with a single flap approach. They were accomplished in the first and fifth sextant, respectively. Finally, for the interdisciplinary phase, a tissue level implant was placed in 4.6 in order to rehabilitate the function of the patient.

**Outcomes**: The endpoints of therapy were fulfilled and no pockets greater than 4 mm with bleeding on probing or probing pocket depths higher than 6 mm were found. The regenerative periodontal surgeries showed clinical attachment level gain up to 4 mm at 1.4 while 4 mm and 3 mm of CAL gain were obtained at 3.2 and 4.1. The resective and the access flap periodontal surgeries were able to result in pocket closure with the establishment of an anatomy that facilitates plaque control and the long-term stability of periodontal tissues.

**Conclusions**: Different periodontal surgeries with different objectives have been applied for the resolution of a periodontitis stage III generalized grade C. Prognosis of some teeth changed from unfavorable to favorable, establishing the patient in gingival health on a reduced periodontium.

## O092: Interdisciplinary reconstruction of lost interdental papillae in patients with stage III periodontitis: Esthetic evaluation and modified classification proposal

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**Background**: Interdental papilla (IP) loss is a common esthetic concern for patients with periodontitis and horizontal bone loss (HBL). An interdisciplinary team approach is necessary to achieve stable long-term results. This clinical report describes two cases of a combined surgical and restorative IP reconstruction treatment. Novel interdental papilla esthetic score (IPES) with included Nordland and Tarnow interdental papilla fill (IPF) classification is presented.
**Description of the procedure**: Two female patients, 42 and 43 years old, diagnosed with Stage III Grade B periodontitis, systemically healthy, non-smokers and with excellent oral hygiene presented with multiple inadequate IP in the maxilla caused by previous non-surgical periodontal therapy. Total of 10 papillae (8 anterior, 2 posterior) were treated by VISTA technique combined with modified tunnel technique or with soft tissue reconstruction technique developed by Masana Suzuki. De-epithelialized connective tissue graft from palate was placed in IP area and a free gingival graft was positioned apically for additional coronal tissue advancement. 6 months post-surgery teeth were restored with ceramic restorations. IPES (0–12) was scored by combining IPF (0–3), papilla level compared to contralateral papilla (0–3), texture (0–3), colour (0–3).
**Outcomes**: Two cases were evaluated after 33 and 12 months respectively. In first case, 5 papillae in anterior region presented with IPES 7 (IPF 3) and after treatment 4 IP improved to IPES 0 (IPF 0) and 1 to IPES 1 (IPF 0) between teeth 13 and 12 due to different papillae levels. In second case, 3 anterior and 1 posterior papillae presented with IPES 6 (IPF 3) and 1 posterior papilla with IPES 4 (IPF 2). After treatment, 4 papillae improved to IPES 0 (IPF 0) except for IPES 1 (IPF 0) between 25 and 26 due to color differences.
**Conclusions**: Stable long term IP reconstruction can be achieved by surgical and restorative treatment for patients with Stage III periodontitis with HBL.

## O123: Novel approach for instrumental periodontal therapy with periosan chips based on chitosan and EPX molecule

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**Background**: The goal of Periodontal therapy is to control and or to eliminate the pathogens contained in periodontal pockets. Local administration of a biological compatible and active agent like chitosan could be effective in the treatment of periodontitis. Periosan chips are made of Chitosan which is a renewable polymer extracted from crustacean shells by deacetylated form of chitin. Chitosan nanoparticles loaded with EPX exhibits remarkable antibacterial activity and have the potential to activate proinflamatory cytokines and it can accelerate wound healing in humans.
**Description of the procedure**: The purpose of this study was to evaluate the clinical effectiveness of Chitosan and EPX molecule, both as a carrier in a membrane form (chip) as a long term active agent in the treatment of periodontitis. The chips were introduced in periodontal pockets with depths between 4 and 7 mm additional to Instrumental therapy such as root planning and scaling in patients. The clinical parameters such as probing depth, clinical attachment level, plaque index, gingival index and bleed on probing were documented at base line and 21 days.
**Outcomes**: In most of the pocket sites we observed reduction of the clinical parameters 21 days after using the Periosan chip. The decrease in probing depth values were 1.9 mm. During the time course no complications were observed in patients.
**Conclusions**: The use of chitosan and EPX molecule could be used as an adjunctive therapy to improve clinical attachment after subgingival Instrumental therapy, in periodontal patients and it could be used as a local antimicrobial agent.

**RESEARCH SESSION | STEP 3 OF PERIODONTAL THERAPY - RESEARCH ON PERIODONTAL SURGERY**

## O093: Pocket closure: A multilevel analysis of patients treated with different modalities of periodontal therapies after one year of maintenance

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**Background and Aim**: Periodontal treatment is known to be effective but several factors may influence its outcomes. The aim of the research was to evaluate the influence of patient, tooth and site-related factors on the pocket closure [pocket depth (PD) ≤4 mm and no bleeding on probing (BoP -)] after active periodontal therapy using a multilevel analysis.

**Methods**: Clinical data of 56 patients with stage III-IV periodontitis were retrospectively collected at baseline (T0), at 3 months after the completion of non-surgical therapy (T1) and 1 year after the end of active periodontal therapy (T2). A multilevel logistic regression model was built to evaluate factors that influence the probability of obtaining pocket closure.

**Results**: Active periodontal therapy was significantly associated with pocket closure; conversely, mobility at T1 (OR = 0.16; p = 0.049), presence of plaque at T2 (OR = 0.13; p = 0.010) and BoP at T1 (OR = 0.09; p-value = 0.006) were negatively associated. Regenerative surgery presented a 77.57% probability of pocket closure; plaque at T2 (OR = 0.11; p-value = 0.034) and BoP at T1 (OR = 0.21; p = 0.049) were statistically associated with this type of treatment. The primary outcome was obtained in 86% of the sites treated with osseous resective surgery (ORS); the factor plaque at T2 (OR = 0.09; p = 0.000) was negatively associated with this treatment. Sites that have undergone only maintenance therapy have reached pocket closure in 78.06% of the cases; plaque at T2 (OR = 0.11; p = 0.001) and BoP at T1 (OR = 0.34; p = 0.006) were statistically associated with this type of treatment.

**Conclusions**: Presence of mobility, BoP and plaque are negative prognostic factors in order to reach pocket closure. However treatment such as regenerative and ORS present high probability of success.

## O094: Clinical evaluation of advanced-platelet-rich-fibrin with open flap debridement versus open flap debridement in intra-osseous defects of stage-III periodontitis patients: A randomized controlled clinical trial

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**Background and Aim**: Advanced platelet rich fibrin, represents an optimized platelets rich concentrate, achieved through a reduction in the centrifugation speed and time during its preparation, resulting in a homogenous platelets/growth factors distribution and superior wound healing properties. The current randomized controlled trial's aim was to assess the effect of advanced platelet rich fibrin with open flap debridement (A-PRF + OFD) versus OFD alone in the treatment of intra-osseous defects of stage-III periodontitis patients.

**Methods**: Following sample size calculation, 22 stage-III/grade B periodontitis patients, with ≥6 mm probing pocket depth (PPD) and ≥3 mm intra-osseous defects, who fulfilled all inclusion criteria, were randomized into test (A-PRF + OFD; n = 11) and control (OFD; n = 11) groups. Clinical attachment level (CAL; primary-outcome), PPD, gingival recession depth (GRD), full-mouth bleeding scores (FMBS), full-mouth plaque scores (FMPS), radiographic linear defect depth (RLDD) and patient's satisfaction (secondary-outcomes) were examined at baseline, 3, 6 and 9 months post-surgically.

**Results**: A-PRF + OFD and OFD demonstrated significant intra-group CAL-gain, PPD- and RLDD-reduction at 3, 6 and 9 months (p < 0.05). A-PRF + OFD exhibited a significant CAL-gain of 3.36 ± 1.12 mm at 6 months and of 3.55 ± 1.37 mm at 9 months (2.36 ± 0.81 mm and 2.45 ± 0.93 mm for the control group respectively; p < 0.05). A-PRF + OFD showed a PPD-reduction of 3.36 ± 1.12 mm at 3 months, of 3.64 ± 1.12 mm at 6 months and of 3.73 ± 1.19 mm at 9 months (2.00 ± 0.89 mm, 2.09 ± 1.04 mm and 2.18 ± 1.17 mm in the control group respectively; p < 0.05). No significant differences were notable regarding GRD, FMPS, FMBS, RLDD and patient's satisfaction between both groups (p > 0.05).

**Conclusions**: Within the current randomized controlled trial's limitations, the use of A-PRF in conjunction with OFD improved CAL and PPD 9 months post-surgically, and could provide a cost-effective modality to augment surgical therapy of periodontal intra-osseous defects.

## O095: Clinical outcomes after subgingival instrumentation and application of EMD by incision-free tension flap access. Results of a 3 year case–control-study

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**Background**: Over the recent decade there has been a trend towards minimally invasive surgical approaches for treating intrabony defects. Enamel matrix derivative (EMD) is known to promote periodontal wound healing and to stimulate periodontal regeneration.

Certain defects allow to perform so called flapless access to treat involved sites of minor attachment loss.

**Description of the procedure**: 28 patients (test group) were followed after subgingival instrumentation (SI) of periodontal defects (N = 376) and incision-free tension flap application of EMD. Data were documented at $T_0$ (baseline), $T_1$ (1yr.) and $T_2$ (mean:3.07 yrs). Another 28 patients (matching control group, N = 347 defects) were selected from 43 patients who had undergone SI after comparable baseline findings ($T_2$/mean:3.24 yrs). All patients were supervised in a supportive therapy.

Primary outcome was pocket closure (PPD ≤4 mm and absence of BOP) at $T_2$. Changes of PPD and BOP were statistically analyzed by multilevel model.

**Outcomes**:

| | Test | Control |
|---|---|---|
| N Patients | 28 | 28 |
| N Teeth / N periodontal pockets | 208/376 | 228/347 |
| Pat. Gender 'F' / Age (years) | 14 (50%) / 54.2 | 16 (57.1%)/56.5 |
| Pat. Smokers | 18 (64.3%) | 13 (46.4%) |
| PD at $T_0$ (mm) | 4.93 | 4.8 |
| Δ.BOP $T_0/T_2$ (%) | −38 *$p = 0.04$ | +5,5 |
| Δ.PD $T_0/T_2$ (mm) | 1.67 *$p < 0.005$ | 1.35 |
| **Teeth showing pocket closure at $T_2$** | **151 (72.6%)** *$p = 0.01$ | **144 (63.2%)** |

**Conclusions**: Within the limitations of a case–control design the results, based on a large number of patients/sites and a mean-follow of 3 years, indicate that in step 3 of periodontal therapy a re-instrumentation of residual pockets with moderate depth in conjunction with EMD application by incision-free tension flap access can lead to superior clinical outcomes compared to re-instrumentation alone. Findings should be underlined by future randomized trials including a cost–benefit analysis.

## O096: Healing of intrabony defects following treatment with a new-generation platelet-rich fibrin or EMD: A randomized clinical trial

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**Background and Aim**: The aim of this study was to clinically evaluate the healing of intrabony defects after treatment with a new generation of platelet-rich fibrin (A-PRF+) respect to enamel matrix derivative (EMD).
**Methods**: Thirty (30) intrabony defects of 18 non-smoker patients (9 males, 9 females) were randomly treated with A-PRF+ (test, n = 15) or EMD (control, n = 15). The following clinical parameters were assessed at baseline and 12 months after surgery: pocket depth (PD) and clinical attachment level (CAL). Open flap debridement (OFD) was performed in each case. The intrabony defects were filled with A-PRF+ in the test group, respectively EMD was applied in the control group and wound closure was performed.
**Results**: 1 year post-operatively, both treatment methods resulted in statistically significant PD reductions and CAL gains. No statistically significant differences were found between the two groups as PD reduction was 4.46 ± 1.24 mm in the test group, respectively 4.33 ± 0.72 mm in the control group ($p < 0.001$). The mean CAL gain was 2.6 ± 2.84 mm in the A-PRF+ group, respectively 3.46 ± 1.59 mm in the EMD group ($p < 0.001$).
**Conclusions**: Within the limits of this study the new-generation platelet-rich fibrin seems to be as clinically effective as EMD following surgical treatment of intrabony defects. Treatment with A-PRF+ or EMD resulted in reliable clinical outcomes. Based on the results obtained after 12 months, the use of a human autologous product can give a positive impact on periodontal healing.

## O097: Comparison of the effects of platelet rich fibrin (A-PRF+) and enamel matrix derivative (EMD) on PROMs (patient related outcome measurements) in regenerative periodontal micro-surgery

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**Background and Aim**: Enamel matrix derivative (EMD) is one of the most used materials for periodontal regeneration but its use is related to some disadvantages such as increased costs and possible patient rejection due to its xenogeneic origin. Advanced platelet rich fibrin (A-PRF+) is an autologous material derived from blood that has demonstrated a high potential in promoting wound healing, and it could be considered as an alternative to EMD. To date, no study has compared directly PROMs between EMD, A-PRF+ and OFD in periodontal surgery. The aim of this study was to investigate whether the application of advanced platelet rich fibrin (A-PRF+) in combination with periodontal regenerative micro-surgery in molar furcations has equal self-reported short-term morbidity in comparison to enamel matrix derivative application (EMD) or open flap debridement (OFD, control).
**Methods**: A prospective randomized controlled trial was designed to study the effects of A-PRF+, EMD or control on further pocket closure of molar furcations grade II. Patients were randomly allocated in one of the three treatment groups: OFD with application of A-PRF+, OFD with application of EMD and OFD alone. In all patients, venous blood was drawn from the antecubital fossa. A minimally invasive microsurgical approach was performed in all groups. Morbidity and patient reported outcome measures (PROMs) were assessed by questionnaires up to 6 weeks postoperatively.
**Results**: 15 patients (n = 5 per treatment allocation) completed the six-week follow-up and included in the analysis. No differences in the consumption of pain medications and PROMs were observed between the three groups, except that patients in EMD group scored statistically significant higher for postoperative morbidity compared to OFD group during the first week. All patients except one reported to be willing to undergo the treatment again.
**Conclusions**: The use of A-PRF+ was not associated with a different post-operative pain and discomfort compared to EMD or OFD.

## O098: Comparison of clinical and radiographic parameters in the application of cross-linked hyaluronic acid and enamel matrix derivative in periodontal regeneration: A randomized clinical trial

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**Background and Aim**: The aim of this randomized controlled trial was to compare the effectiveness in periodontal regeneration of hyaluronic acid (HA) with enamel matrix derivative (EMD) in periodontal bone defects evaluating their clinical and radiographic variables.
**Methods**: Fifty-two intrabony defects in 52 healthy subjects was randomly assigned to HA group (test group; n = 22), EMD (active comparator group; n = 20) or open flap debridement group (OFD; control group; n = 10). Clinical attachment level (CAL), probing depth (PD), gingival recession (REC), bleeding on probing (BoP), plaque index (PI) and radiographic variables (registered with bite blocks) were recorded at baseline, 6, 12 and 18 months after surgery.

**Results**: At 18 months, HA group and EMD resulted in statistically significant clinical improvements evidenced by PD-reduction and CAL gain ($p < 0.01$). Treatment with HA yielded a mean CAL gain of 2.34 ± 1.09 mm ($p < 0.01$) at 18 months. Treatment with EMD resulted in a mean CAL gain of 2.81 ± 1.14 mm ($p < 0.01$) at 18 months. Mean CAL gain in the OFD group was 0.93 ± 1.11 ($p > 0.01$). Compared with OFD, the two regenerative treatments resulted in statistically significant ($p < 0.05$) CAL gain at 18 months.

**Conclusions**: The results indicated that both treatments, HA and EMD in conjunction with a surgical approach, led to statistically significant clinical improvements compared to OFD group and baseline.

## O099: Evaluation of gingival tissue healing following periodontal surgery using chlorhexidine plus hyaluronic acid mouth-rinse

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**Background and Aim**: Biofilm formation is critical in wound healing following periodontal surgery. Post-operative hygiene instructions may be insufficient, and adjunctive chemical agents may improve plaque control. The aim of this study was to evaluate wound healing in patients treated with chlorhexidine (CHX) and hyaluronic acid (HA) mouth-rinse after periodontal surgery.

**Methods**: This randomized clinical trial included 33 patients (11 per group) undergoing periodontal surgery. For each periodontal flap, a secondary vertical incision was performed in the keratinized gingiva. Vertical incisions, used as in vivo wound healing model, were sutured only when needed. After surgery, patients were randomly prescribed 0.2% CHX + HA (Group 1), 0.2% CHX (Group 2) or a placebo mouth-rinse (Group 3). Patients were re-evaluated at 3, 7 and 14 days post-operatively. Wound closure was assessed at the interdental papilla and the experimental incision using the Wound Healing Index (WHI), ranging from score 1 (complete healing and absence of fibrin line) to 5 (incomplete healing with necrosis).

**Results**: Vertical incisions were sutured in 18.2% of the cases in Group 1, 27.3% in Group 3, and never sutured in Group 2. At 3 days, 73% of patients in Group 1 showed WHI score 1 both at the interdental papilla and the experimental incision. In group 2, 18% had WHI score 1, while group 3 received WHI scores >2 ($p < 0.01$). At 7 days, all patients in Group 1 showed complete healing, compared to 54% in group 2 and 9% in group 3. At 14 days, 80% of patients in Group 2 and 27% in group 3 were assigned score 1, in the absence of significant improvement in WHI between treatment groups.

**Conclusions**: Patients administered with CHX + HA mouth-rinse presented lower wound healing scores at days 3 and 7. The combination of CHX with HA showed a positive role in accelerating wound healing process in the early post-operative period.

## O100: The effects of systemic antibiotics on periodontal regeneration: A systematic review with meta-analysis of randomized controlled trials

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**Background and Aim**: Antibiotics have been widely used in adjunct with periodontal surgeries. However, guidelines for prescribing antibiotics in periodontal therapy have not been fully established. The role of systemic antibiotics in regenerative periodontal therapy remains unclear. Therefore, the aim of this systematic review was to answer the following focused question: What is the clinical efficacy of the use of systemic antibiotics in regenerative periodontal surgery in terms of probing pocket depth (PPD) reduction and clinical attachment level (CAL) gain?

**Methods**: Electronic and manual literature searches for studies published up to May 2021 were conducted by two independent reviewers. Included studies were human randomized clinical trials reporting clinical outcomes including change in PPD and CAL, with a minimum of 6 months follow-up time with at least 10 subjects. Meta-analysis was performed to assess PPD reduction and CAL gain in groups receiving systemic antibiotics compared to those not receiving systemic antibiotics.

**Results**: A total of eight studies were included. While treated sites consisted of intrabony defects in six papers, two articles focused on furcation defects. For intrabony defects, the weighted mean difference (WMD) of 0.30 mm (95% CI: −0.18 to 0.78) and 0.27 mm (95% CI: −0.13 to 0.66) were calculated for PPD reduction and CAL gain, respectively. The differences between antibiotics and non-antibiotics groups for PPD and CAL were not statistically significant. Quantitative analysis could not be performed for furcation defects since only two studies were available. However, both furcation defect studies, regardless the membrane type selection, indicated that antibiotics did not lead to superior clinical outcomes at 9–12 months after regenerative procedures.

**Conclusions**: In conclusion, the use of systemic antibiotics in regenerative periodontal surgery did not appear to achieve more favorable clinical outcomes. Thus, the use of adjunct systemic antibiotics as part of the regenerative periodontal therapy might not be justifiable and should be reconsidered.

**RESEARCH SESSION | TREATING INTRABONY DEFECTS AND GINGIVAL RECESSION**

## O101: Hyaluronic acid applied at GTR surgery effectively promotes regenerative healing in infrabony defects – A clinical and radiographic 12–32 months follow-up in 15 cases

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**Background**: Recent pre-clinical and clinical research points to the stimulating role cross-linked hyaluronic acid (xHyA) plays in regenerative treatment of infrabony defects after history of periodontitis. xHyA successfully promotes clinically assessed CAL gain as well as histologically confirmed formation of new periodontal attachment when used alone or combined with a bone substitute, respectively. We studied xHyA regenerative capacity in combination with a resorbable synthetic membrane barrier applied for guided tissue regeneration (GTR) at infrabony defects intentionally rejecting any bone graft material regardless defect morphology.

**Description of the procedure**: Four periodontists calibrated with respect to papilla preservation flap design, defect instrumentation, xHyA application, membrane barrier use, and suture technique consecutively treated 15 patients and 16 defects. Initial mean CAL loss equaled 11.1 ± 2.23 mm and infrabony defect component was 7.56 ± 2.06 mm. Mean defect angle was 33.6° (range 16.5°-64.6°). The defect morphology enclosed 6 one-, 8 two- and 2 three-wall defects with a mean of 1.75 walls. Clinical parameters and periapical radiographs were followed-up for at least 12 months.

**Outcomes**: One fourth of sites (25%) experienced compromised soft tissue healing. The 12 months reevaluation revealed a mean CAL gain of 5.25 ± 1.77 mm combined with an increased recession height of 1-2 mm. Pairwise analyzed periapical x-rays estimated an apparent bone gain of 5.96 ± 2.49 mm in height. Horizontal defect fill assessed radiographically corroborates successful healing outcome. As a result of PPD reduction and defect resolution, all sites clinically featured residual PPD ≤4 mm with negative BoP at 12 months irrespective of healing history.

**Conclusions**: As defects were not filled with bone graft material at surgery, apparent density increase in the next proximity of previously affected roots documented by 12-month radiographs reflects newly formed mineralized compound. These data prove the feasibility of xHyA-mediated promotion of regenerative healing using GTR in vertical infrabony defects at teeth with severe attachment loss due to periodontitis.

## O103: Effect of a connective tissue graft in combination with the regenerative treatment of deep intrabony defect: 18-months follow-up of 15 cases

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**Background**: Postoperative gingival recessions may occur after surgical treatment of periodontal intrabony defects (PID), especially in the non-containing ones and in the presence of thin gingival phenotype. This undesired effect of treatment may alter the aesthetic outcome and the patients' perception of therapeutic success. The present 15-case series reports the 18-months clinical outcomes of the combination of a connective-tissue graft (CTG) with regenerative procedures, in deep periodontal intrabony defects in the attempt to improve the stability of the gingival contour.

**Description of the procedure**: Fifteen deep PIDs with mean clinical attachment loss (CAL 10.3 ± 2.5 mm, probing depth (PPD 7.6 ± 1.3 mm), recession of the tip of the interdental papilla (TP 2.5 ± 2 mm) and buccal recession (REC 3;1 ± 2.1 mm) were accessed with papilla preservation flaps and treated with a combination of amelogenins and bone-substitutes (EMD + BS). Prior to the site closure a CTG obtained from de-epithelialization of a free gingival graft was placed and secured and the vestibular flap was repositioned and sutured. Probing parameters (PPD, CAL) and the soft tissue position (REC, TP) were assessed at baseline and 18 months post-surgery.

**Outcomes**: In addition to a significant CAL gain (+5.1 ± 2.5 mm, $p < 0.001$) and PPD reduction (−4.7 ± 1.4 mm, $p < 0.001$), a stable or even improved gingival profile was observed at 1-year. Pre-operative buccal gingival recessions decreased (mean REC reduction 1.1 ± 1.4 mm, $p = 0.047$) and the tip of the interdental papilla tends to move coronally (0.5 ± 1.6 mm, $p = 0.078$).

**Conclusions**: The results of the present case series suggest that the adjunctive use of a CTG in the regenerative treatment of severe PIDs may prevent the occurrence or increase of postoperative buccal gingival recessions thus supporting the stability of the gingival contour. This technique may be valuable to improve both regenerative and aesthetic parameters in a single session.

## O104: Evaluation of the efficacy and safety of a three-dimensional collagen matrix for the treatment of single and multiple gingival recessions: A retrospective clinical study

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**Background**: Periodontal plastic surgery includes procedures aimed at correcting quality and/or quantity defects of periodontal soft tissues for aesthetic and functional purposes. These deficiencies can be treated with flaps and/or soft tissue graft procedures. In the literature, several different surgical techniques have been proposed to treat gingival recession type defects in order to cover an exposed root surface: recent systematic reviews have clearly indicated that, among many others, some are particularly effective in the treatment of gingival recessions: Coronally Advanced Flap (CAF) and Coronally Advanced Flap (CAF) associated with a connective graft (CTG). In more recent times research focused on possible alternatives to autologous tissue harvesting. With this purpose different types of collagen matrices have been proposed, to be utilized in association with coronally advanced flap. The aim of this study was to evaluate the clinical efficacy of a new 3D

volume stable collagen matrix (Fibrogide,Geistlich Pharma) for recession type defects treatment.

**Description of the procedure**: A total of 35 gingival recessions, RT1 and RT2 class, have been treated by means of collagen matrix in association with coronally advanced flap. All flaps were elevated in a split full split manner, the collagen matrices were placed on the exposed roots and were stabilized by means of sutures, then the flaps were coronally positioned and sutured in order to completely cover the matrix. A comparison between baseline and a mean follow-up of 2.1 ± 1.4 years was made, in order to evaluate CRC, Rec Red, RES and PROMS outcomes.

**Outcomes**: CRC was obtained in 91% of recessions, Recession Reduction was 97%. The mean RES was 9.7 and PROMS, evaluated by means of a VAS scale, had a mean score of 9.1 for morbidity and 9.3 for aesthetics.

**Conclusions**: The use of a new 3D volume-stable collagen matrix could represent a viable alternative to autologous tissue harvesting in root coverage procedures.

## O105: Software-designed 3D-printed surgical guide to treat multiple recessions in mucogingival surgery

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**Background**: Mucogingival surgery is a popular and reliable approach to treat both functional and esthetic issues affecting soft tissues around teeth. In particular, the treatment success of multiple gingival recessions often depends on flap design. A poor surgical plan as well as an inaccurate flap design could lead to surgical failure. For this reason, a new software-guided approach to design and perform mucogingival incisions was proposed.

**Description of the procedure**: A patient with multiple RT1 gingival recessions in the upper jaw was considered for this project. After the definition of the flap design according to the coronally advanced flap technique, a surgical template was designed and 3D-printed with a specific cad dental software. The template was designed to allow the clinician to accurately perform the mucogingival flap in terms of position of the incision lines and blade inclination. The guide also incorporated two palatal boxes to guide the collection of a connective tissue graft.

A the moment of the surgery, the guide was positioned on the patient teeth. A 15c scalpel blade was used to design the flap following the surgical guide. The 45-degree inclination of the blade allowed to realize a beveled incision as planned. After the removal of the guide, the mucogingival surgery was completed with papillae de-epithalisation, connective tissue grafting and flap closure.

**Outcomes**: At 1 year follow up the treatment was successful and complete root coverage was maintained. The patient's esthetic was completely restored.

**Conclusions**: Flap design could be considered as important as the grafting technique. A perfectly performed connective tissue graft might fail if the surgical incision is not adequately planned and realized. For this reason, a new technique based on digital tools was proposed to perform mucogingival flaps and grafts that can reduce surgical time and intraoperative mistakes that could lead to reduced clinical success.

## O106: Treatment of gingival recessions using titanium platelet rich fibrin in combination with current approaches: Case series

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**Background**: Variety of methods are used for the treatment of gingival recessions. Blood-derived Titanium Platelet Rich Fibrin (T-PRF) is an autogenous, easily manipulated biomaterial. The Web Coronally Positional Flap technique reduces muscle and frenulum tensions in multiple gingival recessions ensuring that wound healing environment remains stable. For single gingival recessions, Modified Tunnel Technique or Double Papilla are successfully applied methods as well.

**Description of the procedure**: A total of 9 patients having 5 single and 25 multiple gingival recessions were treated. Among them, 4 patients with 25 multiple gingival recessions were treated with Web Coronally Positional Flap Technique and T-PRF. Five patients with single gingival recession were treated using Double Papilla (2 patients) or Modified Tunnel Technique (3 patients) and T-PRF. Recession and root surface characteristics, gingival phenotype and keratinized tissue width (KTW), detectability of the cemento-enamel junction (CEJ) or presence of root steps were evaluated clinically.

**Outcomes**: A total of 30 gingival recessions from 16 teeth were classified as recession type 1 (RT1) and 14 teeth were classified as RT2. Nine teeth had a thin gingival phenotype whereas 21 teeth had a thick phenotype. It was determined that CEJ was prominent in 21 teeth, and its contours were altered in 9 teeth. At 6-months follow-up period, mean root coverage percentage was 88.94% for single gingival recession defects. The mean KTW was 3.25 mm before treatment and it was measured as 3.75 mm 6 months following mucogingival surgery. At 1-year follow-up, the mean root coverage percentage for sites with multiple gingival recessions treated with Web Coronally Positional Flap Technique and T-PRF was 82.21%.

**Conclusions**: All applied muco-gingival approaches demonstrated successful clinical outcomes. T-PRF could be used predictably for the treatment of RT1 and RT2 single and multiple gingival recessions.

RESEARCH SESSION | CLINICAL APPLICATIONS AND EMERGING TECHNOLOGIES IN PLASTIC AESTHETIC PERIODONTAL SURGERY

## O107: Modified coronally advanced tunnel versus epithelialized free gingival graft technique in gingival phenotype modification. A comparative randomized controlled clinical trial

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**Background and Aim**: Both modified coronally advanced tunnel technique (MCAT) and free gingival grafts (FGG) are used in modifying the gingival phenotype. This study aimed to compare MCAT and FGG in GP modification.

**Methods**: Fifty patients with the thin gingival thickness (GT) and insufficient keratinized tissue (KT) at the anterior mandible were treated with either MCAT or FGG. At baseline (BL), 6 weeks ($T_1$), 6 months ($T_2$), 12 months ($T_3$) visits, gingival thickness (GT) keratinized tissue height (KTH), recession depth, recession width, probing depth and clinical attachment level, were evaluated. GT change (GTC), keratinized tissue change (KTC), root coverage (RC), clinical attachment gain (CAG), and complete root coverage (CRC) were calculated. Wound healing index, tissue appearance, patient expectations, aaesthetics, and dentine hypersensitivity (DH) were assessed at BL and $T_2$.

**Results**: One hundred and forty recessions were treated and evaluated. All periodontal variables showed significant change from BL to $T_3$ in both groups ($p < 0.05$). While FGG provide more KTC ($p < 0.001$), all MCAT sites reached ≥2 mm at $T_3$. MCAT showed higher GTC ($p < 0.05$) and RC (85.8 vs. 63.5) ($p < 0.003$). Whereas, CRC did not show any significant inter-group difference ($p = 0.523$). Except for DH ($p = 0.225$), all patient-based variables were in favor of MCAT ($p < 0.05$).

**Conclusions**: Both techniques were successful in GP modification at the lower anterior region. Additional GT increase, RC, and patient-based outcomes favored MCAT but KTC was superior with FGG.

## O108: Long-term comparison of root coverage procedures at single RT2 maxillary gingival recessions: 10-year extension results from a randomized, controlled, clinical trial

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**Background and Aim**: The aim of the present randomized clinical trial was to compare Connective Tissue Graft (CTG) plus Coronally Advanced Flap (CAF) versus CAF alone 10 years after treatment of single RT2 maxillary gingival recession.

**Methods**: Twenty-one of the initial 29 patients, 11 treated with CAF + CTG and 10 with CAF, were available at final follow-up. Measurements were performed by a blind and calibrated examiner. Outcome measures included complete root coverage (CRC), recession reduction (RecRed), Root coverage Esthetic Score (RES) and Keratinized Tissue (KT) Gain. A Visual Analogue Scale (VAS) was used to assess patient satisfaction. General linear models and logistic regressions were used for inferential analysis.

**Results**: Complete root coverage was maintained in 64% of test group and 20% of the control group after 10 years, with a significant difference (OR = 39; $p = 0.030$) favoring CAF + CTG. Furthermore, add of CTG was associated with higher KT gain ($p = 0.0002$) and higher papilla tip recession ($p = 0.023$) than CAF at the last follow-up. No difference was detected in terms of RecRed, RES and patient satisfaction.

**Conclusions**: Root coverage outcomes in single gingival recession with inter-dental CAL loss are stable after 10 years. Add of CTG under CAF improved the probability to maintain complete root coverage at the last follow-up.

## O109: MCAT + CTG versus CAF + EMD for gingival recession therapy: 10-year results of a RCT using 3D digital evaluation of root coverage and gingival dimensions

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**Background and Aim**: This long-term randomized clinical trial comparing coronally advanced flaps with enamel matrix derivative (CAF + EMD) to a tunnel technique with connective tissue grafts (MCAT + CTG) uses 3D digital measurement technology. This method is highly precise and allows to look at the third dimension while evaluating the thickness as well. The goal is to capture correlations between the dimensions of the gingiva and the long-term stability after recession coverage.

**Methods**: Models were scanned and superimposed (1 year/10 year). Two-dimensionally recession reduction (RECred), complete root coverage (CRC) and percentage of root coverage (PRC) mid-buccally was measured. Furthermore, volumetrically soft tissue thickness was assessed, and pointwise, two-dimensional measurement of soft tissue thickness ensued.

**Results**: Mean RECred in the CAF + EMD group amounted to 0,73 mm versus 1,8 mm in the MCAT+CTG group. CRC was achieved in only 2 recessions in total, both in the MCAT+CTG group. PRC after 10 years was mean 42% in the CAF + EMD group versus 82% in the

MCAT+CTG group. Independent of the treatment group, a clear correlation between soft tissue thickness and RECred could be identified.
**Conclusions**: The gingival thickness above the previously exposed root surfaces was strongly correlated to PRC and the long-term stability of the treatment outcomes in both groups. The MCAT + CTG performed better than the CAF + EMD group over the observation period. Other long-term RCTs are needed to identify prognostic factors for long-term stable outcomes of gingival recession treatment.

## O110: Comparison of pinhole surgical technique and tunnel technique for the treatment of gingival recession: A split mouth clinical and digital prospective study

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**Background and Aim**: Pinhole and Tunnel techniques have been described as minimally invasive procedures that successfully rectify the gingival recession. The aim of this investigation was to compare the outcome of pinhole surgical technique and tunnel surgical technique in the treatment of gingival recession.
**Methods**: This study was a split-mouth longitudinal clinical instigation. Twenty subjects who had two contralateral teeth with Cairo type I gingival recession were recruited for this study. Each of the two contralateral teeth in the same subject was randomly assigned to test group (n = 20) that underwent pinhole surgical technique (PST) and control group (n = 20) that underwent tunnel surgical technique (TST). Clinical variables were probing pocket depths, bleeding on probing, gingival recession, and width of attached gingival tissue. The gingival thickness gain was measured by digital superimposition of the intraoral scan before and after treatment. The amount of facial swelling was digitally compared between the two contralateral sites using the facial scanner. Patient reported outcomes of pain intensity and overall satisfaction were measured using Visual Analogue Scale (VAS) for 7 days and at 6 months after the surgical procedure respectively. The subjects were followed up 3 days, 1, 3, 6 weeks and 3, 6, 12 months after the procedure.
**Results**: The PST and TST resulted in an average net gain of 3.73 mm, 3.82 mm in root coverage respectively. TST group has statistically higher gingival thickness and more attached gingival tissue compared to PST group. There was no statistically significant difference between both techniques in the amount of facial swelling and patient reported outcome.
**Conclusions**: PST achieved root coverage result that is comparable to those of TST, however, gingival thickness and amount of attached gingival tissue was slightly better in TST group compared to PST one. Both techniques provided less postoperative morbidity.

## O111: A novel augmentation technique for the management of interdental papilla

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**Background and Aim**: Management of the Interdental papillary Recession is extremely important to avoid aesthetic challenges such as black triangle and also functional challenges such as food impaction and phonetics. The purpose of this study is to evaluate the Novel augmentation of the Interdental Papilla with Platelet Rich Fibrin.
**Methods**: Thirty-six sites in systemically healthy individuals presenting with Nordland & Tarnow Class 1 & Class 2 papillary recession were recruited in our study. Augmentation of the Interdental Papilla was done with a novel technique along with platelet-rich fibrin. The following parameters namely width of the attached gingiva, JEMT Score, distance from the tip of the contact point of the teeth to the gingival margin were assessed at baseline, 3 months, 6 months and 1 year postoperatively. Healing was assessed at 1st, 2nd and 3rd week postoperatively.
**Results**: The results of our study suggested both clinical and statistically significant improvements of all the parameters(width of the attached gingiva, JEMT Score, distance from the tip of the contact point of the teeth to the gingival margin) at 1 year post-operatively compared to that at baseline.
**Conclusions**: Although our findings are positive, a study with a larger sample size and longer follow-up prospectively would be required in future to affirm the findings of this study. This presentation gives a take-home message of a simple new augmentation technique that could be used routinely in daily clinical practice.

## O112: Efficacy of the combined surgical–restorative treatment for multiple gingival recession associated with noncarious cervical leisons. Randomized clinical trial

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**Background and Aim**: One of the treatment options reported in the literature for NCCLs associated with gingival recessions is the combined restorative-periodontal approach.
Few evidences are available in the literature about the efficacy of mucogingival techniques on multiple combined defects (multiple gingival recession+ NCCLs).
The primary objective is to evaluate the difference in complete root coverage (primary outcome measure, CRC) treating multiple combined defects either by Multiple Coronally Advanced Flap (control, MCAF)

or Coronally Advanced Flap plus Connective Tissue Graft (test, MCAF+CTG).

Secondary aims are the evaluation of patient related outcomes (PROMs) and the esthetic impact of such treatment.

**Methods**: The current study was designed as a single blind, single-center, parallel arms, superiority and balanced randomization clinical trial. Patients with a diagnosis of RT1/RT2 multiple recessions associated with NCCL were consecutively enrolled. A composite resin restoration of the whole portion of the NCCL coronal to the line of maximum root coverage (MRC), previously outlined, was performed (T7). At T14, Multiple coronally advanced flap (MCAF) either with (test group) or without (control group) connective tissue graft (CTG) were performed. Clinical variables, patient-centered outcomes and objective esthetic score were recorded at baseline and after 4 and 12 months by a single calibrated examiner.

**Results**: A total of 42 patients were treated. CRC and RC at 1 year were 57.14% and 85% and 54.17% and 78.39% for test and control group respectively.

Subjective and objective esthetic score (VAS) increased significantly from baseline for both treatment procedures: 7.67 (5.50–9.83; C.I 95%) and 8.29 (7.13–9.45; C.I. 95%) for test; 9.5 (9.15–9.85; C.I. 95%) and 7.71 (7.14–8.27; C.I. 95%) for control.

**Conclusions**: Within the limits of this study, in case of combined defect, it is possible to conclude that both procedures were effective to obtain adequate clinical and esthetic outcomes at 1 year follow-up.

## O113: Root coverage of RT1 gingival lesions with gingiva-derived mesenchymal stem cells embedded in a xenogeneic collagen matrix: An in vivo preclinical study

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**Background and Aim**: The use of xenogeneic collagen matrixes (CMX) is not yet comparable to the subepithelial connective tissue graft when used in combination with the coronally advanced flap (CAF) for root coverage (RC) procedures, in terms of mean recession reduction and percentage of RC. The aim of this preclinical study is to evaluate the added effect of seeding autologous gingiva-derived mesenchymal cells (GMSCs) into a porcine-derived collagen matrix for the treatment of localized Recession Type 1 (RT1) lesions.

**Methods**: Dehiscence-type defects were artificially created on seven *Beagle* dogs. The lesions were randomly allocated to 1) the test group (CAF/CMX with autologous GMSCs), 2) control 1 (CAF/CMX with autologous fibroblasts, 3) control 2 (CAF/CMX without cells) or 4) control 3 (CAF alone). Two and six weeks after the procedure, the four treatment groups were compared in terms of clinical and histological variables. Descriptive statistics were performed for quantitative variables and differences between the groups were analyzed by using One-Way ANOVA and Kruskal-Wallis tests.

**Results**: The use of GMSCs resulted in greater mean recession reduction (1.42; SD = 1.88 mm) and percentage of teeth with recession reduction of ≥2 mm (57%) than the control groups, between baseline and 6 weeks but the differences were not statistically significant. Regarding histological variables, no significant differences were found between groups in terms of cementum and bone formation. Nevertheless, the combination CAF/CMX/autologous GMSCs exhibited a lower inflammatory reaction than the control treatment groups.

**Conclusions**: The application of autologous GMSCs to CAF/CMX for the treatment of experimental RT1 recession lesions was safe and provided preclinical efficacy, although its additional benefit, when compared with the control groups was not demonstrated.

## O114: Evaluation of angiogenesis of soft tissue substitutes using a Chick chorioallantoic membrane (CAM) assay: A preclinical study

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**Background AND Aim**: Angiogenesis has been recognized as a crucial process in promoting wound healing. This is particularly true when scaffolds/substitutes are used in periodontal soft tissue augmentation procedures. Limited comparative evidence exists on the microscopic and molecular events associated with the angiogenetic phases in periodontal soft tissue augmentation procedures. The aim of this study was to compare the angiogenetic potential of different soft tissue substitutes (STS) using a chick chorioallantoic membrane (CAM) assay.

**Methods**: Six different types of collagen-based STS including porcine derived collagen matrix (Mucoderm®, Mucograft®, and Novomatrix®), volume-stable cross-linked collagen matrix (Fibrogide®), porcine-derived collagen fibres (Derma Osteobiol®) and allograft collagen matrix (Puros® dermis) were implanted to act as scaffolds in the CAM assay. Analyses and quantification of a) vascular density and bifurcation points, b) scanning electron microscopy (SEM) images, c) histological haematoxylin and eosin staining (H&E) and d) optical coherence tomography (OCT) data were completed. GraphPad Prism 9 was used to analyse all data. A minimum n = 4/5 scaffolds were analysed per sample tested.

**Results**: The percentage vascular area of porcine-derived collagen (Mucoderm® ($p < 0.0001$), Mucograft® ($p = 0.0012$), Novomatrix® ($p = 0.0012$)) and allograft collagen matrices (Puros® dermis, $p = 0.0105$) was statistically significantly higher than the negative control (PBS sample). One of porcine-derived collagen matrix (Mucoderm®) exhibited a statistically significant higher value than vascular endothelial growth factor (VEGF) solution as a positive control (mean difference of 18.7, 95% CI 8.2 to 29.2, $p = 0.0003$). In addition, porcine-derived collagen matrices (Mucograft® and Novomatrix®) exhibited a marked higher number of vascular bifurcation points than the positive control VEGF. All the scaffolds integrated well with surrounding CAM thereby showing biocompatibility.

**Conclusions**: Six collagen-based STS commonly used as clinical scaffolds in mucogingival surgical treatments showed promising angiogenetic characteristics and could represent valid alternatives to autologous connective tissue grafts.

**RESEARCH SESSION | RESEARCH IN PERIODONTOLOGY – MISCELLANEOUS**

## O115: Oral health, salivary response and risk of injuries to physical training in young professional football players

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**Background and Aim**: High stress levels and poor oral health in athletes are common findings, and both are associated with less performance and higher injury incidence. Saliva sample may be collected non-invasively and easily to monitor athletes' response to stress from physical activity and burden to overtraining.Main aim was to measure in saliva cortisol as a marker for stress in response to an outdoor training session in young professional football players. Secondly, protease, amylase, immunoglobulin A, mucin5B, lactate, ammonium, potassium, sodium, magnesium and calcium were measured as markers for inflammation, immunological and physical performance. Finally, the periodontal and oral health conditions of these players, and self-reported history of injuries was assessed.

**Methods**: Young professional football players (age 18–21 years) from two teams in Belgium were recruited. Periodontal and oral examination was carried out before an afternoon outdoor training and history of injuries was assessed by means of questionnaires. Oral rinse samples were collected before and after the training session. ELISA, capillary electrophoresis and enzymatic fluorescence were used to determine salivary markers.

**Results**: 36 players were recruited. After training significant increases were found for levels of cortisol ($p = 0.001$), protease ($p = 0.001$), mucin 5B ($p = 0.002$) and sodium ($p = 0.002$). Periodontal examination showed that 36% had gingivitis and 8% periodontitis. Further, 50% of the players had >1 active caries lesion and 28% moderate/severe erosion. No correlations were found between the changes in salivary markers and oral health outcomes or history of injuries. However, considerable inter-individual variability among the players in the response to physical activity was noted.

**Conclusions**: Young professional athletes need to improve their periodontal and oral health. Saliva is a promising tool to monitor biomarkers in response to physical activity. Inter-individual variability in the response to physical activity should be further investigated in relation to performance and risk of injuries.

## O116: Morphometric analyses of alveolar bone height in ligature-induced periodontitis associated with surgically induced osteoarthritis: An experimental study in rats

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**Background and Aim**: Arthritis and periodontitis are chronic inflammatory diseases sharing similar host-mediated pathogenesis. Studies suggest an association between periodontitis, osteoarthritis, and rheumatoid arthritis, but a causal relationship has not been established.To investigate the effect of experimentally-induced osteoarthritis on alveolar bone loss in ligature-induced periodontitis in rats.

**Methods**: Twelve male rats were used, divided into a test and control groups of 6 rats each. On day 1, animals in both groups were anaesthetized with intramuscular injection of a combination of ketamine hydrochloride and xylazine. Periodontitis was induced using silk suture ligated around the cervical region of two maxillary 2nd molars in each rat. In addition, osteoarthritis was induced surgically in the test group only. This was done by transecting the medial collateral ligament of the knee, then reflecting and resecting the medial meniscus. In all animals, the ligatures were kept for 30 days and then sacrificed. The alveolar bone height was assessed morphometrically by measuring the distance from the CEJ to the alveolar bone crest using a stereomicroscope. Knee specimens of both groups were processed for light microscopy histological analysis.

**Results**: The histological analysis showed differences in osteoarthritis between the groups including differences in lymphocyte infiltration of synovium, the state of articular bone, and the width of joint space. There were also significant differences in bone loss between the groups, with the test group having significantly lower bone level

(1.1533 ± .43226 mm) than the control group (7587 ± .35664 mm) ($p < 0.001$).

**Conclusions**: Rats with surgically induced osteoarthritis develop significantly higher bone loss than animals without osteoarthritis in the experimental periodontitis model.

## O117: Development of a biomechanical model for the study of tooth auto-transplantation outcomes: Towards in-silico modelling

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**Background and Aim**: Tooth auto-transplantation is resurfacing as an alternative to tooth replacement for both children and adults. Its use has shown indications both for children (following trauma, agenesis and/or dental abnormalities) and adults (for the replacement of terminally decayed first and second molars with third molars and for the treatment of impacted canines).The aim of this study was the development of a biomechanical model for the study of tooth auto-transplantation outcomes.

**Methods**: 3-D models were created based on cone beam computed tomography (CBCT) images from 10 patients (mean age 10.7 years ± 1.1) having had tooth auto-transplantation from the premolar to the antero-maxillary region (EC: S55287, KU Leuven). Included patients had pre-operative, post-operative and 1 year follow-up CBCTs.

All scans were registered and segmentations of the different structures of the teeth (including enamel, dentine, pulp), bone (including cortical, trabecular, sclerotic) and periodontal ligament were executed. Linear and volumetric measurements were then performed to assess changes happening at root-level and at different time-points.

Meshes for the models were generated using Desk Software, and finally finite element analyses were performed based on a novel design-of-experiment approach for the study of stress distribution, accounting for extensive possibilities of loading conditions scenarios.

**Results**: Preliminary results show successful implementation of the modelling approach, with positive correlation between patterns of root formation and stress distribution. Statically significant differences were also observed in the intensity and distribution of Von Mises stresses between the auto-transplanted tooth and the contra-lateral incisor, as well as between pre- and post-operative tooth auto-transplantation locations.

**Conclusions**: Accurate patient-specific modelling (PSM) combined with finite element analyses could help in accurate modelling and assessment of surgeries such as tooth auto-transplantation and open doors for PSM in oral implantology.

## O118: Generation and characterization of recombinant *Porphyromonas gingivalis* W83 FimA

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**Background and Aim**: *Porphyromonas gingivalis* (*P. gingivalis*), a known pathogen in periodontitis, invades host cells and expresses numerous virulence factors. Fimbriae are involved in colonization, invasion and persistence owf bacteria inside the host cells and may affect host immune-response mechanisms that are responsible for bacterial elimination. *P. gingivalis* fimbriae are essential in initial cell attachment and bacterial internalization into gingival epithelial cells. The major fimbriae, coded by the FimA gene, are able to bind specifically to different host cells, amongst them human epithelial cells and monocytes. The aim of this study was to generate and characterize the properties of a recombinant *P. gingivalis* W83 FimA.

**Methods**: The FimA gene was cloned in *Listeria innocua* using the vector Pimk2sph His-N. The Protein was purified using fast protein liquid chromatography (FPLC) and characterized by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS PAGE) and mass spectrometry. The biological activity was shown by stimulation of primary and immortalized human gingival keratinocytes (PHGK, IHGK), SCC-25 cells and human monocytes. After 24 h FimA supernatants were harvested and the cytokines IL-12p70, TNF, IL-10 IL-6, IL-8, IL-1β were quantified using the human inflammatory cytokine cytometric bead array (CBA) kit (BD) and analyzed by flow cytometry.

**Results**: Pure fractions of the FimA protein were sequenced and identified and used for the proof of biological activity. Human oral epithelial cells did not induce cytokine production upon stimulation. In contrast, monocytes reacted with production of inflammatory cytokines i.e. TNF, IL-10, IL-6 and IL-1β in high concentrations in the cell supernatant.

**Conclusions**: Our results demonstrate, that human monocytes react by inducing high-level productions of cytokines to recombinant *P. gingivalis* W83 FimA. Further studies are required to study the

mechanisms underlying this induction and for determining those features of FimA that lead to this induction.

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## O119: Comparison of two different LED devices for photodynamic therapy in combination with aminolevulinic acid

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**Background and Aim**: The aim of this study was to evaluate the effects on bacterial and fibroblasts cells provided by two different LED devices (630 nm ± 10) used for photodynamic therapy. A handpiece with a single LED (TL-01) that irradiates one periodontal site per time was compared with a multi-led device that allows to irradiate all the vestibular sites of a single arch at the same time.

**Methods**: *E. faecalis* ATCC 29212 bacterial suspensions (OD600 = 0.12, 10^8 Colony Forming Units (CFU)/mL) and 6000 human gingival fibroblasts (HGFs) were distinguished in three test groups and treated according to the following scheme: TL-01N and TL-03N (N = near), and TL-03F (F = far). Test groups were incubated for 45 minutes with a gel containing 5% of delta-aminolevulinic acid and then irradiated by two devices for 15 minutes. TL-01 was characterized by a single emitter, surface irradiance of 380 mJ/cm$^2$ and put a distance of 0.5 mm from the samples. TL-03 had a multiple emitter with 32× Power LED with 30 mW of power, surface irradiance of 6 mJ/cm$^2$ and the distance of irradiation was 35 mm. Controls were unexposed and untreated cells. The samples were tested for (i) CFU/mL for the quantification of cultivable bacterial cells (ii) fibroblasts viability and morphology. The significance threshold was set at 0.05.

**Results**: Both TL-01 and TL-03 demonstrated a significant reduction of *E. faecalis* bacterial load. TL-01 was characterized by the higher antibacterial activity, but no significant differences were found respect to TL-03 regardless of the distance of the light source. The viability and morphology assay showed that TL-01 and TL-03 were fully biocompatible and exerted similar effects on HGFs by promoting their proliferation.

**Conclusions**: Both tested devices had similar effects to significantly reducing *E. faecalis* load and to stimulating HGFs proliferation in vitro and represent a promising new method as nonsurgical oral cavity treatment.

## O120: Combined periodontal and orthodontic treatment in stage IV periodontitis patients with pathological tooth migration: A long-term retrospective study

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**Background and Aim**: Recent systematic reviews focused on the available evidence on risks and benefits of orthodontic tooth movement (OTM) in periodontitis patients, and emphasized the need for additional studies. Thus, the aim of this retrospective study was to assess the long-term response of periodontal tissues after combined periodontal-orthodontic treatment in Stage IV periodontitis patients with pathological tooth migration (PTM).

**Methods**: Forty Stage IV periodontitis patients who completed step 3 of therapy and subsequently underwent fixed orthodontic treatment were retrospectively assessed at baseline (T0), at the end of active periodontal therapy (APT, T1), at completion of OTM (T2), and at the last supportive periodontal care visit (SPC, T3). Full-mouth periodontal parameters were recorded at all timepoints, while periapical radiographs were taken at baseline, T2 and T3.

**Results**: APT resulted in statistically significant clinical improvements, with FMPS and FMBS decreasing below 20%. A mean PPD reduction of 1.5 ± 1.1 mm and a mean CAL gain of 0.9 ± 1.0 mm were achieved, together with a significant Rec increase (0.6 ± 0.4 mm). OTM had no significant impact on periodontal outcomes, and no further significant changes were observed throughout T3. The mean duration of SPC was 9.5 ± 4.6 years and lasted up to 17 years. A slight alveolar bone level gain and average root length decrease were observed at T3. A total of 115 teeth were lost during APT (90 due to periodontal reasons), 5 molars at the completion of OTM (used as orthodontic anchorage), and 10 molars during SPC (due to root fracture). All anterior migrated teeth were in function at T3.

**Conclusions**: Within the limits of the present design, these data suggest that a combined periodontal-orthodontic treatment may be a reliable approach in order to re-establish a stable occlusion and to improve long-term prognosis of severely compromised teeth in Stage IV periodontitis.

## O121: Characterization of oral mucosa wound healing in a porcine model using histology, proteomics and molecular imaging

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**Background and Aim**: Gingiva wound healing constitutes one of the few *ad integrum* healing model in adult mammals. It heals without fibrosis nor keloids. However, we still lack a global view of the molecular events orchestrating this process. Especially, dynamics and spatial proteins changes in the extracellular matrix (ECM) during wounding have not been investigated with histological description. Thus, the objective of this study is to characterize an oral mucosa healing model in minipigs. Histology and omics approaches will decipher the spatial distribution of proteins during wound healing remodeling.

**Methods**: Standardized gingival wounds were performed on Aachner minipigs and analyzed at different time points corresponding to the inflammatory (D7), early (D21) and late remodeling (D60) phases. Conventional histology, second harmony generation and proteomic analyses by mass spectrometry on solubilized protein extracts and on tissue sections were performed.

**Results**: Standardized wounds showed macroscopically *ad integrum* healing after 60 days. Histologically, the cellular and matrix organization recovered an architecture close to the unwounded tissue. Proteomics analyses revealed that synthesis profile showed significant variations throughout the healing process. Thus, cell motility and inflammation predominated at D7, while at D60, cell–cell interactions were enriched. The molecular imaging identified three distinct peptide populations for each healing time points.

**Conclusions**: This model of gingival healing in large animals confirmed the exceptional healing capacities of the gingival This model of oral mucosa healing confirmed the lack of fibrosis and macroscopically visible scar tissue in minipigs. Histology, proteomics and molecular imaging characterized the evolution of key protein clusters during ECM remodeling. This model will enhance our knowledge of the protein mechanisms involved in oral mucosa healing and in *ad integrum* tissue regeneration.

## O122: SHED Promote the maturation of a functional vascular network in prevascularized grafted collagen scaffolds

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**Background and Aim**: Angiogenesis is a critical determinant of success for any periodontal regenerative application. The rapid vascular perfusion at the regeneration site is crucial for providing oxygen and nutrients to the grafted tissues. In this regard, the use of mesenchymal stem cells (MSC) is an appealing option since they release proangiogenic factors and can be recruited as perivascular cells to promote vessel maturation. This study aims to investigate the capacity of MSC derived from the dental pulp of deciduous teeth (SHED) to stabilize a vascular network previously established in vitro before implantation and enhance its functionality.

**Methods**: SHED were seeded in prevascularized collagen scaffolds carried in a printed PLA grid and these constructs were implanted subcutaneously in nude mice. Three different conditions were tested 1) co-culture of endothelial cells (EC) and SHED (EC-SHED), 2) EC treated with SHED conditioned medium (EC-SHED-CM), 3) SHED alone. At 4 weeks, a contrast agent was injected to image the vascularization network via CT-scan and human and murine lectins were injected to evaluate the number of perfused human vessels and the number of anastomoses by ex-vivo bi-photon acquisition.

**Results**: Human blood vessels were functional and able to anastomose with the host's vessels, as revealed by specific lectin binding. The prevascularized scaffolds of the EC-SHED and EC-SHED-CM groups demonstrated an increased vascular perfusion and increased number of total vessels and vascular area compared to the control SHED group.

**Conclusions**: This study shows the capacity of SHED to optimize a mature and functional vascular network in vivo and introduces prevascularization as an important clinical prospect to consider in grafted periodontal tissue engineering.