PARIS

CHALLENGES, OPPORTUNITIES AND NEW PERSPECTIVES IN ENDODONTOLOGY

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ESE Wladimir Adlivankine Research Prize, ESE Education Prize, Research Abstracts & Educational Abstracts

ESE WLADIMIR ADLIVANKINE RESEARCH PRIZE COMPETITION

WAC001 | ESTABLISHMENT OF IN VITRO PULPITIS MODELS USING PRIMARY HUMAN DENTAL PUPL CELLS AND INVESTIGATION OF ANTI-INFLAMMATORY EFFECTS OF < 3-O-ACETYL-11-KETO-BETA-BOSWELLIC ACID (AKBA)

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AIM: The most common causes of pulpitis are deep caries leading to bacterial infection of the pulp. Bacterial ligands with pathogenic and tissue damage-associated molecular patterns (PAMPs and DAMPs) enter the pulp, where odontoblasts and other pulpal cells recognize them with their Pattern Recognition Receptors (PRRs), among them Toll-like receptors (TLRs) emerge. The activation of PPRs initiates complex inflammatory responses. In our study, we established in vitro pulpitis models by applying various TLR ligands on human dental pulp cells (hDPCs) and characterized the subsequent inflammatory reactions. Moreover, we studied the potential anti-inflammatory effect of 3-O-acetyl-11-keto-β-boswellic acid (AKBA). AKBA is an active ingredient in the resin of the Indian frankincense tree (Boswellia serrata).

Methodology: Our experiments were carried out on primary human dental pulp cells (hDPCs) isolated from wisdom teeth. We characterized the effect of bacterial lipopolysaccharide (LPS), polyinosinic-polycitidilic acid (poly(I:C), lipoteichoic acid (LTA) and peptidoglycan (PGN), activating different TLRs in whole transcriptome analysis (RNAseq). Inflammatory responses were further dissected by qPCR and ELISA techniques. Production of reactive oxygen species (ROS) and activation of intracellular Ca2+ signalling were also investigated.

Results: We found that poly(I:C) induced strong and extensive inflammatory responses including the production of inflammatory cytokines and ROS. LPS was less effective whereas LTA and PGN were practically ineffective. The presence of AKBA did not affect ROS production, but significantly promoted the survival of the hDPCs in inflammatory conditions, and reduced the production of certain inflammatory cytokines.

Conclusions (mandatory): According to our results, poly(I:C) is very effectively induces inflammatory responses in human pulpal cell cultures and AKBA has a significant anti-inflammatory effect in vitro. Our findings indicate that AKBA can be a promising anti-inflammatory substance in the future treatment of pulp diseases.

Acknowledgements (optional): Our work was supported by NKFI FK_20 134725, PD_134791 OTKA, ÚNKP-23-3-II-DE-430 and EKÖP-24-3-I-DE-420 grants.

WAC002 | EFFECT OF MARESIN-1 ON ACUTE PULPITIS: A PRECLINICAL EVALUATION

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AIM: This study evaluates the effect of Maresin-1 (MaR1), a specialized pro-resolving mediator, on inflammation and lesion size in an acute pulpitis model in mice.

Methodology: Acute pulpitis was induced in mice using mechanical pulp exposure. Experimental groups included a MaR1-treated group and control groups (untouched, control and vehicle-treated). 2D and 3D imaging techniques, including micro-CT, were used to analyze lesion progression and bone integrity. Statistical comparisons were made between groups.

Results: 2D imaging revealed a statistically significant reduction in lesion size in the MaR1-treated group compared to control and vehicle groups ($p<0.01$). Untouched and control groups also showed a significant difference ($p<0.05$), confirming that the model was effective. Analysis of individual roots demonstrated consistency with total lesion data, though minor variations were observed, particularly in the distopalatinal root. 3D analysis showed a significant difference in bone volume fraction (BV/TV) between the untouched group and all other groups ($p < 0.001$), confirming bone loss due to pulpitis. While MaR1-treated mice exhibited a trend toward higher BV/TV values, the differences between MaR1, vehicle, and control groups were not statistically significant. However, bone mineral density (BMD) was significantly higher in the MaR1-treated group compared to vehicle and control groups ($p<0.05$). Bone mineral content (BMC) values also showed a trend favoring MaR1 treatment, though no statistical significance was reached.

Conclusions (mandatory): The results indicate that MaR1 treatment may modulate the inflammatory response and limit tissue destruction in acute pulpitis. Further studies with histological validation and increased sample sizes are needed to confirm these findings and explore the clinical applicability of MaR1 in endodontic therapy.

WAC003 | EVALUATION OF INFLAMMATORY MEDIATORS, PULPAL BLOOD PH AND OXYGEN SATURATION IN TEETH WITH PULPITIS

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AIM: This study aimed to evaluate the levels of inflammatory mediators, pulpal blood pH and oxygen saturation in teeth diagnosed with pulpitis, as well as to investigate the correlations among these parameters.

Methodology: This study investigated selected biomarkers in pulpitis by analyzing clinical and laboratory examinations from patients aged from 19 to 55 undergoing endodontic treatment. Patients were divided into test groups (reversible/irreversible pulpitis) and a control group (healthy teeth). Clinical assessments included pulse oximetry measurement and pulpal blood collection for biomarker and pH analysis. Five inflammatory mediators (IL-1alpha, IL-6, IL-8, MMP-9, TIMP-1) were evaluated using a Luminex multiplex assay. Statistical analysis was performed using SPSS 30.0, employing both parametric and non-parametric tests with a significance level of $p < 0.05$.

Results: Several investigated markers exhibited significant differences among the groups. The levels of SpO2 and pH were highest in the control group and lowest in in cases of irreversible pulpitis. Additionally, the levels of IL-1alpha, IL-6, and IL-8 increased with the severity of pulpitis. Significant correlations were identified between inflammatory mediators, pH, and pulse oximetry. Notably, IL-1alpha, IL-8, and TIMP-1 correlated with pH ($p<0.01$), and pulse oximetry was strongly associated with IL-1alpha, IL-6, and IL-8 across all groups ($p<0.01$).

Conclusions (mandatory): The values of inflammatory mediators (IL-1alpha, IL-6, IL-8, MMP-9, TIMP-1), along with the pulp blood pH and oxygen saturation levels differed according to the pulp condition and a positive correlation was established among the parameters analyzed.

Acknowledgements (optional): The authors would like to acknowledge the Kristupas Gutauskas Foundation for making this research possible.

WAC004 | ALIGNING IRRIGATION AND SEALER SELECTION FOR AN OPTIMAL ROOT CANAL TREATMENT

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AIM: To investigate different irrigation protocols, their ability to modify root canal dentine and influence the performance of endodontic sealers. This study aims at irrigation protocol-sealer selection for improved endodontic outcomes.

Methodology: Extracted human teeth were chemo-mechanically prepared and subjected to various irrigation protocols using 2% sodium hypochlorite (NaOCl), 17% ethylenediaminetetraacetic acid (EDTA), and 5% dimethyl sulfoxide (DMSO). Scanning electron microscopy (SEM) and energy-dispersive spectroscopy (EDS) were used to assess dentine microstructure and composition, Fourier transform infrared spectroscopy (FT-IR) evaluated compositional changes. XRD to assess the crystalline phases of the tested sealers. The prepared root canals were then obturated with either AH Plus or tricalcium silicate (TCS) based sealers - BioRoot RCS, BioRoot Flow, and AH Bioceramic. The material-tooth interface was analysed using SEM, EDS, and FT-IR microscopy. Statistical analysis included ANOVA with Tukey post-hoc tests for parametric data and the Kruskal-Wallis test for non-parametric data.

Results: EDS detected calcium, phosphate, silicon, and zirconium in AH Plus, AH Plus Bioceramic, BioRoot RCS and BioRoot Flow. FTIR determined the carbonate, phosphate, and amide content in the dentine and dentine-sealer interface. SEM analysis showed a dense smear layer with NaOCl and DMSO, while NaOCl-EDTA caused dentinal tubule widening, cracks, and erosion. DMSO improved sealer penetration while causing minimal damage to the dentine, allowing for better adaptation of sealers. The NaOCl-EDTA-DMSO sequence effectively removed the smear layer but led to some alterations in dentine composition. Elemental analysis revealed shifts in calcium, phosphate, and zirconium levels, impacting the dentine-sealer interface.

Conclusions (mandatory): The incorporation of 5% DMSO in irrigation protocols shows promising results in enhancing dentine-to-sealer interaction. TCS sealers in general had better sealer penetration and mineral deposition at the material to dentine interface.

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WAC005 | OPTIMIZING CXCR4 DETECTION IN HUMAN DENTAL-PULP AND APICAL-PAPILLA CELL LINES

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AIM: This study aimed to compare three dissociation methods (enzymatic digestion, non-enzymatic digestion, and mechanical collection), focusing on their effect on the cell viability and the CXCR4 expression levels on the cell membrane under different conditions.

Methodology: Human dental pulp stem cells (hDPCs) and stem cells from the apical papilla (SCAPs) were collected by the outgrowth method from human third molars (n=6) from 16-18-year-old healthy patients. Six different methods (Enzymatic digestion: 0.25% Trypsin, TrypLE, 0.05% Trypsin+2mM EDTA; Non-enzymatic digestion: 2mM EDTA, 5mM EDTA; Mechanical collection: cell scraper) were used to dissociate cells to obtain single-cell suspensions. Afterwards, the cells were resuspended in culture medium and recovered at 37°C for 0, 1, 2, 3, and 4 hours. Surface expression of CXCR4 on viable cells was assessed using flow cytometry. The data was statistically analyzed using GraphPad prism using $p<0.05$ as a statistical significance reference.

Results: hDPCs and SCAPs exhibited comparable cell viability and CXCR4 expression under the same dissociation methods and time points. Cell viability declined from 0-4 hours, with the enzymatic digestion group showing the highest viability, followed by the non-enzymatic and mechanical groups. Notably, cells detached with 0.25% trypsin maintained above 90% cell viability even after 4 hours of recovery. Meanwhile, in enzymatic and non-enzymatic groups, CXCR4 expression levels increased steadily after 0-2 hours of recovery time, followed by a decline after 2 hours, whereas the mechanical group displayed an opposing trend. In enzymatic groups, the expression levels were comparable in TryplE and 0.05% Trypsin+2mM EDTA groups, while lower than 0.25% Trypsin group.

Conclusions (mandatory): The dissociation method and recovery time can significantly affect the expression of CXCR4 on the cell membrane. To balance optimal cell viability and detection reliability, enzymatic dissociation followed by a 2-hour recovery time is recommended for CXCR4 detection and subsequent downstream experiments.

ESE EDUCATION PRIZE COMPETITION

EDP001 | DEVELOPING AN AI-POWERED TOOL FOR RADIOGRAPHIC FEEDBACK ON WORKING LENGTH (WL) DETERMINATION IN PRE-CLINICAL ENDODONTIC TRAINING

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AIM: This study aimed to develop a machine learning-based tool to facilitate personalized, constructive feedback on radiographic working length determination in a pre-clinical set-up.

Methodology: Machine learning models were utilized to provide customized feedback in pre-clinical endodontic training A new, large, balanced, and labeled dataset for working length (WL) determination was created. It consists of over 3,000 radiographic images categorized into optimal WL (0-2 mm from the radiographic apex), over-extended WL (extending beyond the radiographic apex), and under-extended WL (more than 2 mm shorter than the radiographic apex). 22 convolutional neural network (CNN) models were constructed, fine-tuned, trained and evaluated using this dataset. A comprehensive performance assessment based on 5 metrics was conducted, followed by an in-depth analysis of the results. Diagnostic test parameters such as accuracy (Ac), F1-score, precision, recall, testing time were evaluated. Further detailed metrics were constructed on the most performing model.

Results: out of 22 CNN models, the custom-developed deep CNN (DCNN) were considered the highest-performing model. The diagnostic test parameters were found to be 97-99 % accuracy, 95-98% for F1-score, and 94-99% precision with a recall rate 96-98% and testing time as 0.54 second. The case study of this model has shown reliable output data when used to test a simulated case following its development.

Conclusions (mandatory): The custom-developed deep CNN (DCNN) model demonstrates high accuracy in providing reliable feedback for working length (WL) determination during root canal treatment using WL dental radiographs. This system balances accuracy and efficiency, making it an ideal tool for enhancing dental education through constructive feedback in endodontic pre-training.

EDP002 | EVALUATION OF THE EFFECTIVENESS OF VIRTUAL HAPTIC TRAINING IN MICROSURGICAL ENDODONTICS AND STUDENT BACKGROUND WITH VIRTUAL REALITY

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AIM: To evaluate the endodontic microsurgery performance of a group of students in a virtual reality simulation setting by using haptic feedback technology, compared to a group of expert operators.

Methodology: Two exercises focused on the essential feature of endodontic microsurgical preparation (osteotomy and apicoectomy) were conceptualized and developed to be carried out with a VR dental simulator. The data volumes were collected by CBCT scanning and exported in stereolithography (STL) format to optimize them to the VR environment. The elements were exported into a graphical scene, which can be interacted with an haptic device for the purposes of performing a treatment. Ten undergraduate students and eight expert operators in the field were selected to perform both the exercises once a week during a 4-week program. Target volume to be removed was showed during all working sessions, except for the lasts one. Surgery and drilling time, accuracy and target progress were recorded for each exercise. Mean values were compared between groups for performance analysis. A questionnaire on previous knowledge of the virtual world and the results obtained was submitted.

Results: A t-test showed significant difference ($p<0,05$) between the first and the last simulation performed by the undergraduate students in accuracy and target progress for the osteotomy exercise while there was no difference in the apicoectomy exercise, although a better trend was evidenced. Expert operators yielded better accuracy values than students, without statistical significance ($p>0,05$).

Conclusions (mandatory): A learning curve is necessary since most participants reported an increasing ease of handling the simulator components during the training program. The addition of haptic feedback in VR training reduces surgical error and it is important during the early phase of psychomotor skill acquisition by enhancing the trainee's haptic perception capabilities and thus facilitating transfer of skill from simulation to the operating room.

EDP003 | EVALUATING GENERATIVE AI TOOLS FOR ENDODONTIC EDUCATION: A COMPARATIVE ANALYSIS OF CHATGPT DEEP RESEARCH AND NOTEBOOKLM IN SIMULATED LEARNING SCENARIOS

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AIM: Artificial intelligence (AI) increasingly informs dental education, notably within specialized fields such as endodontics. Despite widespread adoption in clinical diagnostics and treatment planning, there remains limited investigation into generative AI tools tailored for postgraduate endodontic education. This study comparatively evaluates two prominent generative AI platforms—OpenAI's ChatGPT Deep Research and Google's NotebookLM—to assess their efficacy in supporting postgraduate dental learning.

Methodology: Employing a descriptive, narrative-based analytical approach, this study simulated realistic postgraduate endodontic tasks using structured educational scenarios. ChatGPT Deep Research was tasked with autonomously synthesizing web-based literature to address a clinical inquiry concerning endodontic treatment outcomes. NotebookLM was evaluated in a simulated revision scenario, where a postgraduate student had already collected relevant research papers on endodontic irrigation, aiming to use NotebookLM for efficient review and synthesis of this topic.

Results: Results demonstrated distinct educational strengths inherent to each tool. ChatGPT Deep Research produced comprehensive, logically structured reports, facilitating critical thinking, literature appraisal, and evidence-based decision-making. Its autonomous, exploratory capabilities closely mirrored the clinical reasoning process crucial for postgraduate learners. NotebookLM excelled in organising and visually representing complex academic information through structured summaries, interactive mind maps, and multimodal outputs, effectively catering to diverse learning preferences and enhancing knowledge retention.
Both tools have the potential to significantly enhance learner autonomy, support evidence-based practice, and provide robust frameworks for self-directed study, though each showed specific limitations in source reliability and context scope. Their complementary functionalities suggest substantial potential when strategically integrated into endodontic curricula.

Conclusions (mandatory): The study concludes that generative AI tools, exemplified by ChatGPT Deep Research and NotebookLM, offer transformative opportunities to enrich postgraduate endodontic education.

EDP004 | THE USE ON A NEWLLY DESIGNED 3D PRINTED MODEL FOE ENDODONTIC EDUCATION IN PRECLINICAL DENTAL STUDENTS

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AIM: This study aimed to create a 3D-printed model for endodontic education, addressing the challenges of traditional teaching methods.

Methodology: To provide a correct teaching experience, the jaw-like model was designed to accommodate extracted teeth, support the use of EALs, and the possibility to be mounted to the phantom. In that way, pre-clinical students could work on an endodontic treatment in indirect vision and place the treated tooth in the correct position in the mouth. Isolation, access cavity, electronic working length measurement, chemomechanical preparation, and obturation were performed with the tooth mounted in the phantom.
Students evaluated the use of the model during their preclinical course. A questionnaire was filled out about the device's usefulness during each endodontic step, from isolation to root canal obturation.

Results:
Preliminary results showed positive student feedback (76% positive), indicating the model's effectiveness in preparing students for clinical practice. The full results will be available at the end of March when all questionnaires will be available.

Conclusions (mandatory): The 3D-printed model developed in this study significantly enhanced student practice during their preclinical endodontics course. It allowed them to replicate real treatment conditions, including isolation, electronic measurement, and indirect vision throughout the treatment process.

EDP005 | DENTAL TRAUMA MANAGEMENT IN PRIMARY DENTAL CARE – PERCEPTIONS AND CONFIDENCE OF DENTAL FOUNDATION DENTISTS AND EDUCATIONAL SUPERVISORS IN WALES

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AIM: Self-reported knowledge and confidence of Dental Foundation Trainees (DFs) and their Educational Supervisors (ESs) in managing dental trauma has not been previously explored in Wales. The aim of this project was to investigate the self-reported perceptions and confidence in dental trauma management by DFs and ESs across Wales.

Methodology: A prospective cross-sectional survey of DFs (n=68) and ESs (n=86) across Wales, United Kingdom, was performed between January and July 2024. Digital questionnaires were created and split into 3 sections, teaching received at dental school, preparedness for dental trauma management, and respondents' demographics. Data was collected on self-reported perceptions and confidence for both cohorts in the management of dental trauma, and relevant dental trauma teaching received at dental school. ESs were additional asked about their confidence and preparedness to supervise their DFT managing dental trauma. Responses were anonymised analysed with reporting of descriptive statistics. Confidence and perceptions were measured using a 5-point Likert Scale with 1 = least confident/agreement and 5 = most confident/agreement according to different statements presented.

Results: Forty-three responses were obtained resulting in a combined response rate of 27.9% with 18 DFs (26.5%) and 25 ESs (29.1%) responding. Confidence was overall higher in ES group (69%) compared with DFs (34%). Both cohorts reported the most confidence in managing crown fractures, soft tissue injuries and avulsions, and the least confidence managing alveolar bone fracture injuries. ESs (78%) reported high level of confidence in supervising DFs managing dental trauma cases, particularly for crown fractures, soft tissue injuries, and avulsion. Both cohorts recognised a requirement for further education in dental trauma management.

Conclusions (mandatory): DFs were overall underconfident in management of dental trauma whilst ESs reported higher confidence in both management and supervision of similar dental trauma cases. A new training initiative was therefore identified for all DFs and ESs in Wales.

PAUL DUMMER RESEARCH AWARD COMPETITION

R057 | RISK FACTORS FOR FURTHER INTERVENTIONS OF ROOT FILLED TEETH IN A LONG-TIME PERSPECTIVE – A SWEDISH REGISTRY STUDY

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AIM: To investigate tooth survival after root canal treatment (RCT) and to analyse factors associated with extraction in the Swedish adult population over 11–12 years.

Methodology: Searches for all registrations of treatment codes of RCT to the government agency SSIA (Swedish Social Insurance Agency) during 2009 formed the cohort of individuals followed in the registry until the end of 2020. For individuals with several RCTs, only the first registered tooth was included in the analyses. Sex, age, tooth type and registrations of further treatments such as coronal restorations and post and cores were obtained from SSIA. Kaplan-Meier survival and multivariable logistic regression analyses were used and $p < 0.05$ was considered statistically significant.

Results: A total of 215,611 individuals with at least one RCT were registered in 2009. During the follow-up period 43,238 teeth were extracted, resulting in a tooth survival of 79.9% over 11-12 years. Logistic regression analysis found significant association for all variables except sex ($p = 0.853$). The highest odds ratio (OR) for extractions were associated with the type of restoration: teeth with composite filling and post and core (OR = 2.61; 95% CI 2.16-3.16; $p < 0.001$) and teeth with composite crown combined with post and core (OR = 2.48; 95% CI 1.88-3.27; $p < 0.001$) were more likely to undergo extraction compared to teeth with an indirect restoration without any post and core (reference).

Conclusions (mandatory): Overall, root-filled teeth had a tooth survival of approximately 80% over 11-12 years and high OR for extractions were associated with type of restoration, more specifically composite restorations. In summary, after RCT in the Swedish adult population, several individual- and tooth-specific variables were associated with extraction.

Acknowledgements (optional): Grants from the Swedish Dental Society and the Public Dental Service in Region Örebro County.

R137 | SMARTER SCORING: AI VS EXPERTS IN DIAGNOSING APICAL PERIODONTITIS

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AIM: The study aimed to (1) train an Artificial Intelligence (AI) model to score periapical index (PAI) on radiographs, and (2) to compare AI based scoring with human evaluators.

Methodology: For AI training, 9023 radiographs from endodontically treated teeth at the Department of Endodontics, University of Oslo from 2008 until today, were PAI scored and annotated with apex locations by a calibrated human evaluator. These data were used to train an EfficientNet B3 convolutional neural network (CNN).
A set of 100 digital periapical radiographs, with equal distribution across all five PAI categories, was obtained by a panel of experts. AI scoring was then tested on the 100-image set and compared to scores from 10 human elevators (scored twice five days apart). Agreement was calculated by using weighted kappa statistics. The radiographs were evaluated using PAI and classified as healthy (PAI=1-2) or not healthy (PAI=3-5). Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) were calculated from the new set of radiographs and compared between human evaluators and the AI model.

Results: Weighted kappa for the AI model was 0.70 compared to 0.81 for human evaluators. The AI sensitivity was 100%, specificity 72%, PPV 75% and NPV 100%. In comparison, humans achieved sensitivity of 91%, specificity 95%, PPV 92% and NPV 94%.

Conclusions (mandatory): AI-based scoring of periapical radiographs using CNN model achieved results comparable to human experts. This supports AI's future role as a reliable and scalable tool for radiographic evaluation in endodontics, particularly when large datasets are involved.

R152 | THE EFFECTIVENESS OF TREATMENTS OF TEETH WITH EXTERNAL RESORPTIONS – A REGISTER-BASED STUDY ON TOOTH SURVIVAL

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AIM: The aim of this study was to assess the survival of teeth with external root resorption after treatments aimed at salvaging them in routine clinical settings using a register.

Methodology: Data were extracted from the Swedish National Dental Health Register, encompassing all adult patients (>19 years old) registered with at least one tooth affected by external resorption between 2009 and 2018. Patients with multiple affected teeth were included, but only one tooth per patient was selected to ensure the independence of observations. Wisdom teeth were excluded. The included teeth were followed through the database over time until terminal events occurred: extraction or a proxy event for extraction (e.g., a pontic in the same tooth position or an implant). Observations were censored if the patient died, emigrated, or reached the end of the study period (December 2023). Survival analyses were performed to evaluate tooth survival.

Results: A total of 14,881 individuals (and teeth) were identified with a registered resorption. Of those teeth, 6,366 (42.7%) were extracted as the first treatment, while 8,515 underwent treatments aimed at salvaging the tooth. Among the salvaged teeth, 2,026 (23.8%) were eventually extracted. The estimated 10-year and 15-year survival rates were 74.9% (95% CI: 73.9%, 75.9%) and 67.8% (95% CI: 63.7%, 71.9%), respectively. The first year after treatment had the highest rate of extractions, at 5.5%. During the observation period, 6 individuals emigrated, and 1,165 died before the study concluded.

Conclusions (mandatory): The results suggest that treatments aimed at salvaging teeth with registered external resorption have favourable outcomes in terms of tooth survival. However, these findings should be interpreted with caution.

Acknowledgements (optional): This project was funded by the Region Norrbotten (NLL-981599).

R160 | LEVELS OF NEUTROPHIL EXTRACELLULAR TRAPS IN PULPAL BLOOD OF MATURE PERMANENT TEETH WITH SYMPTOMATIC PULPITIS: A PROSPECTIVE COHORT STUDY

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AIM: To estimate and compare the concentration of neutrophil extracellular traps (NETs) in the pulpal blood of mature permanent teeth undergoing pulpotomy in cases of symptomatic reversible and irreversible pulpitis.

Methodology: A total of 40 healthy adults (>18 years) with extremely deep carious lesions in mandibular molars were divided into two groups: Group I (Reversible Pulpitis, n=20) and Group II (Symptomatic Irreversible Pulpitis, n=20). Additionally, a control group (Group III, n=5) included non-carious teeth indicated for intentional root canal treatment due to prosthodontic or orthodontic needs. Pulpal blood samples (~100 µU/ml) were collected immediately after accessing the pulp chamber under rubber dam isolation and transferred to an Eppendorf tube. Following sample collection, full pulpotomy was performed in Groups I and II, with a 2–3 mm calcium silicate material applied over the pulp, followed by permanent restoration. In the lab, blood samples were centrifuged (400 × g, 10 min, room temperature), and plasma was stored at -80°C. Plasma samples were then diluted, treated with NETosis assay kit (Abcam, Cambridge, UK) reagents, and analysed in duplicates using colorimetric enzyme-linked immunosorbent assay (ELISA) at a 1:100 plasma dilution to quantify NET levels (Neutrophil elastase levels in µU/ml). Statistical analyses were performed using STATA 18 (StataCorp LLC, TX 77845, US).

Results: The mean elastase activity, a key marker of NETosis, was highest in symptomatic irreversible pulpitis, followed by reversible pulpitis, and lowest in healthy controls. However, the difference was not statistically significant ($p > 0.05$).

Conclusions (mandatory): Within the limitation of the study, pulpal NETosis levels may serve as a potential biomarker for distinguishing different grades of pulpitis. However, larger sample sizes are needed to confirm these findings and evaluate their correlation with pulpotomy outcomes.

Acknowledgements (optional): This research is funded by the institute thesis grant (1-2/JR-SR-Thesis/2023/RS)

R176 | A CLINICAL APPROACH USING TEETH ALREADY SCHEDULED FOR EXTRACTION TO VALIDATE AN IN VITRO METHOD TO ASSESS THE PERFORMANCE OF THE EALS

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AIM: This study aimed to validate a commonly used in vitro methodology of testing the performance of the EALs. For that, teeth already scheduled for extraction and micro-CT technology were used in the validation process of the in vitro method. As a secondary aim, the accuracy and precision of the Root ZX II apex locator were assessed in both clinical and laboratory settings.

Methodology: In a clinical setting, the working length of 11 root canals already scheduled for extraction was established using the Root ZX II apex locator. Subsequently, these teeth were extracted and scanned with the file in place using micro-CT technology to determine the real canal length. The working length of the extracted teeth was thus obtained through the alginate in vitro model. Datasets were co-registered, and the accuracy and precision of both in vivo and in vitro measurements were compared by determining the distance from the file tip to a tangential line crossing the major foramen margins. Statistical comparisons were performed using Friedman post hoc Related Samples Sign and Bland-Altman tests with a significance level set at 5%.

Results: Statistical analysis revealed no significant difference between the accuracy ($P = 0.368$) and precision ($P = 0.761$) measurements obtained in both in vivo and in vitro conditions. Additionally, the Bland-Altman analysis revealed an agreement between in vivo and in vitro ($P > 0.05$).

Conclusions (mandatory): The agreement between in vivo and in vitro readings validated the alginate model to test the EALs in the lab setting. The Root ZX II apex locator demonstrated comparable accuracy and precision in determining the position of the apical foramen in both clinical and laboratory settings.

RESEARCH POSTERS 01

R001 | ENAMEL MATRIX PROTEIN PROMOTE THE MINERALIZATION OF HUMAN DENTAL PULP CELLS

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AIM: This study investigates enamel matrix proteins (EMD), which promotes cell adhesion, proliferation, and differentiation in periodontal regeneration, for its potential application in regenerating the pulp-dentin complex.

Methodology: Cell viability was measured using the WST-8 assay. A scratch wound was made on a monolayer of HDPCs, and the cells were treated with EMD. Cell migration was measured after 24 hours. HDPCs treated with EMD underwent RNA extraction for cDNA synthesis and gene expression analysis. Cells treated with EMD were stained to assess mineralization. Statistical analysis was conducted Tukey's multiple comparison test using Prism 5.0, with a significance level set at $p<0.05$.

Results: EMD treatments showed no significant cytotoxicity toward HDPCs, indicating low toxicity. A scratch wound assay revealed a 13% increase in migration at 50 μM EMD compared to the control. Gene expression levels of DSPP and DMP1 were increased in experimental groups compare to control. However, there were no significant differences. Alkaline phosphatase (ALP) and Alizarin Red-S (ARS) staining showed enhanced mineralization in EMD-treated cells.

Conclusions (mandatory): EMD promotes mineralization in HDPCs. This result highlights the potential role of EMD in dental pulp regeneration.

Acknowledgements (optional): This study was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIP) (Nos. RS-2022-NR069575 and RS-2022-NR070738).

R002 | PARATHYROID HORMONE-CONDITIONED DENTAL PULP STEM CELLS AND GROWTH FACTOR RELEASE: AN IN VITRO STUDY

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AIM: Dental pulp stem cells (DPSCs) are gaining attention in regenerative medicine therapies because of their multipotent capabilities, which allow them to differentiate into various cell types and tissues. This presents potential applications for enhancing overall quality of life. Research has demonstrated that parathyroid hormone (PTH) stimulates the expression of matrix metalloproteinase-13 (MMP-13), a protein essential for bone formation and remodelling. MMP-13 is linked to tooth development through the Wnt signalling pathway, which promotes increased expression of RUNX2 and miR-873-3p (a microRNA sequence with a role in bone remodelling). Consequently, the PTH-DPSCs signalling pathway may enhance the differentiation of DPSCs during dentinogenesis. This study aims to investigate the expression of MMP-13, miRNA and related mineralization gene expressions in the presence of PTH.

Methodology: DPSCs and dental pulp fibroblasts were co-cultured and treated with parathyroid hormone (PTH) at a concentration of 10-8M, along with control groups. Samples were collected at various time points: 0hrs, 1hr, 2hrs, 4hrs, 8hrs, and 24hrs. Cell media was gathered to analyse MMP-13 activity using an MMP-13 activity assay. Additionally, cell lysates were collected, purified, and amplified for analysis using quantitative PCR (qPCR). Runx2, MMP-13, and miR-873-3p expressions were measured and tabulated.

Results: A time course curve was observed for the markers MMP-13 and RUNX2, showing that their gene expression peaked at 4 to 8 hours and then decreased with longer incubation times. The MMP-13 activity assay also revealed a similar pattern, with peak activity in the PTH group occurring at 4 to 8 hours.

Conclusions (mandatory): The relationship between osteoblastic and odontoblastic signalling pathways was observed through the addition and regulation of PTH. The identification of a new pathway for gene expression that may be more predictable was established. This research aims to enhance our understanding of complete pulp regeneration and support future tissue engineering efforts.

R003 | OPTIMIZATION AND EVALUATION OF A THREE-DIMENSIONAL PULP CELLULAR MODEL SUPPLEMENTED WITH BONE MORPHOGENETIC PROTEIN-7 FOR REGENERATIVE ENDODONTICS

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AIM: The tissue engineering triad- comprising scaffolds, stem cells, and growth factors- has played a crucial role in advancing regenerative endodontics, aiming to gain neurogenesis for pulp function. However, the optimal materials for each component remain undetermined. Bone morphogenetic protein-7 (BMP-7) enhances the cell viability and is crucial in signaling pathway for neural differentiation with dose-dependent effect. To improve understanding of regenerative strategies especially in neurogenesis, this study aimed to develop and optimize a novel three-dimensional pulp cellular model and evaluate its histological characteristics and cell viability following supplementation with BMP-7.

Methodology: Human dental pulp stem cells (hDPSCs) were isolated from the healthy human pulp and expanded to passage 5. Human platelet-rich plasma (PRP) was obtained via a two-step centrifugation process, subsequently hDPSCs were seeded and polymerized using calcium chloride. The engineered tissues formed were cultured in six different media conditions: Knockout Dulbecco's Modified Eagle Medium (KO-DMEM) as positive control, KO-DMEM supplemented with 25 ng/ml BMP-7, KO-DMEM supplemented with 50 ng/ml BMP-7, Neurobasal-A Medium (NAM) as neural differentiation media control, NAM supplemented with 25 ng/ml BMP-7, and NAM supplemented with 50 ng/ml BMP-7. Cell viability was assessed at Day 0, 7, and 14 using the AlamarBlue assay, while histological analyses were performed on Day 0 and 14.

Results: Histological evaluation at Day 14 revealed distinct morphological changes, with cells exhibiting an elongated, spindle-like morphology and spatial organization. Tissues supplemented with 25 ng/ml BMP-7 demonstrated central cell aggregation with darkly stained nuclei. Cell viability was maintained over 14 days in KO-DMEM, with a trend of higher viability observed in BMP-7-supplemented conditions. Conversely, tissues cultured in NAM exhibited significantly reduced viability, irrespective of BMP-7 supplementation.

Conclusions (mandatory): The viability of the engineered pulp model is maintained with KO-DMEM, with BMP-7 at 25 ng/ml enhancing cellular organization and survival. However, NAM was less conducive to cell viability.

R004 | ASSESSMENT OF DECELLULARIZED HUMAN DENTAL PULP AS A POTENTIAL NATURAL SCAFFOLD FOR REGENERATIVE ENDODONTICS

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AIM: Decellularized human dental pulp (DHDP) retains the extracellular matrix and acts as a natural structured scaffold for stem cell attachment, proliferation and proangiogenic marker binding. Subtle variations in the scaffold's physical properties can influence cellular behaviours and, consequently, its regenerative potential. This study evaluates DHDP as a potential scaffold by assessing its histology, morphology, physical properties, and cytotoxicity.

Methodology: Human dental pulp (HDP) was harvested from extracted sound teeth and subjected to a decellularization process to obtain DHDP. Both HDP and DHDP were fixed in 10% formalin for histological analysis, including haematoxylin and eosin (H&E) and 4,6-diamidino-2-phenylindole (DAPI) staining, while 10% glutaraldehyde fixation was used for morphological evaluation via scanning electron microscopy (SEM). Physical properties were assessed by measuring 24-hour water absorption and degradation rates over 7, 14, and 21 days. Cytotoxicity was determined following ISO guidelines by collecting DHDP leachate and evaluating stem cell viability using the MTT assay, with culture media as the control at 72 hours.

Results: Histological and morphological analyses confirmed the complete decellularization of DHDP, as evidenced by the absence of nuclei. The scaffold exhibited favourable physical properties, with a water absorption rate of 77.2% and degradation rates of 20.27%, 30.83%, and 40.19% over 7, 14, and 21 days, respectively. The MTT assay showed a stem cell viability of 89.6%, exceeding the 70% threshold, confirming the non-cytotoxic nature of DHDP.

Conclusions (mandatory): DHDP shows potential as a biocompatible scaffold for regenerative endodontics through cell transplantation, supporting its further investigation in tissue engineering application.

R005 | ENHANCE THE OSTEOGENIC DIFFERENTIATION OF MESENCHYMAL STEM CELLS USING EXTRACELLULAR MATRICES

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AIM: Extra cellular matrices (ECM) is a complex network of fibrillary proteins and growth factors, which is important to regenerate the complex tooth structure in regenerative endodontics. Due to these properties, cultured cell-derived ECM has been widely used as a scaffold in tissue engineering to create a biometric environment that provides physical, chemical, and mechanical signals to support cell adhesion, proliferation, migration, and differentiation. This study aims to investigate the osteogenic differentiation of mesenchymal stem cells using ECM derived from cultured human dental pulp cells (hDPCs) as a scaffold in regenerative endodontics.

Methodology: ECM was decelluarized using Triton X solution and prepared as a decelluarized extra cellular matrices (dECM) scaffold. dECM was reseeded in mesenchymal stem cells to test biocompatibility of dECM. Cell metabolic activity was tested using WST assay. Osteogenic differentiation assay was performed by ALP staining and qRT-PCR.

Results: WST assay showed up-regulated metabolic activity of dECM seeded mesenchymal stem cells. Also, osteogenic differentiation and osteogenic gene expression was increased by seeding dECM. These results indicate that dECM enhances cell regeneration of mesenchymal stem cells.

Conclusions (mandatory): Using cultured cell-derived extracellular matrices as a scaffold enhances the cell metabolic activity and osteogenic and angiogenic differentiation of human dental pulp stem cells. dECM can be a promising strategy to regenerative endodontics.

Acknowledgements (optional): This study was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIP) (Nos. RS-2022-NR069575 and RS-2022-NR070738).

R006 | EFFECTS OF CANNABIDIOL ON HUMAN APICAL PAPILLA CELLS: A POTENTIAL APPLICATION IN REGENERATIVE ENDODONTICS

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AIM: The study aims to evaluate the effects of cannabidiol (CBD) on the proliferation of human apical papilla cells (hAPCs) and investigate the expression of cannabinoid receptors (CB1, CB2) and inflammatory markers (IL-6, TNF-α, IL-1β).

Methodology: hAPCs were isolated and treated with CBD at various concentrations (0.125–16 μM). Cell proliferation was assessed using the alamarBlue® assay at 24, 48, and 72 hours. The expression of CB1 and CB2 receptors, as well as inflammatory markers (IL-6, TNF-α, IL-1β), was analyzed using RT-PCR. Statistical analysis was performed using one-way ANOVA with Tukey's post-hoc test or the Kruskal-Wallis test, with a significance level of $p < 0.05$.

Results: Low concentrations of CBD tended to enhance hAPC proliferation. RT-PCR confirmed the expression of CB1 and CB2 receptors in hAPCs. Additionally, CBD treatment influenced the expression of inflammatory markers (IL-6, TNF-α, IL-1β).

Conclusions (mandatory): CBD promotes hAPC proliferation and modulates cannabinoid receptor expression, suggesting a potential mechanism for its effects in regenerative endodontics. Moreover, CBD influences inflammatory responses. Further studies are needed to elucidate the underlying signaling pathways.

Acknowledgements (optional): This study was supported by the Chiang Mai University PhD Student Research Grant.

R007 | FRACTURE RESISTANCE OF SIMULATED IMMATURE TEETH FOLLOWING REGENERATIVE ENDODONTIC PROCEDURES: AN IN VITRO CYCLIC LOADING STUDY

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AIM: This in vitro experimental study was designed to evaluate the fracture resistance of immature teeth following regenerative endodontic treatment in different simulated healing stages. More specifically, this experimental model investigated the effect of apical closure or combination of apical closure and wall thickening in reinforcement of simulated immature teeth treated with regenerative endodontic procedures.

Methodology: Seventy-five freshly extracted maxillary central incisors were instrumented to simulate different stages of healing after regenerative endodontic treatment and randomly divided into five groups. Group 1: completely immature teeth, Group 2: teeth with apical closure at early healing stages, Group 3: teeth with apical closure and wall thickening at later healing stages, Group 4: intact teeth as negative controls, and Group 5: simulated immature teeth without treatment, representing positive control group. All samples were tested with a cyclic loading device. Fracture resistance was evaluated using the step-stress technique. Number of cycles to failure and the final load to failure, were recorded for subsequent analysis. The Kruskal-Wallis test, followed by Dunn's post-hoc test was used to compare fracture resistance, cyclic load, and forces of the five groups.

Results: The lowest fracture resistance was recorded for positive control and the highest for negative control, followed by completely immature (Group 1), those of apical closure (Group 2) and apical closure wall thickening (Group 3). Kruskal-Wallis H test showed that there was a statistically significant difference in fracture resistance between the different groups of revascularized teeth ($p < 0.001$).

Conclusions (mandatory): Results from the current study highlight that the thickening of the dentinal walls, with or without apical closure, affects the fracture resistance of the tooth. This may be utilized to improve the treatment planning of these teeth and increase their life expectancy.

R008 | AN IN VITRO TUBE MODEL FOR CELL BIOCOMPATIBILITY STUDY OF CAPPING MATERIALS

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AIM: Cell-based pulp regeneration uses capping materials and a final restoration to seal the canal after cell delivery. Assessing the immediate cellular response to these materials is difficult in vivo. This study aimed to use a transparent in vitro tube model to evaluate the biocompatibility of commonly used capping materials in direct contact with dental pulp cells.

Methodology: Plastic tubes (14 mm long, 2 mm apical opening) simulating root canals were filled with fibrin gel containing fluorescence-labeled human dental pulp stem cells (DPSCs). The coronal end was sealed with one of the following: freshly mixed mineral trioxide aggregate (MTA), Biodentine, hydroxyapatite–tricalcium phosphate (HA-TCP) mixed with fibrin gel, composite resin, or glass ionomer cement (GIC). Tubes were cultured in 12-well plates and observed microscopically for cell morphology. Cell viability was assessed using the Alamar Blue assay. The pH inside the tubes was measured using pH strips and microelectrodes. Statistical analysis was conducted via one-way ANOVA with post hoc testing ($p < 0.05$).

Results: Fresh MTA and Biodentine caused strong cytotoxicity, with surviving cells found only apically. Composite and GIC were better tolerated, especially in the middle and apical regions. HA-TCP/fibrin gel showed the best cell compatibility and viability. However, adding HA-TCP/fibrin as a buffer layer beneath MTA or Biodentine did not prevent cell damage. High pH values (>11) measured in MTA and Biodentine tubes correlated with poor cell survival.

Conclusions (mandatory): The transparent tube model enables direct observation of pulp cell responses to capping materials. HA-TCP/fibrin gel demonstrated superior biocompatibility, while freshly mixed MTA and Biodentine were cytotoxic due to high initial alkalinity.

Acknowledgements (optional): This study was supported by institutional research funds. The authors declare no conflicts of interest.

R009 | KNOWLEDGE AND MANAGEMENT OF DENTAL TRAUMA BY GREEK SCHOOL NURSES: A QUESTIONNAIRE BASED CROSS-SECTIONAL STUDY.

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AIM: The purpose of the present study is to evaluate Greek school nurses' level of knowledge and attitudes regarding management of traumatic dental injuries (TDIs).

Methodology: A cross-sectional descriptive study was conducted in Greece among 136 school nurses using an electronic multiple-choice questionnaire. The questionnaire inquired about demographic characteristics, working experience and knowledge of first-aid management of tooth fracture, lateral luxation and avulsion injuries by using clinical case scenarios. Data was analyzed using chi-square tests to identify differences and logistic regression analysis was employed to determine the factors influencing decision-making.

Results: 136 questionnaires were evaluated. Most of the participants worked less than 5 years as school nurses (77,2%). Though almost all the participants were interested in getting informed about dental trauma, less than 35% of them have attended an oral health education course in trauma training. Half of them (57.4%) had experienced once a dental trauma case at school. In the case of crown fracture, 76.5% of the respondents indicated that the tooth was permanent, a decision directly related to dental trauma training. Regarding lateral luxation, calling the child's parents was the first option and referring to a dentist was the next most common choice. However, only 3.7% of them would try to reposition the teeth into place. In the case of avulsion injury, although replantation was the most preferred option, only 14% would procced to immediate onsite management and perform tooth replantation in the accident place. 22.1% of the respondents would replant the avulsed tooth within 15 minutes and normal saline was the preferred transport medium. DT training was found to be related with the replantation decision for placing the tooth into its place.

Conclusions (mandatory): School nurses should be specially trained to manage TDIs, providing first aid and reducing the time needed and improving the prognosis of traumatized teeth.

R010 | HANK'S BALANCED SALT SOLUTION SUPPLEMENTED WITH L-ASCORBIC ACID INHIBITS MMP1 AND ENHANCES COLLAGEN 1A1 EXPRESSION IN PERIODONTAL CELLS OF EXTRACTED TEETH

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AIM: The viability of periodontal ligament fibroblasts (PDLFs) is critical for the successful replantation of avulsed teeth. Although storage media such as Hank's Balanced Salt Solution (HBSS) and Save-A-Tooth have been widely used, their practicality and effectiveness remain suboptimal. Previous research has predominantly focused on cell viability, overlooking key molecular changes affecting periodontal healing. Matrix metalloproteinases (MMPs), particularly MMP1, contribute to extracellular matrix degradation, while collagen 1A1 (COL1A1) is essential for structural integrity and tissue repair. This study investigates the effects of HBSS supplemented with L-ascorbic acid on the gene expression of MMP1 and COL1A1 in PDLFs to enhance preservation strategies for avulsed teeth.

Methodology: Sound premolars (n=6) extracted for orthodontic purposes were collected and exposed to three different storage conditions: HBSS (negative control), HBSS with L-ascorbic acid (intervention), and Dulbecco's Modified Eagle Medium (DMEM) (positive control) for 24 hours. Cell viability was assessed using the AlamarBlue assay. The gene expression of MMP1 and COL1A1 in PDLFs was analysed via reverse transcriptase-quantitative polymerase chain reaction.

Results: HBSS supplemented with L-ascorbic acid maintained PDLFs' viability comparable to DMEM and standard HBSS. Notably, the intervention group demonstrated a significant downregulation of MMP1 expression and an upregulation of COL1A1 expression compared to the HBSS control.

Conclusions (mandatory): All tested storage media effectively preserved PDLFs' viability. However, the addition of L-ascorbic acid to HBSS significantly enhanced COL1A1 expression while suppressing MMP1 activity, suggesting improved periodontal healing potential. Therefore, HBSS supplemented with L-ascorbic acid may serve as a superior alternative to conventional HBSS for avulsed tooth preservation.

R011 | EFFECTS OF A SYNTHETIC FUNCTIONAL PEPTIDE ON TOOTH REPLANTATION OUTCOMES: A CANINE MODEL STUDY

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AIM: The aim of this study is to evaluate the effects of CPNE7-derived peptide as a storage medium component and a root surface treatment agent on histological outcomes following tooth replantation in a canine model.

Methodology: Six adult beagle dogs (total of 24 premolars, 8 per subject) underwent hemi-sectioning of premolars after endodontic treatment. Each hemisectioned root was extracted and subjected to one of four conditions based on clinically relevant extraoral dry time and storage conditions:
(1) Immediate replantation (ideal condition), (2) Soaking in storage medium (PBS or CPNE7, 1 mg/mL) for 30 min (moderate condition) or 60 min (clinical threshold), (3) Air-dried for 30 min or 60 min before replantation (poor prognosis condition). These time points were selected based on previous studies indicating that periodontal tissue viability declines sharply after 20 minutes of extraoral time, with 60 minutes being a critical clinical threshold for tooth replantation. Teeth were stabilized using semi-rigid wire splinting and monitored for 8 weeks. After euthanasia, histological evaluation of PDL regeneration, cementum formation, and alveolar bone resorption was performed.

Results: Histological analysis revealed that CPNE7-treated groups exhibited favorable outcomes, including enhanced cementum formation and more organized periodontal ligament fiber arrangement. Notably, cases of functional root integration with the alveolar bone were observed, suggesting that CPNE7 may contribute to improved stabilization of replanted teeth. Additionally, structural adaptations such as bone remodeling were noted in certain specimens, further indicating the potential of CPNE7 in facilitating long-term retention.

Conclusions (mandatory): CPNE7 peptide demonstrates promising potential in promoting favorable healing following tooth replantation, particularly by supporting cementum deposition and structural integration. The findings suggest that CPNE7 may contribute to improving the biological adaptation of replanted teeth, offering insights into its application in endodontic procedures. Further studies are needed to optimize its clinical use and evaluate long-term functional outcomes.

R013 | EVALUATION OF IMMUNOEXPRESSION OF PRO-INFLAMMATORY CYTOKINES AND BIOMARKERS OF BONE ACTIVITY IN PERIAPICAL LESIONS OF SICKLE CELL ANEMIA PATIENTS

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AIM: To compare the expression of pro-inflammatory cytokines (IL-6, TNF- alpha, IL-12) and chemical mediators involved in the regulation of osteoclastogenesis (RANKL, OPG) between periapical lesions (PL) of individuals with sickle cell anemia (SCA) and controls (C).

Methodology: 40 PL (20 SCA and 20 C) were collected from teeth with primary endodontic infection. Silanized slides containing paraffin sections were used to perform immunohistochemical reactions. Image analysis was performed using an optical microscope, and each slide was subdivided into 5 high-magnification fields. Values (0-2) were assigned to each field, according to the number of positive markings for the antibody. The data were analyzed considering a p value < 0.05 as statistical significance.

Results: The qualitative evaluation revealed a predominance of weak to moderate and strong marking in the SCA group: IL-6 (91%); IL-12 (91%); OPG (92%); RANKL (91%); TNF- alpha (85%). In group C, there was a predominance of focal and weak to moderate staining: IL-6 (100%); IL-12 (100%); OPG (89%); RANKL (96%); TNF- alpha (78%). Quantitative analysis revealed greater immunoexpression of cytokines in the SCA group when compared to C (RANKL: $p = 0.0004$; OPG: $p = 0.0007$; IL-6: $p = 0.0025$; TNF- alpha: $p = 0.0145$; IL-12: $p = 0.0283$). RANKL and IL-6 were the cytokines with the highest expressions in the SCA group (RANKL x OPG: $p = 0.0161$, RANKL x IL-12: $p = 0.0455$, IL-6 x OPG: $p = 0.0378$) and RANKL in the C (RANKL x OPG: $p = 0.0303$).

Conclusions (mandatory): The PL of patients with SCA showed higher immunoexpressions of all inflammatory markers evaluated when compared to group C.

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R014 | METALLOMIC CHARACTERISATION OF INDUCED PERIAPICAL LESIONS – IN VIVO STUDY

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AIM: Metals are essential to metabolism and play a crucial role in biological functions. However, the metallographic differences between apical periodontitis and healthy conditions remain unexplored.

Methodology: This study analyzed 76 lower first molars from 38 Wistar rats, comparing periapical lesions and controls (sham). Lesions were induced by pulp exposure, allowing spontaneous infection. After 40 days, animals were reweighed, euthanized, and their hemimandibles analyzed using periapical radiography, histology, micro-computed tomography (μ-CT), X-ray fluorescence microscopy (XRF), scanning electron microscopy with energy dispersive spectroscopy (SEM/EDS), inductively coupled plasma optical emission spectrometry (ICP-OES), and inductively coupled plasma mass spectrometry (ICP-MS). Ten essential metals were assessed (sodium, potassium, magnesium, calcium, iron, manganese, cobalt, copper, zinc, and molybdenum). Analyses were conducted with a 5% significance level.

Results: Radiographic analysis confirmed the induction of periapical lesions, without difference in animal weight between the conditions ($p > 0.05$). Histologically, the periapical lesions showed intense inflammatory infiltrate, cells with bluish cytoplasmic granules, alveolar resorption, and scores ranging from moderate to intense. The μ-CT analysis of the induced lesion revealed a significant difference in the periapical region volume (12.74 mm^3, $p = 0.0017$). SEM/EDS showed limited sensitivity for the investigated chemical elements; however, XRF identified diminished intensities for calcium and zinc and increased intensities for iron. ICPs identified increased concentrations of sodium ($p = 0.0137$), potassium ($p = 0.0005$), calcium (0.0059), magnesium ($p = 0.0004$), iron ($p < 0.001$), 56iron ($p = 0.0078$), 57iron ($p = 0.0315$), and manganese ($p < 0.001$) within the induced periapical lesion, suggesting a direct impact on mineral homeostasis following this pathology.

Conclusions (mandatory): These findings demonstrate, for the first time, mineral profile changes in periapical lesions, emphasizing the need for therapeutic or diagnostic approaches to restore mineral homeostasis. Smart metallic-content technology for endodontic materials and diagnostics is desirable.

Acknowledgements (optional): The São Paulo Research Foundation FAPESP 2022/03093-9

R015 | EXPRESSION OF S100A GENES IN HUMAN DENTAL PULP STEM CELLS FOLLOWING STIMULATION WITH TWO HYDRAULIC CALCIUM SILICATE CEMENTS

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AIM: S100A proteins play crucial roles in various cellular processes, including differentiation, proliferation, host defence, and regeneration. Hydraulic calcium silicate cements (hCSC) are widely used in vital pulp therapy (VPT), where these processes are highly relevant. This study aimed to evaluate the effects of two standard hCSCs on the expression of S100A genes in human dental pulp stem cells (hDPSCs).

Methodology: The expression levels of thirteen S100A genes (S100A1/-A2/-A3/-A4/-A6/-A7/-A8/-A9/-A10/-A11/-A13/-A14/-A16) in hDPSCs were analysed following stimulation (24 h and 72 h) with different concentrations (0.002, 0.02, and 0.2 mg hCSC/ml) of two hCSCs (ProRoot®MTA and Biodentine®) in cell culture medium. Quantitative polymerase chain reaction (qPCR) was used for gene expression analysis. IL-1β (10 ng/ml) and dexamethasone (100 nM) were employed as controls for inducing inflammatory responses and promoting odontoblastic differentiation, respectively. Differential gene expression was assessed relative to unstimulated controls using Student´s t-test ($p<0.05$).

Results: After 24 h, a significant downregulation of multiple S100A genes was observed, with a more pronounced effect in the ProRoot®MTA group. After 72 h, gene expression levels either returned to baseline or were significantly upregulated. The most notable effects after 72 h were observed in the lowest concentration of Biodentine® (S100A2, -A4, and -A13) and the highest concentration of ProRoot®MTA (S100A2, -A3, -A10, -A11, -A13, and -A16).

Conclusions (mandatory): S100 proteins appear to be involved in the proliferative and regenerative processes following hydraulic calcium silicate cement application during vital pulp therapy.

Acknowledgements (optional): The authors declare that there is no conflict of interest.

R016 | CHRONIC INFLAMMATION IN THE DENTAL PULP OF MARFAN SYNDROME MOUSE MODEL FBN1 C1041G+/-

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AIM: To study inflammation in the dental pulp of a mouse model of Marfan Syndrome (MFS). Specifically, to research blood vessel (BV) dilation and metalloprotease 2 (MMP2) expression to assess the potential increased risk of pulpitis in MFS mice.

Methodology: We used the mouse model Fbn1 C1041G, heterozygous and wild-type of the same genetic background. In-situ immunostaining was used to identify the BVs (anti-perlecan) and to show inflammatory marker MMP2 expression. DAPI was used for DNA counterstaining. Images were obtained on an LSM microscope, and image analysis was performed using ImageJ software. We determined the total pulp area and the area occupied by BVs, after which the ratio was calculated (the area unit is pixels). The mean intensity value per pixel was calculated to assess the expression of MMP2. One-way ANOVA was used for statistical analysis to ascertain if a statistically significant difference existed between the two groups of animals in vessel vasodilation and MMP2 upregulation.

Results: We found no statistically significant difference in the dilation state of pulp BVs. However, our results suggest that the capillaries at the pulp periphery might be dilated in the MFS mice. MMP2 appeared upregulated in MFS mice with a p-value of 0.00001, indicative of a statistically significant difference with wild-type mice. MMP2 was found in higher concentrations in the dentinal tubules of MFS mice.

Conclusions (mandatory): No BV dilation was observed in MFS mice. The higher MMP2 expression suggests chronic inflammation in dental pulp in mice with Marfan Syndrome. The infiltration of higher amounts of MMP2 into the dentine tubule may lead to predentin collagen degradation. A secondary inference would be increase in permeability in pulpal capillaries leading to chronic inflammation, which, in turn, could lead to the presentation of pulp stones, frequently seen in patients with MFS syndrome. Further studies may influence MFS patients in the future.

R017 | PTH'S IMPACT AND PROCESS ON ALVEOLAR H-TYPE ANGIOGENESIS

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AIM: Accelerating the healing of alveolar bone defects from oral infections is a key focus in bone regeneration research. Bone-specific H vessels and their vascular pericytes are crucial for regulating bone formation and maintaining balance. Parathyroid hormone (PTH), a common osteoporosis treatment, has been shown to enhance the formation of H-type blood vessels and vascular pericytes in long bones, promoting osteogenesis. However, the exact mechanism and its effects on alveolar bone remain to be studied.

Methodology: 8-week-old C57BL6/J male mice were randomly divided into PTH group and control group. PTH (20 ug / kg/day) or normal saline was injected twice a day. 14 days later, bilateral leg and mandible tissues were fixed and decalcified to make paraffin sections or preserved in liquid nitrogen to extract RNA and total protein. HE staining, TRAP staining and immunohistochemical staining (ALP, endomucin, a SMA, HIF a, VEGF, KDR, PTHR1, c-kit, LepR) and real-timePCR (endomucin, a SMA, HIF a, VEGF, KDR, PTHR1, c-kit, LepR, VE-codherin, VASH1) were performed. MS1 endothelial cells were cultured in vitro. Scratch test, migration test and tube formation test were carried out under the condition of PTH stimulation. Total RNA and mi-RNA were extracted and real-timePCR was used to detect vascular related genes.

Results: PTH stimulation increase the H-type blood vessels and pricyte in alveolar bone.

Conclusions (mandatory): H-type blood vessels exist in alveolar bone, and PTH stimulation can increase their number and enlarge their lumen, potentially promoting osteogenesis via the HIF1a/MALAT1/VEGFA signaling pathway. This study aims to elucidate how PTH influences these vessels and vascular pericytes to aid bone defect healing, offering insights for developing treatments for large-scale alveolar bone defects and reducing healing time while improving success rates.

Acknowledgements (optional): This work was supported by Young Scientist Program of Beijing Stomatological Hospital, Capital Medical University, NO. YSP202210 and National Natural Science Foundation of China, 82301053

R018 | THE EFFECT AND EPIGENETIC MECHANISM OF KDM4D ON ODONTOGENIC AND VASCULAR DIFFERENTIATION AND REGENERATION OF DENTAL PULP STEM CELLS

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AIM: Dental pulp stem cells (DPSCs) hold great promise as candidates for pulp - dentin complex regeneration. Although significant progress has been made in understanding the transcriptional regulation of DPSCs' fate, the mechanisms governing their differentiation remain relatively poorly understood.

Methodology: To assess the osteo/dentinogenic differentiation capacity of Dental pulp stem cells (DPSCs), techniques such as alkaline phosphatase (ALP) activity assays, alizarin red staining, quantitative calcium analysis, and the detection of osteogenic markers were employed. Real - time reverse transcription polymerase chain reaction (RT - PCR) and Western blot analysis were utilized to measure gene expression. The Seahorse Cell Mito Stress Test was carried out to detect the oxygen consumption rate (OCR), while the JC - 10 assay was used to determine the mitochondrial membrane potential (MMP). Finally, animal experiments were conducted to verify the effect of dental formation in vivo.

Results: It was found that KDM4D enhanced the osteo/dentinogenic differentiation, migration, and chemotaxis of DPSCs. The co - immunoprecipitation (Co - IP) results indicated that KDM4D could bind to RPS5. Intriguingly, RPS5 also contributed to promoting the osteo/dentinogenic differentiation, migration, and chemotaxis of DPSCs.

Conclusions (mandatory): In conclusion, KDM4D, in combination with RPS5, promoted the osteo/dentinogenic differentiation and migration potential of DPSCs. This finding offers a valuable therapeutic clue for enhancing DPSC - based dental tissue regeneration.

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R019 | ESTABLISHING REFERENCE VALUES FOR CONVENTIONAL AND MODERN CLINICAL DIAGNOSTIC TESTS IN ASSESSING PULP VITALITY AMONG HEALTHY YOUNG INDIVIDUALS

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AIM: Traditional diagnostic methods for assessing pulp vitality are commonly used but lack precision and reliability. Recent advancements provide non-invasive alternatives that focus on pulp tissue blood flow and oxygen saturation, offering objective data to enhance diagnostic accuracy. This study aims to compare traditional and modern methods for evaluating pulp vitality and establish reference values in healthy young individuals for clinical use.

Methodology: The study enrolled 25 voluntary participants, 20 to 40 years old, with a total of 150 upper front teeth examined, and was conducted at the Department of Restorative Dentistry and Endodontics, University of Belgrade. The inclusion criteria were healthy non-smoker individuals (ASA I), teeth with a mature apex, no or minimal restorations, periodontaly healthy and radiographically visible pulp chambers. Patients avoided hot or cold beverages for two hours before testing. Five tests were performed: electric pulp testing, cold pulp testing, hot pulp testing, laser Doppler flowmetry and pulse oximetry.

Results: The obtained results established reference values for each group of upper front teeth across the diagnostic methods used. For electric pulp testing, the average threshold values were 14.8 for the upper central incisor (UCI), 15.87 for the upper lateral incisor (ULI), and 23.85 for the upper canine (UC). In pulse oximetry, the oxygen saturation levels recorded were 81.7% for UCI, 80.86% for ULI, and 73.55% for UC. Similarly, laser Doppler flowmetry provided blood flow measurements of 4.78 PU for UCI, 3.85 PU for ULI, and 5.09 PU for UC.

Conclusions (mandatory): Modern diagnostic techniques showed more objective and reliable results in determining level of pulp vitality. Establishing reference values is essential for improving diagnostic accuracy. These values will not only enhance clinical decision-making but also serve as a foundation for future investigations into various pulp pathologies, providing a consistent benchmark for the assessment of different conditions.

R020 | EFFECT OF INFLAMMATION ON STEM CELL SPECIFICITY AND WOUND HEALING OF DENTAL PULP CELLS

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AIM: To investigate the stem cell (MSC) marker expression, proliferation rate, migratory and wound healing properties of Dental Pulp Stem Cells (DPSCs) obtained from young healthy, reversible and irreversible pulpitis samples.

Methodology: Healthy dental pulps were obtained from extracted wisdom teeth and dental pulp samples with caries-induced inflammation were obtained from the pulps of young donors during root canal treatment. DPSCs of healthy, reversible and irreversible pulpitis samples were isolated using the explant technique and cultured. The expression of cell surface stem cell markers was assessed by the flow cytometry method and immunofluorescent staining. CD73, CD90 and CD105 were used for (+) MSC markers while CD34 and CD45 were used as (-) MSC markers. The proliferation and migratory characteristics of DPSCs were evaluated by invitro wound healing assay.

Results: Flow cytometry results revealed that, the MSC specificity of all groups was found to be between 98% -100% without any difference between the groups. There was no significant difference in the positive MSC markers expression ($p>0.05$). The immunohistochemical labelling revealed that CD73, CD90 and CD105 antibodies were widely marked in the cell cytoplasm of all samples as (+) MSC markers, while CD34 and CD45 were not marked at all as (-) MSC markers. Furthermore, DPSCs cultured from irreversible pulpitis samples exhibited significant migration properties and wound healing properties, albeit slower than those from reversible pulpitis samples.

Conclusions (mandatory): Observing similar results in terms of both stem cell specificity and wound healing with DPSCs obtained from irreversible and reversible pulpitis or healthy tissues may be an indication that successful vital pulp treatment results can be achieved in advanced pulpitis diseases.

Acknowledgements (optional): This study was supported by Hacettepe University Scientific Research Project Coordination Unit (Grant ID:17984).

R021 | THE INFLUENCE OF AGE ON THE HEALING OF APICAL PERIODONTITIS AFTER NONSURGICAL ENDODONTIC TREATMENT

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AIM: This prospective study aimed to investigate the influence of age on the healing rate of apical periodontitis (AP).

Methodology: The study included 16 patients older than 60 years gender matched to the control group (age 30-40 years). There was no history of smoking or autoimmune diseases for participants in either group. The study included only teeth with clinically and radiographically adequate coronal restorations. The dichotomized periapical index system (PAI) was used to evaluate the periapical status of teeth following endodontic treatment, and follow-ups after 6 and 12 months. Descriptive statistics and Fisher exact test were used to analyse the differences between the groups.

Results: The analysis of the results revealed that more periapical lesions healed in the group of elderly participants than in the control group at the 6-month follow-up, however without the statistically significant difference (68.8 vs. 37.5%; p=0.077). Analysis at the 12-month follow-up revealed a similar percentage of healed AP lesions in both groups (81.3% for the elderly group and 85.7% for the control group; p=0.743).

Conclusions (mandatory): The age of the patients had no adverse influence on the healing rate of AP.

R023 | OUTCOMES OF PULP VITALITY IN TEETH INCLUDED IN A NON-ENDODONTIC LESION AFTER SURGERY: A SYSTEMATIC REVIEW

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AIM: To evaluate (i) pulp survival in teeth with apices involved in non-endodontic lesions after surgery and (ii) factors influencing pulp survival.

Methodology: A systematic review was conducted following PRISMA guidelines, with the protocol registered in PROSPERO (CRD42023449360). Searches were performed across multiple databases (MEDLINE, Embase, PubMed, Scopus, Web of Science) and grey literature sources (Google Scholar, ProQuest). Two reviewers independently selected studies, extracted data, and assessed the risk of bias, with a third reviewer resolving disagreements. Studies evaluating pulp prognosis in teeth with apices affected by non-endodontic lesions—regardless of histopathological diagnosis—following enucleation, decompression, or marsupialization were included. Eligible studies consisted of case reports and retrospective studies. Pulp survival was defined as the absence of clinical signs or symptoms and a positive pulp test. Data were collected on study characteristics, patient demographics, lesion types, surgical approaches, and pulp vitality outcomes assessed through thermal and electric pulp tests. Quality was assessed using the Joanna Briggs Institute tools.

Results: Of the 396 articles screened, 13 studies (10 case reports, 2 case series) met the inclusion criteria, involving 32 men, 19 women, and 119 teeth. Lesions included paradental cysts, solitary bone cysts, retained roots, calcifying odontogenic cysts, central giant cell granulomas, keratocystic odontogenic tumors, hemorrhagic bone cysts, ameloblastomas, and dentigerous cysts. Most studies focused on enucleation and reported 100% pulp vitality over follow-up periods ranging from 6 months to 13 years. However, one study on decompression showed a decrease in pulp survival, with vitality dropping from 94% preoperatively to 89% postoperatively.

Conclusions (mandatory): Teeth with apices involved in non-endodontic lesions maintain high pulp survival following surgery, making prophylactic root canal treatment unnecessary. Further histological studies are needed to clarify lesion healing and pulp survival mechanisms.

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R024 | HISTO-TOPOGRAPHIC ANALYSIS OF PERIODONTAL CELLS DAMAGE ON ROOT SURFACE DURING EXTRACTIVE PROCEDURES

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AIM: To assess the damage undergone by the periodontal ligament (PL) during tooth extraction through histological analysis of the tissues. The initial hypothesis is that extensive PL damage may negatively affect the prognosis of teeth subjected to surgical extrusion, replantation, or autotransplantation.

Methodology: This research protocol has been approved by the Territorial Ethics Committee of Lazio (ID 7188). 60 single and multi-rooted teeth (third molars) were extracted for endodontic, prosthetic, or strategic reasons. Time, difficulty and presence of apical periodontitis were recorded. The specimens were processed through fixation in buffered neutral formalin, decalcification using formic acid and sodium citrate, and subsequent paraffin embedding. Prior to decalcification, the samples were scanned using an iTeroILUMA 3D scanner to obtain a detailed surface geometry analysis. Histological sections were stained with Hematoxylin-Eosin and modified Brown & Brenn to highlight the PL. The digitized slides were analyzed using ImageJ software and correlated with the previous 3D reconstruction in stack images, allowing alignment of the histological sections with their real spatial position. The 3D overlay of the obtained surfaces was performed using Amira Image Software, enabling volumetric assessment of actual periodontal damage. The minimum sample size was determined based on previous studies, considering a significance level of 0.05 and a power of 80%. The statistical analyses used include multiple regression and ANOVAtest.

Results: The difficulty of the extraction had a statistically significant impact ($p = 0.001$) on the percentage of remaining PL. PL damage in the analyzed samples showed a mean value of 20%, with peaks of up to 60% while some samples remained almost intact.

Conclusions (mandatory): In the literature there are not studies showing the percentage of healthy PL that remains attached to the tooth surface after extraction, the aim of this study is to increase predictability of procedures such as transplantation, replantation and surgical extrusion.

R025 | BIOACTIVE SCAFFOLDS CONTAINING RESOLVIN E1 ACCELERATES REPAIR OF HUMAN DENTAL PULP STEM CELLS UNDER INFLAMMATORY CONDITIONS

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AIM: This two-part study hypothesized that a bioactive scaffold releasing Resolvin E1 will enhance the cell viability and early mineralization of inflamed human dental pulp stem cells (hDPSCs). The study aimed to develop and characterize a novel and modified carboxy methyl chitosan scaffold loaded with Resolvin E1 (RvE1-CMC) and to determine its cytotoxicity and mineralization potential on inflamed hDPSC.

Methodology: Part 1 concerns with fabrication AND characterisation of carboxy methyl chitosan incorporated with Resolvin E1 in two concentrations of RvE1 (100nM and 200nM) (CSR100, CSR200). The scaffolds porosity, drug release kinetics, and degradation were assessed. hDPSCs were isolated from teeth indicated for orthodontic extraction from young adults and inflammation was induced with lipopolysaccharide. The impact of RvE1 on inflamed hDPSCs proliferation, proinflammatory gene expression (TNF-alpha), alkaline phosphatase activity and Alizarin red staining were evaluated.

Results: The novel scaffold was observed to be conducive for cellular activity. The scaffold demonstrated highly porous interconnected microstructure with pore diameter ranging from 61.7–174 microns. Incorporation of RvE1 showed sustained gradual release peaking at day 14. Cumulative degradation of CMC scaffold at 28 days was 57.35%. The bioactivity of the scaffold was maintained upto 28 days. Inflamed hDPSCs exposed to 200nM RvE1-CMC scaffold exhibited significantly improved viability compared to 100nM. Both concentrations of RvE1-CMC scaffolds significantly suppressed the expression of TNF-alpha at 7 days. Alkaline phosphatase activity was enhanced by both RvE1 concentrations on days 7 and 14. Alizarin red staining revealed superior biomineralization potential of 200nM RvE1 on days 14 and 21.

Conclusions (mandatory): Pulpitis is an inflammatory disease and use of Resolvin E1 as a therapeutic option has high clinical translational effect. This study concludes 200nM RvE1-loaded CMC scaffold as a promising therapy for inflamed pulp conditions, enhancing hDPSC proliferation and biomineralization potential in inflamed hDPSCs. The result from this study has direct applications in vital pulp therapy.

R026 | LTA-TLR2 INTERACTION TRIGGERS IL-6 PRODUCTION VIA NUCLEAR TRANSLOCATION OF NF- KB IN HUMAN PULP CELLS

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AIM: Inflammatory responses in the dental pulp due to deep caries often require partial or complete pulp removal, which reduces the long-term survival of the tooth. A key trigger of immune activation is the penetration of toxins, such as lipoteichoic acid (LTA) from Gram-positive bacteria, which bind to Toll-like receptor 2 (TLR-2).
This study tests the hypothesis that TLR-2 activation by LTA induces the production of the pro-inflammatory cytokine interleukin-6 (IL-6) through nuclear translocation of the transcription factor NF-κB.

Methodology: To assess the time- and concentration-dependent production of IL-6, human dental pulp cells (DPCs) were exposed to LTA from S. aureus (10, 25, 50 µg/ml) over 72 h. In this context, cell number was determined, and IL-6 secretion was quantified by ELISA. Based on this, DPCs were treated with 50 µg/ml LTA for 24 h, with and without TLR-2 inhibition (100 µM C29), and subsequently, cell number and IL-6 concentration were determined again. In addition, translocation of NF-κB from the cytosol into the nucleus was analyzed by western blot and visualized using immunocytochemistry, while IL6 gene expression was quantified by RT-qPCR 3 h after LTA stimulation, with and without TLR-2 inhibition. Non-parametric statistical analyses were performed to compare groups and time points (Mann-Whitney U test or Kruskal-Wallis test; $\alpha = 0.05$).

Results: LTA exposure of DPCs for 72 h resulted in a time- and dose-dependent increase in IL-6 secretion. TLR-2 inhibition significantly reduced IL-6 release from cells exposed to LTA for 24 h. Furthermore, inhibition of TLR-2 affected translocation of NF-κB into the nucleus as well as IL6 gene expression.

Conclusions (mandatory): TLR-2 activation by LTA promotes NF-κB translocation into the nucleus, inducing IL-6 transcription and secretion. Modulation of IL-6 production by interfering with TLR-2 may help regulate the pulp's immune response to cariogenic bacteria, providing a potential strategy for targeted vital pulp therapies.

R027 | A CELL HOMING APPROACH FOR PULP REGENERATION USING DENTIN MATRIX PROTEINS IN A SEMI-ORTHOTOPIC MOUSE MODEL

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AIM: This study investigated the influence of apical foramen size on tissue formation and evaluated the potential of extracted dentin matrix proteins (eDMPs) to support pulp regeneration in a semi-orthotopic mouse model.

Methodology: Human tooth roots were prepared to receive a cell pellet at the apex, with apical foramina enlarged to 0.3, 0.6, 0.9, or 1.2 mm. Root canals were disinfected (2% NaOCl), conditioned (10% EDTA), and filled with a fibrin-based hydrogel (± eDMPs providing 500 pg/ml TGF-β1). Stem cells of the apical papilla (SCAP, 7×104 cells/µl) were embedded in type 1 collagen and placed in the apical reservoir. A hydraulic calcium silicate cement was used for coronal sealing (Biodentine, Septodont). Constructs were implanted subcutaneously in immunodeficient mice for 28 days (n = 12). Histological analysis included quantification of tissue ingrowth, blood vessels, and immunohistochemistry (HLA, DAPI). Statistical comparisons were performed using the Mann-Whitney U test (α = 0.05).

Results: SCAP migrated into the root canal, leading to fibrin scaffold degradation and the formation of structured, vascularised tissue. Mineral deposition occurred along dentin walls, occasionally with cellular inclusions. Tissue ingrowth was significantly enhanced in roots with apical foramina of greater than 0.9 mm, and the addition of eDMPs further promoted this process.
In addition, vessel extension into the root canal was greater in specimens where eDMPs were supplemented with fibrin, particularly in apical foramina greater than 0.9 mm. Mineralisation in the newly formed tissue was also promoted by eDMP.

Conclusions (mandatory): Supplementation with eDMPs promote cell homing and vascularisation, with tissue development influenced by apical foramen size. An apical foramen greater than 0.9 mm appears critical for consistent and structured tissue formation, highlighting its relevance for regenerative endodontic therapies.

Acknowledgements (optional): This work was supported by the German Society for Endodontology and Dental Traumatology (DGET).

R028 | EFFECT OF NITROUS OXIDE ON THE EFFICACY OF THE INFERIOR ALVEOLAR NERVE BLOCK IN MANDIBULAR POSTERIOR TEETH WITH SYMPTOMATIC IRREVERSIBLE PULPITIS – A SYSTEMATIC REVIEW

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AIM: Several strategies have been investigated for achieving successful pulpal anesthesia during endodontic treatment of mandibular posterior teeth diagnosed with symptomatic irreversible pulpitis. However, comprehensive evaluation and identification of the effect of nitrous oxide in intervention are lacking. This systematic review aimed to determine the effect of nitrous oxide on the efficacy of the inferior alveolar nerve block (IANB) in mandibular posterior teeth diagnosed with symptomatic irreversible pulpitis (SIP).

Methodology: • PICO:
P (problem): The reported low success rate of an IAN block in mandibular posterior teeth diagnosed with symptomatic irreversible pulpitis
I (intervention): Nitrous Oxide
C (comparison): Room air/Oxygen
O (outcome): Pulpal anesthesia

Seven randomized controlled clinical trial studies were identified and included based on the inclusion and exclusion criteria from five electronic databases: MEDLINE, Cochrane, PubMed, Embase, and ProQuest databases were searched from inception until January 1, 2025. with no restriction on publication language.

Results: The findings showed that preemptive administration of 30-50% nitrous oxide/oxygen significantly increased the efficacy of IANB anesthesia in patients diagnosed with SIP. The current best available evidence suggests that nitrous oxide/oxygen is an effective, highly safe, efficacious, and convenient way to provide maximum pulpal anesthesia and less painful endodontic treatments. The findings show that nitrous oxide sedation significantly increases pulpal anesthesia in patients diagnosed with SIP when combined with IANB local anesthesia, resulting in pain reduction.

Conclusions (mandatory): Nitrous oxide might be a useful technique to achieve successful pulpal anesthesia in conjunction with IANB during nonsurgical endodontic treatment for permanent mandibular posterior teeth diagnosed with symptomatic irreversible pulpitis to ensure effective patient care and pain management.

R031 | FRACTURE RESISTANCE OF ROOT CANAL-TREATED MANDIBULAR MOLARS WITH DIFFERENT ENDODONTIC ACCESS CAVITIES AFTER SIMULATED AGING

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AIM: To compare the fracture resistance of root canal-treated mandibular molars with traditional endodontic cavity (TEC), truss endodontic cavity (TrEC), and ultraconservative endodontic cavity (UEC) techniques after chewing simulation.

Methodology: Fifty extracted, caries-free mandibular molars were scanned using CBCT to assess root canal morphology and randomly assigned to control (n=8) and three test groups (n=14): TEC, TrEC, and UEC. Except for the sound tooth control group (STC), all teeth underwent root canal preparation with WaveOne Gold files and 1.25% sodium hypochlorite irrigation, followed by single-cone obturation using WaveOne Conform Fit gutta-percha and AH-Plus sealer. Access cavities were restored with composite resin. Specimens underwent 1,200 thermal cycles (5°C-55°C) and six months of aging in a chewing simulator. Fracture testing was conducted using a universal testing machine with a 2.5 mm round-ended piston at 1 mm/min, recording values in Newtons. Fracture patterns were classified as repairable or non-repairable. Data were analyzed using one-way ANOVA and Tukey post hoc tests ($P < .05$).

Results: The highest fracture resistance was observed in the STC group, significantly exceeding TEC, TrEC, and UEC ($p<0.0001$, $p=0.003$, $p=0.017$, respectively). No difference was found between TrEC and UEC ($p=0.900$), but UEC had significantly higher fracture resistance than TEC ($p=0.035$). Root canal shaping times were similar across groups ($p=0.112$), but TEC showed a shorter total treatment duration than TrEC and UEC ($p=0.003$, $p<0.0001$). The STC group had the highest repairable fracture rate (75%), while other groups showed similar rates.

Conclusions (mandatory): TEC resulted in lower fracture resistance than TrEC or UEC, with UEC not significantly improving resistance over TrEC. Reducing access cavity size preserved dentin and enhanced fracture resistance. UEC demonstrated superior fracture resistance compared to TEC, suggesting that a more conservative approach may provide structural advantages for endodontically treated teeth.

Acknowledgements (optional): This research was supported by the Çukurova University Scientific Research Project Unit (Number: TDH-2023-15542).

R032 | TEMPERATURE CHANGE IN THE PULP CHAMBER INDUCED BY DIFFERENT LIGHT CURING UNITS IN SIMULATED DEEP CAVITIES

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AIM: Dental pulp can be subjected to thermal damage during restorative procedures. This study aimed to assess the impact of different types of photopolymerization devices on pulp chamber temperature during the adhesive bonding phase.

Methodology: Cavities with a mesiodistal diameter of 5 mm, a buccolingual diameter of 3.5 mm, and a remaining dentin thickness of 1.2 mm at the cavity base were prepared. The distance between the cavity surface and the light devices was standardized to 4 ± 0,2 mm. A monowave/LED single-peak fiber-guided (Deepcure-L, 3M ESPE, USA) device with 1200 mW/cm² emittance and two polywave/LED multi-peak (O-Light, DTE Guilin, China and Valo, Ultradent, USA) devices with emittances of 1000- 1200 mW/cm² and 980 mW/cm² respectively were applied for 20 seconds. The temperature change within the pulp chamber was quantified using a K-type thermocouple, with data collected at the 10th and 20th seconds evaluated.

Results: The mean intra-pulp temperature at 10th seconds was 39.9°C, 41.1°C, and 38.7°C, at 20th seconds for the O-Light, Deepcure-L, and Valo groups was 42.4°C, 44.3°C, and 40.4°C respectively. A statistically significant difference was observed between the Deepcure-L and Valo groups($p<.01$) regarding maximum temperature, increase in pulp chamber temperature, and temperature at the 10th and 20th seconds.

Conclusions (mandatory): It is essential to consider that LCUs used during resin polymerization will inevitably generate heat, necessitating the implementation of supplementary protective measures to ensure the maintenance of pulpal health. Further studies are required to gain a comprehensive understanding of the thermal damage caused by LCU devices, utilizing both in vivo and ex vivo functional tissue analysis in conjunction with histology and clinical outcomes.

R033 | EFFECT OF CAVITY DESIGN ON BACTERIAL REDUCTION IN ROOT CANALS AND POSTOPERATIVE PAIN LEVEL: A RANDOMIZED CONTROLLED TRIAL

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AIM: To evaluate and compare the efficacy of the truss endodontic cavity (TREC) design against the traditional conservative endodontic cavity (TEC) design in terms of their effectiveness in removing intracanal bacteria and their subsequent impact on postoperative pain.

Methodology: A randomized controlled trial was conducted involving 100 patients, who were assigned to either the TEC group or the TREC group. Following the preparation of the access cavity, bacteriological samples from the root canals were collected both pre- and post-chemo-mechanical preparation. These samples underwent quantitative real-time polymerase chain reaction to determine total bacterial counts. Postoperative pain intensity was measured using a 100 mm visual analog scale (VAS), with patients reporting pain levels at specified intervals: days 1, 3, 5, and 7 post-treatment. The distribution of categorical variables between groups was assessed using the Chi-square test, while intergroup comparisons were conducted with the non-parametric Mann-Whitney U test. To analyze bacterial load and postoperative pain levels within groups, the Wilcoxon and Friedman tests were utilized, respectively.

Results: Both groups demonstrated a statistically significant reduction in intracanal bacterial counts following chemo-mechanical preparation compared to baseline measurements. The TEC group achieved a 96% reduction in bacterial counts, while the TREC group exhibited a 92% reduction, with this difference being statistically significant. Furthermore, both groups reported a significant decrease in postoperative pain levels from day 1 to day 7; however, no statistically significant differences in pain levels were observed between the groups at any assessment point.

Conclusions (mandatory): The TREC design appears to impede effective debridement in mandibular molars, leading to a less efficient reduction of intracanalar bacteria compared to the TEC design. These findings highlight the importance of cavity design in endodontic procedures and its potential implications for clinical practice.

Acknowledgements (optional): The study was funded by Atatürk University scientific research project unit

R034 | INVESTIGATION OF SHORTWAVE INFRARED TRANSILLUMINATION MECHANISMS FOR ENDODONTIC NAVIGATION

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AIM: Shortwave infrared (SWIR) transillumination has been shown to enhance visualization of pulpal structures during endodontic access preparation. However, the precise anatomical structures being represented and the underlying visualization mechanisms remain unclear. This study investigates the optical principles for pulpal structure visibility under SWIR illumination during access preparation.

Methodology: Extracted human teeth (molars or premolars) were examined in vitro using SWIR transillumination at wavelengths 780 nm, 1050nm and 1300 nm. Three experimental approaches were employed: (1) stepwise access preparation, (2) horizontal sectioning in 2 mm increments, and (3) vertical hemisectioning. Illumination was applied from both the buccal and oral sides, and findings were correlated with micro-computed tomography (µCT) imaging.

Results: During stepwise access preparation, darker regions were observed up to 2 mm coronal to the pulp chamber, corresponding to pulp horns as well as root canal orifices in µCT images across all tested wavelengths. Upon breaching the pulp chamber, illumination intensity increased, particularly at canal orifices, enhancing their visibility. Horizontal sectioning confirmed that pulp horns appeared significantly darker, while the rest of the pulp chamber was uniformly illuminated. In vertical hemisections, a dark halo surrounding the pulp chamber was observed, corresponding to previously reported dentin tubule distributions and their orientation toward the access cavity.

Conclusions (mandatory): SWIR transillumination enables endodontic navigation by revealing anatomical landmarks. Pulp horns appear as darker regions due to dentin tubule distribution and orientation, while root canal orifices become more distinct upon pulp chamber access due to increased illumination. These findings provide new insights into the optical properties of dental tissues and may serve as the basis for a novel, directly applicable guided endodontic technique.

R035 | ACCURACY AND EFFICIENCY OF DYNAMIC NAVIGATION FOR ENDODONTIC ACCESS PREPARATION IN TEETH WITH CALCIFIED CANALS – A PILOT STUDY

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AIM: To evaluate the accuracy and efficiency of dynamic navigation (DN) for endodontic cavity preparation in 3-dimensionally (3D) printed teeth with calcified canals.

Methodology: Twenty 3D printed maxillary central incisors (tooth number 21) with calcified canals were scanned with cone-beam computed tomography and endodontic access cavities were planned virtually using Navident software (Claronav, Toronto, Ontario, Canada). Under simulated clinical conditions, endodontic access cavities were prepared freehand under the dental operating microscope (control group, n=10), and using Navident DN (experimental group, n=10). The accuracy of prepared endodontic accesses was evaluated on postoperative cone-beam computed tomographic scans using Navident's EvaluNav application. Endodontic access entry and apical deviations, angular deflection, the number of mishaps, and operation time were compared between groups. The Mann-Whitney U test for independent samples was used for statistical analysis (analysis of the data) ($P < .05$).

Results: There were no statistically significant differences between the groups at endodontic access entry point deviations ($p=0.393$), apical point 3D deviations ($p=0.353$), apical point depth deviations ($p=0.853$), and angle deflections ($p=0.190$). Freehanded preparation resulted in significantly shorter operation time ($p<0.000$). One perforation was recorded in the experimental group, and three perforations were recorded in the control group.

Conclusions (mandatory): DN was not superior to control group in endodontic access cavity preparation, however it led to fewer procedural mishaps. Further studies with larger sample size are needed to explore DN accuracy for endodontic cavity preparation in teeth with calcified canals.

Acknowledgements (optional): Funded by Kristupas Gutauskas foundation.

R036 | THE EFFECT OF DIFFERENT ACCESS CAVITY DESIGNS ON THE REMOVAL OF CALCIUM HYDROXIDE FROM ROOT CANALS

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AIM: The aim of this study is to investigate the effect of different access cavity designs and irrigation solutions on the removal of calcium hydroxide from root canals.

Methodology: A total of 84 human mandibular molars were selected for this study. The samples were divided into three main groups of 28 teeth to be prepared: conventional, ninja and truss cavity.Calcium hydroxide was placed into the root canals of the teeth after cavity preparation and root canal shaping. To allow imaging under the confocal laser scanning microscope, calcium hydroxide was mixed with rhodamine B dye. The samples were then divided into 4 subgroups according to the irrigation solutions (saline, 17%EDTA, 70%ethanol, 0.2%chitosan) used to remove calcium hydroxide. After the removal process, apical 3 mm sections were taken, and images of these sections were obtained using a confocal laser microscope. The images were analyzed with ImageJ software. The obtained data were analyzed using two-way anova and tukey post hoc tests, keeping the significance level at $p<0.05$.

Results: The truss cavity group showed statistically significantly cleaner canal walls compared to the ninja cavity group($p<0.05$).In terms of irrigation fluid, no statistically significant difference was observed between 70% ethanol and 0.2% chitosan around the cleaned canal wall ($p>0.05$). Also, no significant difference was observed between 0.2% chitosan and 17% EDTA ($p>0.05$). It was observed that 70% ethanol removed calcium hydroxide from the canal walls at a statistically significant level compared to 17% EDTA ($p<0.05$).No significant difference was found in the depth of cleaned tubules between the access cavity designs ($p>0.05$). 70% ethanol showed statistically significantly deeper tubule cleaning compared to 0.2% chitosan and 17% EDTA ($p<0.05$).

Conclusions (mandatory): Minimal invasive cavity designs are recommended to prevent tooth fractures. However, these cavity designs may compromise root canal cleaning. Ethanol and chitosan may serve as alternatives to EDTA for removing calcium hydroxide.

R037 | RETREATABILITY OF EPOXY RESIN- AND CALCIUM SILICATE-BASED SEALERS USED WITH TWO FILLING TECHNIQUES FROM MATCHED OVAL ROOT CANALS: A MICRO-CT ANALYSIS

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AIM: To evaluate the retreatability of oval root canals obturated with AH Plus (AHP) and AH Plus Bioceramic (AHBC) Sealer (both Dentsply Sirona, Ballaigues, Switzerland) using single-cone (SC) and warm vertical compaction (WVC) technique.

Methodology: Forty mandibular incisors with oval-shaped canals were anatomically matched based on micro-computed tomography (micro-CT) analyses. Root canals were prepared using Reciproc Blue R25 instruments (VDW, Munich, Germany) and distributed into 4 groups (n = 10) according to the filling technique: G1 (AHP/SC), G2 (AHP/WVC), G3 (AHBC/SC), G4 (AHBC/WVC). Root canal fillings were removed using the XP-endo Rise Retreatment system and further apical enlargement was performed using BioRaCe instruments to size 40/.04 (both FKG Dentaire, La-Chaux-de-Fonds, Switzerland). Specimens were scanned after each endodontic procedure to calculate percentages of residual filling material and dentine removal. Working time and procedural errors were recorded. Statistical analysis was performed using nonparametric rank-based tests for longitudinal data ($p < 0.05$).

Results: Root canals filled with AHBC showed significantly less remaining filling material compared to AHP ($p = 0.001$). Filling technique had no significant influence on removability of both sealers ($p = 0.611$). Within each group, apical enlargement did not result in an additional significant reduction of filling material ($p > 0.1$) but was associated with a significant increase of dentine removal in G4 ($p < 0.001$). Working time was similar for all groups ($p > 0.05$) and no procedural errors occurred.

Conclusions (mandatory): Root fillings with AHP were more difficult to remove from oval root canals than those with AHBC irrespective of the filling technique. Apical enlargement did not significantly reduce the volume of residual filling material but may be associated with unnecessary dentine removal.

Acknowledgements (optional): Supply of FKG NiTi instruments and FKG X3000 cordless endo motor by American Dental Systems is gratefully acknowledged.

R038 | ENDODONTIC RETREATMENT DECISION-MAKING: THE INFLUENCE OF THE FRAMING EFFECT

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AIM: To explore the influence of the framing effect on endodontic retreatment decision-making.

Methodology: Two questionnaires were created both including two identical clinical cases (an incisor and a molar, both root-filled, symptom-free, with apical periodontitis), where the outcomes of both options were the same.

Questionnaire Options:

Questionnaire 1:
A. Framed positively in favour of 'Wait, no treatment and monitoring (NoTx)'.
B. Framed negatively in favour of 'Non-surgical retreatment (ReTx)'.

Questionnaire 2:
A. Framed negatively in favour of 'Wait, no treatment and monitoring (NoTx)'.
B. Framed positively in favour of 'Non-surgical retreatment (ReTx)'.

Clinicians (n = 105) were randomly assigned to one of two groups: 54 were presented with the 1st, while 51 were presented with the 2nd questionnaire. Statistical analysis of the data was performed using Fisher's Exact test with the significance level set as $p<0.05$.

Results: With the incisor case, of the 54 clinicians presented with the 1st questionnaire, 52 (96.3%) chose 'NoTx' (Option A) and 2 (3.7%) chose 'ReTx' (Option B); of the 51 clinicians presented with the 2nd questionnaire, 40 (78.4%) chose 'NoTx' (Option A) and 11 (21.6%) chose 'ReTx' (Option B); the results were statistically significant ($P=0.006$).

With the molar case, of the 54 clinicians presented with the 1st questionnaire, 29 (53.7%) chose 'NoTx' (Option A), and 25 (46.3%) chose 'ReTx' (Option B); of the 51 clinicians presented with the 2nd questionnaire, 9 (17.6%) chose 'NoTx' (Option A) and 42 (82.4%) chose 'ReTx' (Option B); the results were statistically significant ($P<0.001$).

Conclusions (mandatory): The framing effect had a significant effect on clinicians' decision-making. Despite the outcomes being the same, there was a clear difference in the management option chosen depending on whether it was positively and negatively framed.

R039 | CLINICAL EVALUATION OF INTRACANAL ANTIMICROBIAL EFFICACY OF A ER: YAG LASER-ASSISTED PHOTOACOUSTIC STREAMING AND SONIC-ACTIVATED IRRIGATION DURING SINGLE-VISIT ROOT CANAL RETREATMENT – A PILOT STUDY

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AIM: To evaluate the antimicrobial efficacy of two activated irrigation techniques: Super Short Pulse (SSP) modality of Er:YAG laser-activated irrigation (LAI) and sonic-activated irrigation (SAI), against intracanal bacteria during single-visit root canal retreatment of teeth with apical periodontitis.

Methodology: Thestudy included 34 patients requiring root canal retreatment of teeth with asymptomatic apical periodontitis, who were selected based on strict inclusion and exculsion criteria. All patients were randomly distributed into two groups according to the final disinfection protocol (n=17/each): Group 1. SSP modality of Er:YAG LAI (20 mJ, 15 Hz, pulse duration 50 micro seconds); Group 2. SAI (SmartLite ProEndoActivator, Dentsply Sirona, USA), including 3% sodium-hypochlorite (NaOCl), 15% ethylenediaminotetraacetic acid and 3% NaOCl in both groups. All patients underwent single-visit root canal retreatment using standardized chemo-mechanical root canal instrumentation performed by the same endodontist. The root canals were filled with calcium-silicate sealer (BioRoot Flow, Septodont, Saint Maur Des Fosses, France) using single-cone technique. The microbiological samples were collected after access cavity, after chemo-mechanical preparation and after final disinfection protocol. A quantitative evaluation of total bacteria amount was determined using quantitative real-time polymerase chain reaction (qRT-PCR). This estimation was based on gene copy number for 16S rRNA that was determined by comparing to Ct values/gene copy number of the standard curve. The chi-square test was used for the statistical analysis of the results, with the significance level at 5%.

Results: There were no statistically significant difference in the antimicrobial efficacy between the two experimental groups ($p>0.05$). There was significant reduction in the total bacteria amount after chemo-mechanical root canal instrumentation and after final disinfection protocol CFUs ($p<0.001$).

Conclusions (mandatory): SSP modality of Er:YAG LAI and sonic-activated irrigation provided similar antibacterial efficacy during single visit root canal retreatment of teeth with apical periodontitis.

R040 | AN OBSERVATIONAL STUDY ON SCAR TISSUE AFTER ENDODONTIC SURGERY

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AIM: The aim of this study was to assess the aesthetic outcome regarding scar tissue after endodontic surgery and to compare the subjective aesthetic findings of patients with observations made by calibrated researchers.

Methodology: Patients who underwent endodontic surgery at least 6 months and maximum one year ago were recruited for this observational study. Demographic and procedural information was collected, and each participant completed a brief questionnaire of four questions assessing mucosal scar tissue and their general satisfaction after the treatment. On an intra-oral photograph of the surgical site, scarring was evaluated using the Mucosal Scarring Index (MSI). Linear regression analysis was performed to determine possible relationships between the dependent variable (MSI) and 4 independent variables (age, gender, incision type and suture type).

Results: A total of 25 patients were included, comprising 13 males and 12 females, only one was a smoker. The mean age was 52 years with a range from 30 to 78. The MSI ranged from 0 to 6 with a mean of 2.4. According to the questionnaire, 23 out of 25 patients did not observe any scar at the surgical site. According to the MSI measurements, 6 out of 25 patients did not show any scar. Gender was the only variable with a statistically significant relation ($p <= 0.05$) with a mean MSI for men of 1.62 and a mean MSI for women of 3.25. Age, incision type and suture type showed no statistically significant relationship with MSI scores.

Conclusions (mandatory): This study provides insight into the aesthetic outcome after endodontic surgery and highlights the difference between subjective aesthetic patient reports and clinical measurements using the MSI. Patients reported very few visible scarring whereas the MSI measurements revealed more visible scarring.

R041 | RELATIONSHIP OF THE PALATAL ROOTS OF THE MAXILLARY FIRST & SECOND MOLARS TO THE GREATER PALATINE ARTERY & MAXILLARY ANTRUM IN A WELSH POPULATION: A CONE BEAM COMPUTED TOMOGRAPHY STUDY

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AIM: To establish radiological safety parameters for performing targeted endodontic microsurgery (TEMS) on the palatal roots of the maxillary first (FM) & second molars (SM) using cone beam computed tomography scans (CBCT's)

Methodology: This retrospective study was approved by the Health Research Authority (HRA), Health & Care Research Wales (HCRW) and NHS Research Ethics Committee (REC). Of 2,442 scans screened, 128 met the inclusion criteria. The distances from the palatal root-ends to the greater palatine foramen (GPF), greater palatine artery (GPA) & maxillary antrum (MA), the extent of antral dip between the roots, the palatal vault height (PVH) & palatal transition morphology (PTM) were measured. Significant differences among gender, side of the mouth, age and tooth type were computed with statistical tests.

Results: The FM & SM palatal root-ends were 14.60± 2.41mm & 8.67± 2.01mm from the GPF respectively & 2.47± 1.59mm & 2.65± 2.02mm from the GPA respectively. The PTM was primarily spine & smooth by the FM & bridge & smooth by the SM. The GPA lay superior to 48% of the FM and 56% of the SM with distances ranging between 1-7mm. 90% of scans assessed showed average PVHs. The root-ends for both molars lay as close as 1mm from the MA with antral dip primarily between 1-3mm between roots. No significant differences were noted among gender & side of mouth but differences were seen between tooth type & among age.

Conclusions (mandatory): The parameters determined to be important for TEMS include: the GPA lying superior or adjacent to the palatal root-ends, average or high PVHs, spine or bridge PTM & palatal root-ends at least 2mm from the MA with minimal antral dip between the roots (1-2mm). An overall safety margin of 4mm from the palatal root-ends to the GPA & MA is proposed.

R042 | THE EFFECT OF ROOT FUSION ON THE INTER-ORIFICE DISTANCES IN MAXILLARY SECOND MOLARS

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AIM: To evaluate the effect of root fusion on inter-orifice distances in maxillary second molars and to analyze how different fusion types influence these parameters.

Methodology: A total of 300 maxillary second molars with fused and independent roots were examined (n=150). The samples were scanned using a micro-CT device (SkyScan 1172, Bruker-microCT) with a pixel size of 13.68 um, operating at 100 kV and 100 uA. The reconstructed 3D images were analyzed, and only samples with clearly distinguishable orifices at the cementoenamel junction were selected for further evaluation. The distances between canal orifices (MB1-MB2, MB1-DB, MB1-P, DB-P) were measured and recorded. The Shapiro-Wilk test was used to assess the normality of data distribution. The differences between fused and independent roots were analyzed using the independent samples t-test, while the variations among different fusion types were assessed using one-way ANOVA and Welch's test ($p < 0.05$).

Results: MB1-P and DB-P distances were significantly shorter in fused roots compared to independent roots ($p < .05$). MB1-DB distance was not affected by the presence of root fusion ($p > .05$). MB1-MB2 distances were similar across all groups ($p > .05$). Significant differences were observed in MB1-P and DB-P distances among different fusion types ($p < .05$). DB-P distance was shortest in Type 3 and Type 6 fusion groups.

Conclusions (mandatory): Root fusion significantly influences the inter-orifice distances in maxillary second molars. The results indicate that MB1-P and DB-P distances are shorter in fused roots compared to independent roots, while MB1-DB distances remain unaffected. Additionally, different fusion types exhibit significant variations in inter-orifice distances. These findings provide quantitative data on how root fusion alters canal orifice positioning, which may be relevant for endodontic access and treatment planning.

R043 | MONITORING SIZE OF BONE DESTRUCTION IN ROOT-FILLED TEETH WITH ASYMPTOMATIC APICAL PERIODONTITIS- RESULTS FROM A ONE-YEAR FOLLOW-UP PROSPECTIVE STUDY

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AIM: To prospectively investigate the changes in the size of the apical bone destruction in symptom-free root-filled teeth with persistent apical periodontitis (AP) over one year without treatment.

Methodology: Patients referred to two specialist endodontic clinics in Västra Götaland, Sweden, with asymptomatic periapical bone destructions (summing to equal or more than 10 mm in diameter, when measured in two dimensions) on intraoral radiographs were invited. After informed consent, participants underwent cone-beam computed tomography (CBCT). Patients with bone destructions beyond cortical boundaries were excluded. A one-year follow-up included recording changes in bone destruction size on intraoral radiographs.

Results: Of 234 eligible patients, 171 (91.4%) participated. After CBCT, four were excluded, and ten were lost to follow-up. Among 157 patients, three developed symptomatic AP and were treated, and one tooth was lost due to fracture. A total of 153 patients were available for follow-up. In these patients the lesion size changes were small (M = 0.059 mm), with the mean decreasing from 7.35 mm (SD 2.11) to 7.31 mm (SD 2.33), which was not statistically significant.

Conclusions (mandatory): The findings align with previous studies, suggesting that symptom-free root-filled teeth with apical periodontitis rarely experience significant increase of bone destruction in the short term.

R045 | ANALYSIS OF THE PREVALENCE AND LOCALIZATION OF SECONDARY MESIOBUCCAL CANAL IN MAXILLARY MOLAR TEETH USING CBCT

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AIM: To determine the prevalence of MB2 canals in maxillary first and second molars and measure the shortest distance of the MB2 canal orifice to the mesiobuccal (MB1) and palatal canal orifices, as well as the shortest perpendicular distance from MB2 to the line connecting MB1 and the palatal canal, using cone-beam computed tomography (CBCT) images.

Methodology: 130 Patients who applied to Kirikkale University Faculty of Dentistry between 2022 and 2025 and whose CBCT (ICAT,Hatfield,PA,USA) images were taken for various reasons were evaluated. A retrospective analysis was conducted on randomly selected CBCT images of 445 teeth, including both treated and untreated maxillary molar teeth. The presence of MB2 canals was examined by two experienced endodontists and an oral and maxillofacial radiologist. The distances between MB2 canal orifices and the MB1 and palatal canal orifices, as well as the shortest perpendicular distance from MB2 to the line connecting MB1 and the palatal canal, were measured. Statistical analysis was performed using chi-square independence test (SPSS 21.0).

Results: MB2 canals were identified in 109 (50.4%) and 76 (33.2%) of the 216 first and 229 second molar teeth, respectively. The presence of MB2 canals showed a significant difference across age groups ($p<0.05$), but no significant difference was found between the right and left tooth groups ($p>0.05$). The distance of MB2 to the palatal canal differed significantly between the right and left tooth groups and between first and second molars ($p<0.05$), whereas other distances did not show significant differences ($p>0.05$). Additionally, no significant differences were found in any measured distances based on gender or the presence or absence of root canal treatment ($p>0.05$).

Conclusions (mandatory): This study provides a guide for the localization of MB2 canals, which may help clinicians improve the success of root canal treatment.

R046 | THE RELATIONSHIP BETWEEN TECHNICAL ERRORS AND PERIAPICAL STATUS IN ENDODONTICALLY TREATED MOLAR TEETH: A CBCT ANALYSIS

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AIM: To identify the most common technical errors encountered in endodontically treated maxillary and mandibular molar teeth, determine which root canals are most frequently associated with these errors, and evaluate the relationship between endodontic technical errors, coronal restoration status, and the presence of periapical lesions using Cone Beam Computed Tomography (CBCT).

Methodology: In this retrospective study, 102 CBCT images, obtained for different reasons at Kirikkale University, Faculty of Dentistry between 2022-2025 years and were examined, and a total of 135 molar teeth (424 root canals) were evaluated. The images were analyzed by two endodontists with at least three years of clinical experience and a specialist in oral and maxillofacial radiology. Each root canal was classified according to the corresponding tooth groups, and endodontic technical errors were recorded. Molar teeth were assessed for the presence of coronal restorations and periapical lesions. Data were analyzed using the chi-square test, and the results were expressed as percentages.

Results: Periapical lesions were detected in (27.4%) of the 424 root canals evaluated. The presence of technical errors was associated with a higher frequency of apical lesions. Underfilling and non-homogeneous filling were identified as the most common technical errors. Among maxillary molars, the mesiobuccal canal exhibited the highest frequency of errors (35.6%), whereas in mandibular molars, the distal canal (35.7%) was the most affected. No statistically significant relationship was found between the presence or absence of coronal restoration and the presence or absence of apical lesions. ($p>0.05$).

Conclusions (mandatory): Periapical lesions were more frequently observed in teeth with endodontic technical errors. During root canal treatment, greater attention should be given to achieving proper root canal length access and ensuring the homogeneity of the canal filling.

R047 | PREVALENCE OF APICAL PERIODONTITIS IN ENDODONTICALLY TREATED POSTERIOR TEETH WITH UNTREATED CANAL USING CONE-BEAM COMPUTED TOMOGRAPHY

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AIM: The purpose of this study was to evaluate prevalence of untreated canals in endodontically treated posterior teeth and their association with apical periodontitis (AP) in Serbian subpopulation.

Methodology: A total of 250 cone-beam computed tomography (CBCT) scans obtained between January 2021 and December 2024 from patients aged 24-86 years were retrospectively examined. CBCT images of edentulous patients or patients without endodontically treated teeth were excluded from the study. Periapical and endodontic status scale (PESS) was used as scoring system for evaluating both endodontic treatment quality and periapical pathology of endodontically treated maxillary and mandibular premolars and molars. Presence of untreated canal and the association between unfilled root canal and AP was investigated. The data were statistically analysed using Chi-Square test with level of significance set at $P<0.001$.

Results: A total of 539 endodontically treated posterior teeth were examined, and 231 (42.86%) had signs of AP. Adequate root canal filling with no AP was found in 217 (40.26%) teeth. Teeth with adequate endodontic treatment was associated with AP only in 16 (6.93%) cases, with significant difference comparing to teeth with inadequate treatment 215 (93.07%) ($P<0.001$). Untreated canals were found in 48 (8.90%) posterior teeth, and 38 (79.17%) of those teeth had signs of AP. The frequency of untreated canal was highest in maxillary molars 28 (58.33%), with 82.14% presenting AP. The prevalence of AP in teeth with untreated root canal 7.05% (38/539) was significantly different comparing to total number of posterior teeth with signs of AP (231/539) ($P<0.0001$).

Conclusions (mandatory): The vast majority of endodontically treated posterior teeth with untreated root canal had signs of periapical lesion. Prevalence of apical periodontitis in posterior teeth with unfilled canals was highest in maxillary molars. CBCT is a powerful tool for evaluation of quality of endodontic treatment and periapical pathology.

R048 | INFLUENCE OF DENTAL MATERIALS ON ARTEFACTS AND IMAGE QUALITY IN DENTAL-DEDICATED MRI

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AIM: As dental-dedicated magnetic resonance imaging (ddMRI) emerges as an alternative imaging modality for diagnosis within dentistry, a better understanding on the image characteristics of the commonly used dental materials is needed. This study investigated the influence of restorative and endodontic dental materials on artefact generation and image quality of dental-dedicated MRI (ddMRI).

Methodology: Seventeen dental materials were selected and shaped into custom cubes, which were placed in glass vials within a glass beaker filled with a homogenous solution. A cube with enamel and dentin, tailored from a human tooth, served as reference. Images were acquired using a ddMRI system operating at 0.55 T, with four pulse sequences. Quantitative image analysis involved evaluating the mean voxel values (MVVs) in the centre and periphery of the image, while qualitative analysis was performed by three specialised radiologists who assessed the presence, extent, and type (void, blooming, double contour, truncation, and/or distortion) of artefacts in the images.

Results: The most common artefacts were blooming and distortion, with a higher prevalence in 3D images with fat suppression, particularly in the sagittal and coronal planes. Endodontic materials presented larger MVVs values in all sequences, except for the 3D inflammation sequence.

Conclusions (mandatory): Dental materials cause artefacts in ddMRI, which are confined to the material itself or its immediate surroundings. Endodontic materials generate less artefacts when compared to restorative materials.

R049 | DIAGNOSTIC IMAGE QUALITY OF DENTAL-DEDICATED MRI TAILORED FOR ENDODONTIC PURPOSES

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AIM: Dental-dedicated magnetic resonance imaging (ddMRI) has been suggested as a feasible diagnostic imaging modality in endodontics. This study aimed to assess the diagnostic image quality of ddMRI tailored for endodontic purposes.

Methodology: ddMR images (Magnetom Free.Max Dental Edition, Siemens Healthineers, Erlangen, Germany) of eighteen teeth in nine patients (ten healthy teeth, five non-vital teeth with suspected AP, and three non-vital teeth with no suspicion of AP) were acquired. Six pulse sequences optimized for endodontic purposes were used: three designed to offer detailed anatomic information of the region-of-interest (proton-density-weighted, 2D and 3D), and three to offer insight on the possible presence of inflammation (proton-density- and T1-weighted, with fat suppression, 2D and 3D). The total scanning time was approximately 19 minutes per tooth. Images were assessed by three trained observers for overall image quality, signal-to-noise ratio, and image resolution / presence of artefacts, based on a 5-point Likert scale (1, “very good”; 2, “good”; 3, “acceptable”; 4, “poor”; and 5, “very poor”).
Inter-modality agreement (kappa statistic) was calculated, and diagnostic accuracy was evaluated with a consensus between clinical findings and CBCT as the reference standard.

Results: The average (among observers) overall image quality ranged from 2.0 to 2.5, depending on the pulse sequences, while signal-to-noise ratio varied from 1.8 to 2.4, and image resolution / presence of artefacts ranged from 2.0 to 2.5. When combined, the scores provided an overall quality score of 2.2, suggesting the images were judged as of good quality and good diagnostic value.

Conclusions (mandatory): Diagnostic image quality of ddMRI tailored for endodontic purposes was judged as “good”, and the observers believe they provide good diagnostic value. Further studies are needed to define the diagnostic efficacy of each tested pulse sequence in the detection of the diverse endodontic alterations found in the clinics.

R050 | ASSESSING APICAL PERIODONTITIS WITH DENTAL-DEDICATED MAGNETIC RESONANCE IMAGING AND CONE BEAM COMPUTED TOMOGRAPHY: A PILOT IN VIVO STUDY

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AIM: Dental-dedicated magnetic resonance imaging (ddMRI) has emerged as a potential alternative for dental imaging, providing high-resolution images of the soft and hard tissues in the dentomaxillofacial area without radiation exposure. The aim of this study is to show the comparison of ddMRI to cone beam CT (CBCT) as an imaging modality for diagnosing apical periodontitis (AP).

Methodology: Ten patients referred for CBCT imaging (X1, 3Shape, Copenhagen, Denmark; field-of-view 5x5 cm, resolution 0.075 mm) due to suspicion of a periapical lesion were also imaged using ddMRI (Magnetom Free.Max, Siemens Healthineers, Erlangen, Germany), using two dedicated pulse sequences (field-of-view 6x6 cm, section thickness 2 mm): proton-density-weighted turbo spin-echo (PD-TSE) for sagittal and coronal sections (resolution 0.2 mm) and a PD-TSE with fat suppression for sagittal sections (resolution 0.3 mm). Three observers assessed the presence of AP (disease/healthy/unsure) in CBCT and ddMRI. Inter- and intra-observer reproducibility were assessed using Kappa statistics. The two imaging modalities were compared using the McNemar test.

Results: Inter-observer reproducibility ranged from moderate to excellent for ddMRI (0.6-1.0), and was moderate (0.6-0.8) for CBCT, while intra-observer reproducibility was moderate (0.7-0.8) for ddMRI and ranged from moderate to excellent for CBCT (0.61-1.0). CBCT and ddMRI were statistically similar (p=0.94) regarding the assessment of AP.

Conclusions (mandatory): ddMRI was comparable to CBCT regarding the assessment of AP in this in vivo pilot study. Further studies based on larger case series are needed to define the possible added value of ddMRI when used for diagnosis in apical periodontitis.

R051 | ULTRA- LOW DOSE CONE BEAM CT COMPARED TO STANDARD DOSE IN THE ASSESSMENT OF VERTICAL ROOT FRACTURE: AN IN-VITRO STUDY

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AIM: INTRODUCTION
This in-vitro study aims to evaluate the diagnostic accuracy of the ultra-low dose protocol of the Planmeca cone-beam CT device in detecting vertical root fractures and compare it with the standard protocol in the presence or absence of gutta-percha.

Methodology: Sixty extracted single-rooted mandibular premolars were sectioned at the cemento-enamel junction, and the canals were cleaned and shaped using rotary files. Twenty teeth served as controls, while forty were artificially fractured and categorized as completely or incompletely fractured (n = 20). The specimens were randomly placed in sheep mandibular sockets, and CBCT scans were acquired using both standard and ultra-low dose protocols, with and without gutta-percha in the canals. Two blinded radiologists and two endodontists evaluated the images. Diagnostic accuracy was assessed using receiver operating characteristic (ROC) curves, and a 5% significance threshold was applied to determine statistical differences.

Results: The diagnostic accuracy was significantly high ($P<0.05$) in both complete and incomplete groups with both protocols. Complete fractures were diagnosed more accurately than incomplete fractures in both imaging protocols. Gutta percha had a negative effect on the diagnostic accuracy of images, especially in the incomplete fracture group. According to the diagnostic percentage of the observers, the percentage of correct diagnosis in the control group (teeth without fracture) was above 90% in both protocols and irrespective of presence and absence of gutta-percha. No significant differences were observed in diagnostic accuracy between the ultra-low dose and standard protocols, indicating comparable performance in detecting both complete and incomplete fractures.

Conclusions (mandatory): This study demonstrated that the ultra-low-dose protocol has the same diagnostic performance as the standard protocol for both incomplete and complete vertical root fractures.

R052 | A NOVEL 3D-PRINTED POSITIONING SYSTEM FOR ENHANCED REPRODUCIBILITY IN LONGITUDINAL MICRO-CT STUDIES OF ENDODONTIC TREATMENTS

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AIM: Micro-computed tomography (micro-CT) has revolutionized endodontic research by enabling non-destructive, high-resolution imaging of internal structures. A significant limitation of longitudinal studies is the difficulty of maintaining consistent multi-sample positioning across multiple scans, which impacts data comparability and segmentation accuracy. On the other hand, simultaneous positioning of multiple samples significantly reduces the data volume, ensures uniform acquisition and equal conditions, and significantly speeds up the survey time. This study proposes a novel 3D-printed holder designed to enhance the precision and repeatability of micro-CT imaging in endodontic research. The holder was assessed as working through the success of three longitudinal studies involving more than 200 teeth.

Methodology: The proposed system combines a 3D-printed base with floral foam as a tooth holder. A combination of digital sample markings and metal reference markers is used to properly position specimens and register scans.
To validate the system's effectiveness, we conducted a controlled study with two groups of five samples, each scanned at four distinct treatment stages. Using specialized imaging software (VG Studio 12.4.2024, Hexagon, Germany), automatic surface determination and registration to evaluate repositioning accuracy was performed. The total least square deviation in sample alignment was quantified through spatial analysis of landmark points, revealing a high level of reproducibility with minimal displacement error. ANOVA test was used to statistically analyze the deviation results.

Results: ANOVA confirmed that the deviation between sample positions across scanning stages is not statistically significant ($p > 0.05$), demonstrating the system's reliability for longitudinal micro-CT studies.

Conclusions (mandatory): The foam's adaptability ensures precise, repeatable positioning throughout the different treatment stages, while minimizing X-ray artifacts. The combination of digital sample markings and metal reference markers facilitates accurate orientation and registration of scans. This approach enhances workflow efficiency, especially in progressive treatment studies that requires longitudinal assessment of structural changes in root canal morphology and filling materials.

R054 | PREVALENCE OF DENS INVAGINATUS IN BRITISH POPULATION. A RETROSPECTIVE CBCT OBSERVATIONAL STUDY

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AIM: The scientific literature on this topic mostly consists in case reports, whereas the studies reporting on the prevalence in British population are pretty scarce, therefore the purpose of this study was to determine the prevalence of symptomatic and non-symptomatic Dens Invaginatus (DI), associated dental complications and to classify the type of the anomaly in the British population.

Methodology: This study was a three-centre retrospective analysis of CBCT images taken at imagistic centres in Liverpool, Manchester and London between 2021-2025.

Results: In total a number of 5377 CBCT scans were analysed. DI was identified in 10 patients, representing 0.18% of the studied population. A total of 16 teeth were identified of presenting the anomaly, meaning that 6(0.11% of the population) patients presented the anomaly in more than one tooth, in our case bilateral DI in the top laterals. The most involved tooth was the upper lateral, DI being present in 14(87.5%) teeth, and in 8(0.14%) individuals of the studied population. The most prevalent type was type I – 9(56.25% of the cases and 0.092% of the population). Eight(50%) teeth presented apical periodontitis, identified in 8(80% of the cases, 0.14% of the population) individuals, four of them presenting DI bilaterally (0.07% of the population), with one of the teeth having pathosis, with the homologue tooth being vital. Type II DI is more prone to develop pathosis.

Conclusions (mandatory): Our study couldn't confirm a high prevalence of DI in the British population compared to studies on other populations. The closest to our study, from the prevalence point of view is the study of Ruprecth et al. (1987)

Acknowledgements (optional): there is no conflict of interest

R055 | DENTAL PRACTICALITY INDEX AND ACCEPTANCE OF FURTHER TREATMENT

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AIM: The aim of our study was to evaluate the usefulness of the Dental Practicality Index (DPI) during the first specialized endodontic examination. We aimed to determine the frequency of the total index score at the initial examination and to discover the correlation between the index score and acceptance of further treatment.

Methodology: In January and February 2024, we examined ninety-nine patients referred to us for initial examination at the Center for Dental Diseases of the Dental Clinic, University Medical Center Ljubljana. We recorded gender, age, dental condition, structural integrity scores, periodontal status, endodontic status, broader context, overall DPI score and acceptance for further treatment. Correlations between DPI score and acceptance for further treatment were tested with chi-square tests.

Results: The mean age was 48.89 ± 15.63 years, with 72.5% of participants being female. Referred patients required treatment in the mandible in 42.4% of cases and in the maxilla in 57.6% of cases. Molars were the most commonly affected teeth (70.7%), followed by premolars (17.2%) and incisors with canines (12.1%). The mean DPI score was 1.94 ± 0.90 for endodontic status, 0.42 ± 0.69 for periodontal status, 1.74 ± 0.75 for structural integrity and 0.10 ± 0.30 for the broader context. The mean overall DPI score was 4.18 ± 1.65. The frequency of individual DPI score was 0 (5.1%), 1 (1.0%), 2 (5.1%), 3 (8.1%), 4 (48.5%), 5 (16.2%), 6 and more (16.1%). Overall, 80.8% of cases were accepted for specialist treatment at the Center for Dental Diseases. The data suggest that the likelihood of patients being accepted for treatment decreases as the DPI score increases.

Conclusions (mandatory): There was a statistically significant association between DPI score and patient acceptance for further treatment. General dentists usually refer very complex cases to endodontic specialists.

R056 | PERIAPICAL LESIONS IN PATIENTS WITH ECZEMAS IN NORTHERN FINLAND

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AIM: To investigate the prevalence of periapical lesions among patients having various types of eczemas in the Northern Finland Birth Cohort 1966 (NFBC1966).

Methodology: The study was part of a 46-year follow-up survey of the Northern Finland Birth Cohort 1966 Study. The study population consisted of 1850 participants who lived within 100 km from Oulu. The data included health questionnaires, skin examinations performed by dermatologists and panoramic radiographs. Participation was voluntary and based on informed consent. The data were handled with complete anonymity. The skin examination was done to 1849 participants, and the radiographic periapical lesions were defined from 1850 panoramic radiographs with criterion yes/no. Participants who denied the use of their data for the research and participants who would have required antibiotic prophylaxis for clinical periodontal examinations were excluded from the study.

Results: Almost one fourth of the study population had at least one periapical lesion. Seborrheic, nummulare and atopic eczemas were the most important inflammatory types of eczemas related to periapical lesions in the study population. About one tenth of persons with seborrheic eczema had at least one periapical lesion.

Conclusions (mandatory): In the population studied the prevalence of periapical lesions varied according to types of eczemas. Periapical lesions were most common among patients with seborrheic eczema.

Acknowledgements (optional): We thank all cohort members and researchers who participated in the 46 yrs. study. We also wish to acknowledge the work of the NFBC project center.

R058 | THE INFLUENCE OF MISSED CANALS, QUALITY OF ROOT CANAL TREATMENT AND THE QUALITY OF CORONAL RESTORATION ON THE PREVALENCE OF PERIAPICAL LESIONS IN ENDODONTICALLY TREATED TEETH: A CROSS-SECTIONAL STUDY

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AIM: The objective of this study is to examine the correlation between missing canals, the quality of root canal treatment, and the quality of coronal restoration with the prevalence of periapical lesion in endodontically treated teeth using CBCT in the UAE population.

Methodology: Four hundred twenty preexisting CBCT scans from 3 different health centers were assessed by two independently calibrated observers. One thousand three hundred endodontically treated teeth were inspected, of which nine hundred seventy-one were included. All root-filled teeth were analyzed for the presence of missed canals, quality of root canal treatment, the quality of coronal restoration and their association with apical periodontitis. Chi2 test for proportions was used to analyze differences between groups, and an odds ratio was calculated in order to analyze the association of the relevant factor with periapical disease. P<,.05 was considered statistically significant.

Results: The prevalence of periapical lesions was evaluated at 38.3% (CI 95%: 35.3-41.4%). When the quality of the root canal treatment (RCT) was insufficient, the likelihood of a periapical lesion (CBCT PAI score) increased approximately sixfold (OR=5.71; p<0.001). The existence of missing canals significantly elevated the likelihood of periapical lesion occurrence (OR=6.77; p<0.001). In cases of unsatisfactory RCT quality, the prevalence of periapical lesions was 72.2% in teeth with missing canals. The position of molars considerably elevated the likelihood of periapical lesion incidence in comparison to anterior positions (OR=3.28; p<0.001). The possibility of presence of periapical periodontitis increased approximately threefold when the quality of coronal restoration was insufficient (OR=2.88; p<0.001).

Conclusions (mandatory): The incidence of periapical lesions is influenced by the quality of the root canal, quality of coronal restoration and the presence of missing canals. Furthermore, molars had a greater number of lesions than anterior teeth due to their increased number of roots and root canals.

R059 | PREVALENCE OF PERIAPICAL RADIOLUCENCY AND QUALITY OF ROOT CANAL FILLING IN A SWEDISH POPULATION: A CBCT ANALYSIS

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AIM: Aim: This study investigated the prevalence of periapical radiolucency (PR) and the technical quality of root canal fillings in a Swedish cohort using Cone Beam Computed Tomography (CBCT).

Methodology: CBCT radiographs of 442 patients referred to the Maxillofacial Radiology clinic at Karolinska Institutet were analyzed, assessing 1920 teeth for periapical health. PR presence was evaluated in the axial, coronal and sagittal views. The technical quality of the root canal fillings was scored by obturation length, sealer extrusion, missed canals and homogeneity. The radiographs were assessed by two observers independently.

Results: The prevalence of PR was 11.3% in general, whereas for root filled teeth it was 53.8%. Among root filled teeth with PR, 29% had adequate obturation length, 36% were short, 12% were long, 19% had untreated root canals, and homogeneous obturation was observed in 69%. PR was more prevalent in patients with root filled teeth than those without (72% vs. 11%; $p < 0.05$). No significant differences were found concerning gender, age and ASA-classification (American Society of Anaesthesiologists) ($p > 0.05$).

Conclusions (mandatory): There was a high prevalence of PR in root canal treated teeth which is consistent with previous studies using similar methodology. Only 27% of root filled teeth with PR exhibited good technical quality (adequate length and homogeneous obturation). Future studies should explore additional causes of PR.

R061 | FACTORS INFLUENCING THE LONG-TERM SURVIVAL AND SUCCESS OF ENDODONTICALLY TREATED TEETH: A RETROSPECTIVE STUDY IN AN EDUCATIONAL HOSPITAL

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AIM: Understanding factors that influence the long-term survival and success of endodontically treated teeth (ETT) is crucial for enhancing patient care. This retrospective study evaluates the records of teeth that underwent initial root canal treatment (RCT) or retreatment, examining various predictive factors—including coronal status—and their association with ETT outcomes.

Methodology: Patients who underwent RCT at Princess Nourah bint Abdulrahman University between 2018 and 2023 were included if they attended a recall visit and had accessible pre- and post-treatment periapical radiographs. Clinical and radiographic assessments were performed by two calibrated examiners to evaluate RCT quality and periapical index (PAI) scores. Coronal restorations were assessed for quality, type, and timing. Data on oral hygiene, smoking, medical conditions, periodontal status, and occlusion were also recorded. Survival was defined as a clinically asymptomatic, functional tooth, and success was defined as a PAI score of less than or equal to 2 and clinical asymptomatic status at follow-up. Regression analysis was performed with statistical significance defined as $p < 0.05$.

Results: A total of 463 endodontically treated teeth from 244 patients were analyzed. The overall survival rate was 89.8%, with 80.5% meeting success criteria. The majority of patients were female (65%), and only 8.9% had a healthy periodontium. Multivariate analysis identified the PAI score, RCT filling density, and coronal restoration quality as key determinants of treatment success (Nagelkerke $R^2 = 0.338$). Bivariate analysis confirmed that filling density (OR = 4.49) and coronal restoration type (OR = 5.857) were the strongest predictors of ETT survival.

Conclusions (mandatory): Endodontically treated teeth showed a high survival rate, with success influenced by both patient and treatment-related factors. Key predictors included the pre-operative PAI score, filling density, and coronal restoration quality. These findings highlight the importance of high-quality RCT and coronal restoration in ensuring long-term success.

R062 | INFLUENCE OF ROOT CURVATURE ON THE OUTCOME OF NON-SURGICAL ENDODONTIC RETREATMENT OF MANDIBULAR FIRST MOLARS: A COHORT STUDY

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AIM: The purpose of this study was to assess the impact of root curvature on the results of non-surgical endodontic retreatment in mandibular first molars.

Methodology: Of 1834 teeth that underwent non-surgical endodontic retreatment at the Department of Endodontics, University of Oslo, between 2009 and 2019, we analyzed radiographic data from 179 mandibular first molars with adequate control. Cases were evaluated using the periapical index (PAI) and classified as either success (PAI=1-2) or failure (PAI=3-5). The curvature was measured by the Schneider criteria, and grouped as straight (<20°), medium (20°-30°) and curved (>30°). As length and density are considered important for the outcome, these variables were also recorded. Statistical analyses, including the chi-square test and multiple logistic regression models were conducted to compare subgroups based on the selected explanatory variables.

Results: The overall success rate was 55%. The root curvature appeared not to influence the outcome (p=0.588). Root filling length categorized as short, adequate or long did not significantly impact the outcome (p=0.618), nor did the presence of voids (p=0.796). Logistic regression did not provide additional insights.

Conclusions (mandatory): The success of non-surgical endodontic retreatment was not impacted by root curvature in the present study. Similarly, root filling length or presence of voids did not appear to influence the outcome.

R063 | THE ROLE OF RESTORATIVE FACTORS ON THE OUTCOME OF NON-SURGICAL ROOT CANAL TREATMENT

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AIM: Root canal treatment (RCT) is essential for preventing apical periodontitis by eliminating microorganisms through chemo-mechanical debridement. A key factor for successful RCT is the placement of an adequate root filling to seal the canals and prevent reinfection. However, post-endodontic disease can still occur despite technically sound root fillings, suggesting other prognostic factors may impact treatment outcomes. This study aims to evaluate the impact of post-endodontic restorative factors on the outcome of non-surgical RCT after a minimum one-year follow-up.

Methodology: Patient records from the Postgraduate Endodontic Clinics at King Abdulaziz University Dental Hospital were reviewed. One hundred randomly selected cases of conventional RCT on permanent teeth with a minimum one-year follow-up were assessed through clinical and radiographic evaluations. Treatment outcomes were classified as healed, healing, or diseased. The influence of restorative factors on treatment success was analyzed.

Results: Of the 100 cases analyzed, 35% were healed, 40% were healing, and 25% were diseased. Among the successfully treated cases, 25 had adequate obturation with temporary coronal restorations, 35 had adequate obturation with permanent coronal restorations, and 15 had inadequate permanent restorations. Radiographic evaluation confirmed that all successful cases had adequate obturation. Among failed cases, 20 exhibited either extruded or short obturation, regardless of the coronal restoration. Five failed cases had adequate obturation but lacked coronal restoration, leading to treatment failure.

Conclusions (mandatory): Both obturation quality and coronal restoration significantly influence RCT success. Cases with inadequate obturation or coronal seals had a higher failure rate. Further studies with larger sample sizes are needed to confirm these findings and better understand the impact of restorative factors on endodontic outcomes.

R064 | LONG-TERM EVALUATION OF TOOTH SURVIVAL AND PERIAPICAL HEALING IN ROOT FILLED TEETH

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AIM: To assess long-term survival and periapical status of root filled teeth performed by dental students. Furthermore, to identify and analyze prognostic factors related to the long-term prognosis.

Methodology: This study involves follow-up of potential of 1216 patients who received root canal treatment of one or more teeth at the Department of Dentistry and Oral Health, Aarhus University, be-tween January 1st, 2014, and December 31st, 2019. The patients were invited to a clinical and radiographic follow-up examination. The primary outcome measures included tooth survival, and periapical status assessed using the Periapical Index (PAI).

Information on potential prognostic factors was retrieved from patient files, and included patient related factors, tooth-specific data such as tooth type, root filling quality, antagonist and approximal contacts, and coronal restorative treatment factors.

Results: In total, 468 patients were initially excluded due to missing records. Of the remaining 748 patients, 206 have thus far been offered follow-up examination. Of these, 78 patients accepted and attended a clinical and radiographic follow-up examination, 20 patients are pending for recall, 21 patients were deceased, and 87 patients declined invitations for follow-up examination. Preliminary results of 106 teeth in 78 patients showed an overall tooth survival of 70 % and a healing proportion of 55 % over a mean of 7.84 (0.14, 11) years follow-up. Analyses of significant prognostic factors related to tooth survival and periapical healing are in progress.

Conclusions (mandatory): The preliminary results showed 70 % of root filled teeth treated by dental students survive the observation period. The healing proportion shows that a little more than half of the root filled teeth heal during the observation period and that root filled teeth may require further endodontic treatment or extraction.

Acknowledgements (optional): Funding
Danish Dental Association scholarship for dental students

R065 | EFFECTS OF SPECIALIST TREATMENT IN ENDODONTIC THERAPY ON TOOTH RETENTION AND TREATMENT COSTS: A COST-EFFECTIVENESS ANALYSIS

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AIM: Root canal treatment (RCT) is one of the most frequently performed procedures in dentistry. Endodontic specialists have been reported to achieve higher success rates than general practitioners (GPs). However, treatment by a specialist is also associated with increased costs. Here, we evaluate the impact of practitioners' experience in a cost-effectiveness analysis.

Methodology: A Markov model was developed for a molar requiring a RCT of an initially 25 years old patient. Three treatment pathways were compared: (1) RCT performed by a GP, (2) RCT performed by a specialist, and (3) initial treatment by a GP with referral to a specialist for retreatment in cases of primary RCT failure. Outcomes were assessed in terms of tooth retention and treatment costs, reflecting initial and possible follow-up treatments. Cost estimates were derived from public and private fee schedules in Germany and expressed in EUR, applying an annual discount rate of 3%. Transition probabilities between health states were based on published literature. Monte-Carlo-microsimulations were conducted and the incremental cost-effectiveness ratio (ICER) used as outcome measure.

Results: The cumulative tooth retention time following primary RCT by a GP was 29.25 years, with cumulative lifetime costs of 461.25€. When failed primary RCTs were subsequently referred to a specialist for retreatment, tooth retention increased to 44.13 years at a cost of 824.51€, resulting in an incremental cost-effectiveness ratio (ICER) of 24.41€ per additional year of retention. The highest tooth retention was observed when all treatments were performed by an endodontic specialist, reaching 48.32 years at total costs of 1100.12€, with an ICER of 33.50€ compared to GP treatments.

Conclusions (mandatory): Treatment by a specialist significantly increases tooth retention compared to case management by a GP, although at higher costs. Referral to a specialist for retreatment extends tooth retention by nearly 15 years, offering a cost-effective compromise between treatment success and financial considerations.

R066 | COMPARING SUCCESS RATES OF SELECTIVE AND CONVENTIONAL NON-SURGICAL RETREATMENT: A RETROSPECTIVE STUDY

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AIM: This study aimed to:
- Compare the success rates of selective and conventional retreatment
- Evaluate the impact of underselling on retreatment outcome, considering the presence or absence of periodical radiolucency.

Methodology: A retrospective study was conducted (2023-2025), focusing on permanent multi-rooted teeth that underwent non-surgical retreatmen (selective or conventional).
Clinical and radiographic records were analysed to classify treatment outcomes into “healed,” “healing,” or “failed,” based on clinical and radiographic criteria after a 1-year follow-up.
Treatment outcomes were compared between conventional and selective retreatment groups. Additionally, the association between root filling adequacy (underfilled vs. adequate) and retreatment outcomes was evaluated.
Fisher’s exact test (p-value = 0.05) was used for statistical analysis.

Results: A total of 134 teeth were analyzed. At the 1-year follow-up:
The success rates for conventional retreatment and selective retreatment were similar (93.0% and 94.4%, respectively).
For roots with initially healthy periapical status, selective retreatment achieved a 100% success rate compared to 93.7% for conventional retreatment, without significant difference. Independently from the strategy considered for these roots, getting the patency negatively impacted the success rate (92% when present vs. 97% when absent), but without significant difference.

Conclusions (mandatory): Selective retreatment demonstrated similar success rates to conventional retreatment for resolving periapical pathology. Additionally, the risk of new periapical lesions did not increase in non-retreated roots. Future studies with larger sample sizes and longer follow-up periods are needed to confirm these findings.

R067 | PERIAPICAL HEALING OF TEETH WITH APICAL PERIODONTITIS USING CONE-BEAM COMPUTED TOMOGRAPHY AND DIGITAL PERIAPICAL RADIOGRAPHY

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AIM: To determine after a 1- to 2-year follow-up period, the outcome of root canal treatments and non-surgical retreatments in teeth with apical periodontitis, evaluated by both cone-beam computed tomography (CBCT) and digital periapical radiography (DPR).

Methodology: Sixty-three teeth in 38 patients were selected. Teeth underwent rotary treatments (10 primary / 53 retreatments) and were filled using warm vertically compacted gutta-percha and AH Plus (Dentsply-Sirona, Germany). Two observers compared the initial, 1 and 2-year post-operatively radiographs and CBCT scans and determined the outcome as follows:" healed" for resolved periapical status," healing" for reduced radiolucency and" failure" for new, enlarged or unchanged lesion. The Kappa coefficient (K) was calculated. Pearson correlation, T-test, One-way ANOVA and Linear Regression Analysis tests were used for group comparisons. Statistical significance was set at $p<0.05$.

Results: The study revealed a statistically significant difference in outcome diagnosis of teeth between DPR and CBCT, both at 1 and 2 years ($p<0.01$), with $K=0.936$. At 1 year recall, the" healed" rate was 56.6% using DPR and 39.6% using CBCT ($p=0.006$), while at 2 year recall the" healed" rate increased to 75.9% and 55.2% respectively ($p>0.05$). Preoperative periapical status of teeth and periapical status at 1-year recall evaluated by both CBCT and DPR were consistently associated with maxillary arch ($p<0.01$), while gender influenced healing at 2-year recall when using DPR ($p=0.048$). Also, there was a significant decrease in the apical lesion size of the teeth at all follow-up time periods, using both DPR and CBCT ($p=0.0001$), with complete resolution of the radiolucency in 31 teeth (49.2%).

Conclusions (mandatory): The increased accuracy of CBCT revealed a lower "healed" rates for root canal treatments and retreatments compared to DPR. According to the results of this study, the healing of apical periodontitis is a dynamic process that takes time.

R068 | THE EFFECT OF TOOTH STRUCTURE LOSS ON THE OUTCOME OF ROOT CANAL RETREATMENTS: 10-YEAR RECALL

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AIM: To determine if the volume of residual coronal tooth structure is a prognostic factor for 10-year survival of root canal re-treated teeth, assessed clinically and radiographically and to identify factors which may influence prognosis.

Methodology: A prospective clinical trial of 140 patients (156 teeth) requiring root canal re-treatment undertaken by postgraduate students at Guys Dental Hospital. The volume of residual coronal tooth structure was calculated by obtaining a dental impression following root canal re-treatment and following placement of an indirect restoration. The casts were scanned using an intraoral scanner, to calculate the remaining volume of tooth structure. Patients were contacted at 1 year, 5 years and 10 years for review. Fifty patients attended for clinical review and a further 32 phone call reviews at 10 years.

Results: Of the 129 patients contacted, 40% attended clinical review and 25% phone recall, totalling 92 teeth. Early extractions (1 year) occurred in 8 cases and late extractions (after 5 years) in 9 cases. Mean residual tooth structure was highest in the long-term survival group (73.5%), and lowest in early extraction group (40.2%). Dental Practicality Index (DPI) scores were significantly associated with survival outcomes, early extraction teeth showing a mean DPI of 4.0 compared with those teeth that survived to 10 years having a DPI of 3.08. A higher DPI was linked to increased extraction risk ($p < 0.05$).

Conclusions (mandatory): A promising 89% survival outcome was recorded at 10 years with as little as 13% residual coronal tooth structure at the time of re-treatment. Long term survival is strongly influenced by residual tooth structure and DPI scores.

R069 | SURVIVAL RATES AND PREDICTORS OF EXTRACTION OF TEETH RECEIVING A ROOT FILLING AND SUBSEQUENT ORTHOGRADE RETREATMENT DURING A 9-YEAR PERIOD. A SWEDISH REGISTRY STUDY

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AIM: This study aimed to assess the survival rate of teeth that received root filling and a subsequent orthograde retreatment within a 9-year period and to investigate factors affecting the risk of extraction during the same period.

Methodology: Data from the Swedish Dental Register identified individuals (>19 years) who had a tooth root filled between 2015 and 2016 and later during the period between 2015 and 2023 received an orthograde retreatment on the same tooth. The teeth were tracked longitudinally to identify registrations of codes indicating the tooth had been extracted. Data was censored in case the individual deceased or emigrated during the follow-up, that is until December 2023. Sex, age, number of intact teeth, remaining teeth and tooth type were used to identify possible factors affecting the outcome. Survival and Cox regression analyses were performed. $P < 0.05$ was considered statistically significant.

Results: The cohort (n=7,349) comprised 50.8% women, with a mean age of 57.4 years. Most treated teeth were in the maxilla (57.6%) and molars (53.9%). During the observation period (up to 8.9 years), 1 039 teeth were extracted. The 5-year survival rate was 84.8%, and the 7.5-year rate was 79.0%. The highest annual tooth loss (4.3%) occurred in the first year following retreatment. Preliminary results indicate that higher hazard ratio for extraction was associated with older age, having fewer remaining teeth, and with molar teeth.

Conclusions (mandatory): Approximately 77% of teeth that received a root filling followed by an orthograde retreatment within 9 years were retained during the period. Several factors seem to be associated with extraction which clinicians should be aware of in decision-making of root filled teeth in need for reintervention.

Acknowledgements (optional): This project was funded by the Region Norrbotten (NLL-1014423).

R070 | FACTORS AFFECTING ROOT CANAL FILLING QUALITY AND OUTCOMES OF ENDODONTIC RETREATMENT: A RETROSPECTIVE STUDY IN THE ENDODONTIC POSTGRADUATE PROGRAM

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AIM: Aim: This study aimed to assess the quality of root canal fillings before and after retreatment and to identify factors influencing the quality of fillings in retreatment cases.

Methodology: Materials and Methods: The study included 666 radiographs from patients undergoing endodontic retreatment between 2021 and 2023 at Ajman University's postgraduate clinic. Unreadable radiographs were excluded, leaving 565 radiographs (n=1055 roots). Each radiograph was evaluated for root filling homogeneity and the distance between the root canal filling and the radiographic apex using a six-point scoring system (UNAL score). The data were analysed using simple binary logistic regressions with generalized estimation equations (GEE) to analyse the effect of independent factors on acceptable quality of filling. Raw odds ratios and 95% confidence intervals were estimated from the Wald´s Chi2 statistic ($p < 0.05$). Then, multiple models were estimated to adjust by potential confounding factors.

Results: Results: The study found that 92.8% of retreatments achieved acceptable homogeneity and length, compared to only 8.9% before retreatment. Conversely, 91.1% were unacceptable before retreatment, decreasing to 7.2% after. Factors affecting retreatment quality included pre-sealer extrusion, which increased the risk of failure (OR=2.93; p=0.057). Sealer pre-extrusion was statistically significant (p=0.043), but post-extrusion remained relevant (p=0.062). Temporary restorations were preferred over no restoration (OR=0.35; p=0.073). Broken instruments, combined with MTA + Gutta Percha (GP) or MTA plug + continuous wave condensation filling techniques, significantly increased the risk of unacceptable fillings.

Conclusions (mandatory): Conclusion: Endodontic retreatment in a postgraduate setting significantly improved root canal filling quality. Pre-sealer extrusion was a key factor in retreatment failure, while temporary restorations showed positive trends. Complex cases involving broken instruments and specific filling techniques had higher risks of unacceptable outcomes. These findings emphasize the importance of specialist intervention and careful case management for optimal retreatment success.

R071 | SHORT-TERM OUTCOME OF NON-SURGICAL ENDODONTIC TREATMENTS PERFORMED BY PRE-GRADUATE STUDENTS OVER 13 YEARS: A RETROSPECTIVE STUDY AT THE UNIVERSITY OF COPENHAGEN

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AIM: To evaluate the short-term outcome of root canal treatments in permanent teeth performed by dental students and to assess the influence of patient- and clinical factors.

Methodology: Electronic patient records (2010–2023) from the University of Copenhagen, Denmark were accessed via a Structured Query Language database, using metadata to map relevant codes and enable automated data extraction. Data was collected on cases treated by students supervised by clinical instructors and included sex/age/health status/smoking/tooth type/pulp diagnosis/periapical status, underlying dental factors (e.g. obliteration) and treatment-related factors (e.g. root filling quality). A favorable outcome was defined as absence of pain and no or a reduction of the periapical radiolucency. A non-favorable outcome was defined as severe post-treatment pain and/or an unchanged or enlarged periapical radiolucency. The follow-up period was predominately 6–12 months. Patients with missing follow-up data were excluded. Chi-square was used for comparisons and multivariate logistic regression analyses to assess factors associated with outcome. $P<0.05$ was considered statistically significant. Ethical approval was obtained.

Results: A total of 1021 teeth in 804 patients were included; 295 teeth with vital pulp and 517 were necrotic; 406 had a periapical lesion; and 39 were previously root-filled. 111 of 1021 teeth lacked data. Overall, a favorable outcome was assessed in 87.5% of the teeth.
No significant differences were found between favorable and non-favorable outcomes regarding age, pulp diagnosis, periapical status, health status or smoking.
Multivariate analysis showed an unfavorable outcome to be significantly ($p<0.05$) influenced by sex (female:male OR=1:0.61), tooth type (anteriors:premolars:molars OR=1:0.51:1.07), underlying dental factors (no:yes OR=1:1.91), and treatment-related factors (no:yes OR=1:1.75).

Conclusions (mandatory): In a short-term perspective, dental students demonstrated a fairly high frequency of favorable outcome, independent of diagnosis. The underlying dental factors and treatment-related factors seem to affect the outcome, though the reason for this remains unsolved and should be studied further.

RESEARCH POSTERS 02

R072 | PHYSICO-CHEMICAL AND ANTIMICROBIAL PROPERTIES OF BIOROOT RCS MODIFIED WITH HYDROXYAPATITE, SILVER NANOPARTICLES AND PMETAC

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AIM: Evaluate physico-chemical and antimicrobial properties of BioRoot RCS (BR) modified with hydroxyapatite (HA), 2 nm colourless silver particles (nAg) and 2-methacryloyloxyethyl-trimethylammonium chloride polymer (PMETAC).

Methodology: Four groups were prepared: BR (control); BR+HA (90% BR + 10% HA powder and BR liquid); BR+HA+PMETAC (90% BR + 10% HA powder and liquid of distilled water + 1M calcium chloride + 9.75% PMETAC); BR+HA+PMETAC+nAg (90% BR + 10% HA powder and liquid of distilled water + 1M calcium chloride + 9.75% PMETAC + 0.22% nAg). The assessment of solubility, flowability, setting time, chemical composition (X-ray diffraction analysis, Fourier-transform infrared spectroscopy), ion release (inductively coupled plasma optical emission spectroscopy), pH, surface morphology (scanning electron microscopy, energy dispersive spectroscopy), thermal stability (thermogravimetric analysis), antimicrobial activity against Enterococcus faecalis and Staphylococcus aureus (agar diffusion and direct contact tests) were performed at 24 hours and 7 days (n = 5 per assessment). The Shapiro-Wilk and one-way ANOVA with Tukey post-hoc tests were used for statistical analysis ($p < 0.05$).

Results: All groups met the ISO 6876:2012 requirement for flowability (> 17 mm), except BR+HA (16.92 mm). The greatest solubility in HBSS using ISO recommended ratio (14.45 mm²/ml) was for BR+HA+PMETAC+nAg (24h: 4.39%; 7 days: 7.96%), the lowest for BR (24h: 2.93%; 7 days: 6.87%). At 3 cm²/ml ratio, the greatest solubility was for BR (24h: 1.43%; 7 days: 2.54%), the lowest for BR+HA (24h: 0.88%; 7 days: 1.27%). The greatest pH (24h: 11.85; 7 days: 12.13), calcium release (24h: 223.64 mg/L; 7 days: 445.18 mg/L), and antibacterial activity was determined for BR+HA+PMETAC+nAg ($p < 0.05$). No significant differences in surface morphology and thermal stability were noticed, along with zirconium oxide and calcium hydroxide peaks being predominant in chemical composition for all groups.

Conclusions (mandatory): The sealer formulation of BR+HA+PMETAC+nAg significantly improves BR antimicrobial activity with no adverse impact on physico-chemical properties.

R073 | RETROSPECIVE CLINICAL STUDY ON THE COMPARISON OF EXTRUSION AND POSTOPERATIVE PAIN OF CALCIUM SILICATE AND RESIN-BASED ROOT CANAL SEALER

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AIM: The purpose of this study was to compare the incidence of sealer extrusion and post obturation of pain after root canal obturation using calcium silicate- and resin-based sealers.

Methodology: This study included patients with a history of nonsurgical root canal treatment and retreatment from January 2019 to December 2020 who had been evaluated both clinically and radiographically 1 week after root canal obturation. The records were reviewed to assess the patient's age, sex, presence of preoperative pain, periapical lesions, tooth vitality, and postoperative pain. The radiographic evaluation was performed blindly. Each tooth was examined for overextension of the root canal filling. A total of 967 patients were selected and evaluated in this study.

Results: A total of 103 patients obturated with AH Plus sealer (22%), and 120 obturated with Ceraseal (24%) had sealer extrusion. Thirteen patients obturated with AH Plus sealer (13%) and 14 obturated with Ceraseal (12%) experienced post-obturation pain after sealer extrusion. There was no statistically significant difference in the occurrence of pain between the sealer groups after sealer extrusion. However, significant differences were observed in the proportions of sealer extrusion occurrences based on age group when each sealer was used individually.

Conclusions (mandatory): . In conclusion, this study does not intend to promote sealer extrusion but rather proposes that practitioners should adopt a more positive approach when using injectable sealers. Within the limitations of this study, our data showed no significant difference in postoperative pain between the calcium silicate and resin sealers after sealer extrusion.

Acknowledgements (optional): This study was supported by grant no 08-2021-0016 from the SNUDH Research Fund.

R074 | THE EFFECT OF SETTING CONDITION ON MECHANICAL PROPERTIES OF PREMIXED – PUTTY TYPE BIOACTIVE CERAMIC CEMENT

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AIM: This study aims to compare the mechanical properties of Mineral Trioxide Aggregate (MTA) with various premixed putty-type bioactive ceramic cements (PPBCs) under different setting conditions, specifically focusing on their performance when in contact with Fetal Bovine Serum (FBS) or saline.

Methodology: All cements were placed on a floral foam soaked with saline or FBS during the setting process. The setting time and microhardness of ProRoot MTA (PMTA; Dentsply, Tulsa, USA) and four PPBCs—EndoSequence BC RRM™ fast-set putty (BCPT; Brasseler, Savannah, USA), Endocem MTA premixed regular (ECPM; Maruchi, Wonju, Korea), Well-Root PT (WRPT; Vericom Co., Chuncheon, Korea), and One-Fil PT (OFPT; Mediclus, Cheongju, Korea) were evaluated. Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS) were employed to analyze crystal morphology and elemental composition. A two-way ANOVA was used to analyze the interaction between setting conditions and cement types. The Mann-Whitney U test, Kruskal-Wallis test, and Scheffé's post hoc test were also used.

Results: The setting time increased under FBS conditions for all materials, but the difference was not statistically significant among cements ($p>0.05$). Overall, BCPT and ECPM had significantly shorter setting times compared to PMTA ($p<0.05$). Microhardness measurements revealed that while PMTA's microhardness decreased under FBS conditions ($p<0.05$), all PPBCs showed increased microhardness under FBS conditions, with ECPM and BCPT demonstrating the highest values ($p<0.05$). SEM analysis indicated distinct crystallization patterns, with BCPT showing better crystallization under FBS conditions compared to saline.

Conclusions (mandatory): PPBCs exhibited comparable or superior mechanical properties to PMTA under FBS and saline conditions, with a similar increase in setting time. However, all PPBCs showed significantly enhanced microhardness under FBS conditions, whereas PMTA decreased. These findings suggest that PPBCs may be effective alternatives to PMTA, especially in blood-contact scenarios.

Acknowledgements (optional): This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (NRF- 2019R1C1C1003240)

R075 | THE IMPACT OF MAIN IRRIGATION LIQUIDS ON BIODENTINE IN PERFORATION CLOSURE – A MICROSCOPIC COMPARISON

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AIM: To evaluate the influence of sodium hypochlorite, ethylenediaminetetraacetic acid and citric acid with and without ultrasound activation on the surface appearance and chemical composition of Biodentine used in perforation repair.

Methodology: 147 Biodentine samples were divided into 3 groups based on the setting time: 12 minutes, 45 minutes and 24 hours. Specimens from each group were rinsed with 2% and 5.25% sodium hypochlorite, 17% ethylenediaminetetraacetic acid and 40% citric acid for 5 or 20 minutes with or without simultaneous ultrasonic activation. The control group was not subjected to any irrigation. Specimens were then analyzed with energy dispersive X-ray spectroscopy. Visual evaluation of their surfaces was performed using a scanning electron microscope.

Results: Specimens with the shortest setting time were excluded from further analysis due to severe material degradation during irrigation. The results indicate that the investigated irrigation protocols influenced material's surface. When sodium hypochlorite was applied, no alteration in chemical composition was detected compared to the control group. Visible surface modifications were observed, with the most pronounced changes occurring in samples subjected to 20 minutes of ultrasonically activated irrigation. Rinsing with chelating agents significantly impacted the surface appearance of Biodentine and altered its chemical composition in the tested groups relative to the controls. Ultrasonic activation and extended liquid exposure time generally amplified the effects on the cement surface.

Conclusions (mandatory): The longer the setting time, the greater Biodentine's resistance to the tested rinsing protocols. Citric acid and ethylenediaminetetraacetic acid have a significantly stronger impact on the cement's surface appearance compared to sodium hypochlorite. Ultrasonic activation and prolonged rinsing time further enhance the destructive effects of the rinsing liquids. In the context of endodontic treatment, allowing Biodentine to fully set is crucial.

Acknowledgements (optional): This work was supported by the project: "InterChemMed-Interdisciplinary Doctoral Studies of Lodz Public Universities", cofinanced by the European Social Fund (POWR.03.02.00-00-I029/16).

R077 | EFFECT OF ONE-YEAR STORAGE IN PHOSPATE-BUFFERED SALINE ON MICROHARDNESS OF MINERAL TRIOXIDE AGGREGATE MODIFIED BY ADDITION OF SHORT GLASS FIBERS

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AIM: To evaluate microhardness of mineral trioxide aggregate (MTA) modified by addition of short glass fibers (SGF) after one-year storage in phospate-buffered saline (PBS).

Methodology: Three groups were prepared (n=20 per group). For control group, encapsulated MM-MTA (MicroMega, Besacon, France) was used. In two experimental groups, MTA powder was modified by SGF (Central Glass Co., Tokyo, Japan). Five wt% and 10 wt% of MTA powder was replaced with 5 wt% SGF (MM-MTA+5%SGF) and 10 wt% SGF (MM-MTA+10%SGF), respectively. After mixing the materials according to the manufacturer' s instructions, the materials were placed in custom made teflon molds (6mmx4mm). Vickers micorhardness testing machine (KB Prüftechnik GmbH, Hochdorf-Assenheim, Germany) was used to measure microhardness of samples in triplicates after seven days, baseline, and after one year of storage in PBS. A pyramid shaped diamond peak was used to apply pressure of 200 g during 10 seconds. The mean Vickers hardness value of the three measurements was calculated for each sample and expressed in HV. For statistical analysis, Kolmogorov-Smirnov normality test, ANOVA and post-hoc Scheffe test were used, with level of significance set at 5%.

Results: After one year storage in PBS, the highest microhardness value was measured for MM-MTA+10%SGF (22.93±5.62) with statistically significant difference in comparison to microhardness of other two groups measured both at baseline and after one year ($p<0.05$). Microhardness of MM-MTA+10%SGF after one-year storage in PBS statistically significanly increased in comparison to its baseline microhardness (14.73±3.09), ($p<0.05$). There was no statistically significant difference in microhardness of MM-MTA or MM-MTA+5%SGF measured at baseline (7.76±3.09 and 12.1±2.44, respectively) and after one-year storage in PBS (7.86±1.54 and 12.49±2.57, respectively), ($p>0.05$).

Conclusions (mandatory): One-year storage in PBS contributed to enhanced microhardness of only MM-MTA with addition of 10%SGF.

Acknowledgements (optional): This work was supported by the Croatian Science Foundation under the project number HRZZ-IP-2022-10-6065.

R078 | THE EFFECT OF TEMPERATURE ON FLOWABLITY AND MICROSTRUCTURE OF A NEW CALCIUM SILICATE-BASED ROOT CANAL SEALER

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AIM: To investigate the effect of temperature on the flowability and microstructure of a new calcium silicate-based sealer.

Methodology: Calcium silicate-based sealer EndoSequence BC Sealer(BC Sealer; Brasseler USA, Savannah, GA) and Endosequence BC sealer Hiflow (Hiflow; Brasseler USA, Savannah, GA)) were selected. Resin-based sealer AH plus (AH plus; Dentsply International, York, PA) was used as a control. ISO 6876/2012 was used to measure the flowability at room temperature (26 centigrade) and 150 centigrade by heating the glass pad. The three sealers were cured at room temperature and heating in 150 centigrade for 20s then cured at room temperature in 100% humidity. The surface and internal morphology were observed with a scanning electron microscope and the energy dispersive spectrum analysis.

Results: The flowability of the three sealers at different temperatures were higher than the ISO standard and the Hiflow had the highest flowability; but high temperature caused a significant drop in Hiflow. There are more particles on the surface of high-temperature set iRoot SP, the diameter of the particles is 200-500nm, and the internal fan leaf crystals are stacked. The size of particles of Hiflow is less than 50nm.

Conclusions (mandatory): Heating reduces the flow of the calcium silicate-based sealer; heating increase crystal particles, and the diameter of Hiflow particles is significantly smaller than that of iRoot SP.

R079 | IMPACT OF MATCHING GUTTA-PERCHA CONES ON BIOCERAMIC SEALER PENETRATION AND SEAL INTEGRITY: A COMPARATIVE ANALYSIS USING CONFOCAL MICROSCOPY AND MICRO-CT

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AIM: This study evaluates the impact of system-matching gutta-percha cones in single-cone obturation on sealer penetration and void formation using micro-computed tomography (micro-CT) and confocal laser scanning microscopy (CLSM).

Methodology: Forty-eight extracted human mandibular premolars with single, straight canals were prepared using ProTaper Ultimate F3 files. Irrigation was performed with 2.5% NaOCl, 17% EDTA, and saline. Teeth were divided into two groups (n=24): Group A (system-matching cones) and Group B (standardized taper cones). Each group was further divided (n=12) based on sealer type: TotalFill BC (TF) or Plan B (PB). Fluorescein-labeled sealers were applied using manufacturer-provided applicators, and obturation was performed with the single-cone technique. Samples were stored at 37°C and 100% humidity for one week. Micro-CT (Bruker SkyScan 1172) assessed void and gap distribution, while CLSM analyzed sealer penetration at 2 mm, 6 mm, and 8 mm from the apex. Image J software quantified gaps and sealer infiltration. Significance was set at $p<0.05$.

Results: Total voids and gaps were similar between cone groups but highest in the coronal third ($p<0.0001$). Sealer type influenced gap formation, with PB showing fewer gaps than TF in the non-matching group ($p=0.013$). Matching cones enhanced sealer penetration, especially in apical sections ($p=0.022$). PB resulted in a larger sealer penetration area compared to TF ($p=0.039$)

Conclusions (mandatory): System-matching cones enhanced sealer penetration but did not influence gap or void formation. Sealer type influenced both porosity and penetration area, with PB outperforming TF. Optimal cone-sealer selection is crucial for effective root canal sealing.

R080 | ASSESSMENT OF PH VALUES OF FOUR CALCIUM SILICATE-BASED SEALERS IN DIFFERENT TIME INTERVALS

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AIM: To assess pH values of calcium silicate-based sealers in different time intervals.

Methodology: Four calcium silicate-based sealers were included in the study: Endosequence BC, USA (BC), Bio C, Brazil (Bio C), BioRoot Flow, France (BRF), BioRoot RCS, France (BR) and control epoxy -based AH Plus, Germany (AH). Polyethylene tubes measuring 10 mm in height, 1.6 mm in diameter were filled with each sealer (n =5). Each specimen was placed in a flask containing 10 mL deionized water and stored at 37°C, 100 % humidity. The pH assessment was performed after 1, 7, 14, 21 and 28 days of immersion. Prior to each measurement cycle, pH electrode was calibrated using two calibration solutions pH 7 and 10. Each measurement was done in triplicates and a mean value was calculated. After each measurement, the specimens were immersed in fresh deionized water and kept at 37 °C. Statistical analysis was performed using two-way ANOVA. Tukey's post-hoc comparison test was conducted to test differences between sealers at each time point. The level of significance was set at alpha=0.05.

Results: Calcium silicate-based sealers BC, Bio C, BRF and BR showed significantly higher pH values than AH in all time intervals ($p < 0.001$). All calcium silicate-based sealers exhibited similar pH values in all measured intervals. The pH values for these sealers varied from nearly 12 after 24 hours, to 7.5 after 28 days. The highest pH value was 11.95 and it was recorded in the first-time interval (after 1 day) for BRF.

Conclusions (mandatory): Conclusions: All calcium silicate-based sealers exhibited and maintained high alkaline pH values through-out the 28-day time interval. The highest values at or above pH 10 were recorded in all calcium silicate-based sealers over the first 7 days.

R081 | COMPARISON OF MTA COMPACTION TECHNIQUES FOR PERFORATED INTERNAL ROOT RESORPTION CAVITIES: MICRO-CT ANALYSIS OF VOID FORMATION

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AIM: This study aims to compare the compaction efficiency of three different methods for filling perforated internal root resorption cavities in resin tooth models with MTA using Micro-CT analysis: plugger condensation, plugger condensation combined with ultrasonic activation, and a novel approach utilizing an endodontic motor with sonic vibration.

Methodology: Thirty radiopaque resin tooth models with standardized internal resorption cavities (4mm diameter, 4mm from the apex, and 2mm buccal perforation) were used. The teeth were divided into three groups based on the MTA compaction technique:
Plugger Compaction: MTA was delivered into the root canal and compacted using a plugger size 3/4 (VDW, Munich,Germany).
Ultrasonic Activation Compaction: MTA was placed into the root canal, VDW Ultra (Munich, Germany) device was used at 30% power and indirect ultrasonic activation was applied 3 times for 10 s.
812-MT-Motor (Woodpecker, Guilin, China) Compaction: MTA was placed into the root canal and compacted using the Tmode+ setting of the motor, which applied sonic activation and counterclockwise movements.
Micro-CT imaging evaluated the gaps between the MTA and the root canal walls and the gaps within the MTA. Since the Shapiro-Wilk test showed a deviation from normal distribution, intergroup comparisons were performed using the Kruskal-Wallis test at a 5% significance level.

Results: The total volume of voids was 6.49 mm^3 in the plugger compaction group, 2.61 mm^3 in the ultrasonic activation group, and 3.89 mm^3 in the 812 MT motor group. Although the highest volume of voids was observed in the plugger compaction group, no significant differences were found across the groups ($p>0.05$).

Conclusions (mandatory): The use of ultrasonic or sonic energy in filling internal resorption cavities with MTA may contribute to a reduction in the void volume within the material.

Acknowledgements (optional): This work was supported by Çanakkale Onsekiz Mart University The Scientific Research Coordination Unit, Project number: TDH-2025-5012

R082 | BOND STRENGTH AND POROSITY OF A NEW PREMIXED CALCIUM-SILICATE ROOT CANAL SEALER AFTER DIFFERENT LASER-ASSISTED DISINFECTION PROTOCOLS

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AIM: To evaluate the bond strength (BS) and porosity of a premixed calcium-silicate root canal sealer (BioRoot Flow, Septodont, France) used with a single-cone obturation technique after shock wave-enhanced emission photoacoustic streaming (SWEEPS) mode of Er:YAG laser-activated irrigation (LAI); a diode laser root canal irradiation and conventional irrigation (CI).

Methodology: The study included 40 extracted intact single-rooted human teeth with one root canal, confirmed on CBCT scans. The root canals were instrumented up to Reciproc Blue 50 (50/.05) instrument with 3% NaOCl irrigation, and afterwards randomly distributed in three experimental groups based on disinfection protocol used (n=10/each): Group 1. SWEEPS (AutoSWEEPS; 3%NaOCl, followed by ethylenediaminotetraacetic acid (EDTA) and NaOCl), Group 2. Diode laser root canal irradiation (975 nm, 1.5W, three cycles of 20 s), 3. CI (NaOCl, EDTA, NaOCl). In the control group (C, n=10), no final irrigation protocol was applied. The canals were filled with calcium-silicated root canal sealer (BioRoot Flow, Septodont, Saint Maur Des Fosses, France) using single-cone technique. After two weeks, the samples were subjected to micro-CT scanning and the porosity of the fillings was calculated. Dentin discs (1 mm thick) from the middle third of canals were cut and prepared for push-out test to calculate the BS of the sealer. The results were analysed using Kruskal-Wallis and post-hoc Dunn test with 5% level of significance.

Results: Micro-CT analysis showed voids formation in all samples, mostly open porosity, with no significant differences between groups ($p>0.05$). SWEEPS showed the highest median values of BS (3.233MPa), and was superior to CI and C (median 1.923, 1.989 MPa) ($p<0.05$), but with no significant difference compared to diode laser irradiation (median 2.349MPa) ($p>0.05$).

Conclusions (mandatory): The BS of BioRoot RCS was similar after SWEEPS and diode laser root canal irradiation, but lower after CI. Open porosity of the sealer was recorded after all disinfection protocols.

R083 | EVALUATION OF METAL ARTIFACT REDUCTION WITH DIFFERENT FILLING MATERIALS BASED ON STANDARD DENTAL PHANTOM ROOT CANALS USING DUAL-ENERGY CT AND TRADITIONAL DENTAL CONE-BEAM CT

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AIM: Metal artifacts caused by canal fillings significantly degrade the image quality of dental CBCT. The methods of DE projections acquisition including fast kV switching (FKS), sequential scans and dual- layer detector. In this paper, we conduct a phantom study to evaluate of performance of DE imaging in MAR for dental CBCT, to investigate the performance of metal artifact reduction with different filling materials based on standard dental and root canal phantom using dual-energy CT and traditional Cone-Beam CT.

Methodology: Phantom model and artificial roots (taper 04, size #25 ~ #50) with X-ray suppression simulation effect were uesd. The specimens were scanned with CS 9300 3D (at two different resolutions), 3D Accuitomo, and NewTom VGi Cone Beam CT systems. A prototype dual-layer FPD is equipped on the system to evaluate its performance in MAR. The FKS is also developed with the kVp switching range of 40 to 150 kV and the sequential scans were then performed. The hyperdense and hypodense axial slice artifacts were recorded and subjected to statistical analysis.

Results: The hypodense band was found mostly in the CS9300 3D system with 0.18 mm voxel sizeresolution, especially in the buccal-lingual (95%) and coronal (64%) sections.
The DE method could greatly suppress the metal artifacts. The strong streak artifacts in the single-kVp CT images are reduced obviously in the VMIs generated from the material decomposition.
Metal artifacts are almost completely eliminated in switching imaging, and metal artifacts in high-low energy sequential scanning images are also significant suppress.

Conclusions (mandatory): We conduct a phantom study to evaluate of performance of DE imaging in MAR for dental CBCT. Our study demonstrate the potential of metal artifact reduction for DE imaging in the application of dental CBCT.

Acknowledgements (optional): This project was supported by the National Natural Science Foundation of China (No. U20A20169)

R084 | A NEW METHOD FOR GUTTA-PERCHA POINT MEASUREMENT EMPLOYING CUSTOMISED IMAGE ANALYSIS SOFTWARE

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AIM: The standard sizes of gutta-percha cones (GP) are defined by the ISO and ANSI/ADA standards, which specify the allowed deviations in diameter measurements at 3 mm and 16 mm from the GP tip, D3 and D16 respectively. The tolerances are ±0.05 mm for GP cones of ISO sizes 008 to 025 and ±0.07 mm for ISO sizes 030 to 140. The aim of this study was to develop a simple and cost-effective method for measuring GP cones.

Methodology: 72 sets of GP cones, ranging from ISO size 15 to ISO size 80, with tapers of .02, .04, and .06, from three different manufacturers (M+W Dental, VDW, and Coltene) were analysed. Each set contained 30 randomly selected GP cones. Images of each individual GP samples were utilised, using a flatbed computer scanner at a resolution of 4800 dpi (pixel length 5.29 µm). Each image was analysed using a custom-developed program written in Python.

Results: 7 out of 24 sets of GP samples, manufactured by M+W met the standard requirements. The highest deviations were observed in .06 taper samples, mainly at the D16 parameter. In contrast, 18 out of 24 VDW GP sets of GP samples failed to meet the standard. The GP not meeting the standards were all samples of ISO sizes 15, 20, and 25, and all .04 taper samples. For Coltene GP cones, only 4 out of 24 sets of GP samples did not meet the standards.

Conclusions (mandatory): The described method offers high output measurement and analysis of GP samples at low cost. A process for dimensions evaluation for a set of 30 GP cones takes only 30 minutes. While the standards define permissible deviations only at D3 and D16, our method allows for precise diameter measurements at any distance from the GP tip, thus enabling additional analyses of the GP dimensions.

R085 | LONG-TERM ANTIBACTERIAL EFFICACY AND CYTOCOMPATIBILITY OF BIOROOT FLOW, AH PLUS BIOCERAMIC, AND AH PLUS SEALERS USED FOR WARM VERTICAL COMPACTION

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AIM: The purpose of this study was to evaluate the long-term antimicrobial effect and cytocompatibility of the new calcium silicate-based root canal sealer, Bioroot Flow, under the influence of heat from a System B heating source used for warm vertical compaction, and to compare these effects with those of AH Plus Bioceramic and AH Plus sealers.

Methodology: The effect of temperature during warm vertical compaction was investigated by testing the properties of the sealers after 30 seconds at 37°C or 100°C. The long-term antimicrobial effects and cytotoxicity were evaluated after 4 weeks of aging using standardized disks of Bioroot Flow, AH Plus Bioceramic, and AH Plus. Antimicrobial activity against Enterococcus faecalis biofilm was evaluated using bacteria incubated for 24 hours with direct contact and membrane separation tests. Cell viability was measured by culturing MC3T3-E1 mouse osteoblasts and performing MTT assays.

Results: Bioroot Flow and AH Plus Bioceramic exhibited higher antimicrobial activity against Enterococcus faecalis biofilm compared to AH Plus, which was observed both when the sealer was in direct contact with the biofilm and when a membrane was used to separate the sealer from the biofilm. Diluted extracts of Bioroot Flow, AH Plus Bioceramic, and AH Plus did not significantly affect cell viability.

Conclusions (mandatory): All the sealers used in the experiments showed stability even in the high-temperature environment generated by warm vertical compaction technique. Bioroot Flow and AH Plus Bioceramic demonstrated superior antimicrobial activity compared to AH Plus. Bioroot Flow, AH Plus Bioceramic, and AH Plus sealers showed similar cell compatibility in MC3T3-E1 mouse osteoblasts.

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R086 | IN VIVO COMPARISON OF TISSUE REACTIONS TO IMPLANTED CALCIUM SILICATE-BASED ROOT CANAL SEALERS

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AIM: This study aimed to evaluate and compare the inflammatory responses of subcutaneous connective tissue in BALB/c mice to different calcium silicate-based root canal sealers.

Methodology: Two calcium silicate-based root canal sealers, CeraSeal (MetaBiomed, Korea) and EndoSeal MTA (Maruchi, Korea), were tested with AH Plus (Dentsply Sirona, Germany) as a positive control. Ten specimens of each material were prepared by filling sterile polyethylene rings (5.0 mm diameter, 2.0 mm height) and allowing them to set for 24 hours. The specimens were implanted subcutaneously into the dorsal connective tissue of ten BALB/c mice. At 7 days (7D) and 28 days (28D), the mice were euthanized, and tissue samples were histologically analyzed using hematoxylin-eosin staining. Inflammatory cell infiltration was graded from 0 to 3 under the light microscope (Olympus BX53, Japan). Statistical analysis was conducted using the Kruskal-Wallis test ($P<0.05$).

Results: No significant differences in inflammatory cell count were observed among the three sealers at either time point ($P>0.05$). At 7D, inflammatory responses of all three sealers ranged from moderate to severe, while at 28D, CeraSeal and EndoSeal MTA expressed mild to moderate responses. CeraSeal and EndoSeal MTA showed a statistically significant reduction in inflammatory cells from 7D to 28D ($P<0.05$), whereas AH Plus did not exhibit a significant decrease ($P>0.05$).

Conclusions (mandatory): The inflammatory responses of CeraSeal and EndoSeal MTA were comparable to those of AH Plus, with all materials showing similar tissue reactions. However, the significant reduction in inflammation over time observed with the calcium silicate-based sealers suggests they may offer superior long-term biocompatibility.

R087 | OSTEOGENIC POTENTIAL OF VARIOUS PREMIXED BIOCERAMIC SEALERS ON HUMAN BONE MARROW STEM CELLS

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AIM: This study aims to compare the osteogenic potential of bioceramic sealers to a resin-epoxy-based sealer in human bone marrow-derived stem cells (hBMSCs).

Methodology: Three premixed bioceramic sealers (EndoSequence BC Sealer, White Endoseal MTA, and One-Fil) were compared with AH Plus Jet, an automatically mixed resin-epoxy-based sealer. Disk-shaped specimens (6 mm in diameter, 3 mm in height) were prepared using sterilized Teflon tape and then immersed in an osteogenic medium to create an eluate (5 mg/mL). hBMSCs were cultured in each eluate, and their osteogenic potential was assessed by measuring alkaline phosphatase (ALP) activity, Alizarin Red S staining (ARS), quantitative real-time polymerase chain reaction (qPCR), and Western blot analysis. Statistical analysis was conducted using SPSS (version 24.0), with one-way ANOVA followed by Tukey's post hoc test and an independent t-test. Statistical significance was set at $p < 0.05$.

Results: All experimental groups exhibited higher ALP activity than the control group. ARS staining showed no significant differences in mineralization activity among the bioceramic sealers ($p > 0.05$); however, White Endoseal MTA exhibited the highest staining intensity on day 14 compared to AH Plus Jet ($p < 0.05$). qPCR analysis revealed that EndoSequence BC Sealer induced the highest SMAD1 expression on day 4, while One-Fil and EndoSequence BC Sealer significantly upregulated RUNX2 expression compared to AH Plus Jet ($p < 0.05$). Western blot analysis confirmed that EndoSequence BC Sealer had the highest RUNX2 protein expression.

Conclusions (mandatory): Premixed bioceramic sealers demonstrated superior osteogenic potential in hBMSCs, promoting osteoblastic differentiation. These findings support the use of bioceramic sealers in root canal treatments, particularly in cases involving large apical lesions.

R088 | ASSESSMENT OF VOIDS IN A HYDRAULIC CALCIUM SILICATE SEALER USING THREE DELIVERY METHODS: AN IN VITRO MICRO-COMPUTED TOMOGRAPHY STUDY

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AIM: To evaluate the voids resulting from three delivery methods of hydraulic calcium silicate sealer using the single cone root canal filling technique in the distal canals of human mandibular molars.

Methodology: Forty-eight human mandibular molars prepared under x10 magnification (Leica, Germany) with Wave One Gold (Dentsply Sirona, Ballaigues, Switzerland) were scanned using a high-resolution micro-CT scanner (Nikon XT H225 ST CT). A helical scan of each sample was obtained at a resolution of 8 microns, using settings of 90 kV, 75 microAmp, 6.8 W without any filters. Projections were set at 1200. Only the 12 round distal canals were selected for this part of the study. Root canal filling was performed using a single conform-fit Gutta-Percha cone and a hydraulic calcium silicate sealer (EndoSequence® BC sealer (Brasseler, USA). According to the sealer delivery method, three experimental groups were established: single cone coating with the sealer, injection of sealer into the canal using the designated manufacturer syringe and syringe injection with sonic agitation of the sealer using EndoActivator (Dentsply Sirona). After incubation of the teeth at 37 degrees for 8 days, all samples were re-scanned using the aforementioned settings to determine the percentage of voids in the total root canal space. Kruskal–Wallis and Dunn's tests were performed, and the significance level was set at $p < 0.05$.

Results: The mean percentage of voids was lowest in the EndoActivator group 0.89 ± 0.34 followed by the syringe injection group 2.54 ± 0.56 and finally the single cone coating group 3.12 ± 1.84. The intergroup comparison showed that the effect of sealer delivery method on the percentage of voids was not statistically significant ($p=0.124$).

Conclusions (mandatory): The method of sealer delivery did not influence the overall voids in round canals of mandibular molars.

R089 | CLINICAL AND RADIOGRAPHIC OUTCOMES OF ROOT CANAL TREATMENT USING WARM AND COLD OBTURATION TECHNIQUES WITH BIOCERAMIC SEALERS: A SYSTEMATIC REVIEW AND META-ANALYSIS

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AIM: This systematic review aims to compare the clinical and radiographic outcomes of non surgical root canal treatment reported by clinical studies when obturated using bioceramic sealers using a warm compaction technique compared to a single cone technique.

Methodology: Two reviewers independently searched databases including PubMed, Embase, Cochrane Library, Web of Science, and SciELO, supplemented by searches in selected journals and textbooks up to February 2025. The inclusion criteria encompassed clinical studies on outcome of root canal treatment utilizing both clinical and radiographic assessment, covering prospective, retrospective, randomized, and non-randomized clinical trials, case series, conducted on humans with at least a one-year follow-up. The risk of bias was evaluated using the Newcastle Ottawa scale and Cochrane's criteria. A total of 19 studies, employing both warm and cold obturation techniques with boioceramic sealers were included. These studies measured the outcomes of root canal treatment or retreatment as either favorable or unfavorable, applying strict or loose criteria.

Results: The results indicated no significant difference between warm obturation or cold lateral/single cone obturation using bioceramic sealers and gutta percha using both strict and loose criteria.
When the clinical and radiographic outcome was assessed for primary root canal treatment, there was no significant difference, nor was there any significant difference for root canal retreatment between the two obturation techniques
The findings may provide new insights into the conclusions of previous ex vivo studies on the application of heat on bioceramic sealers.

Conclusions (mandatory): There appears to be no significant difference in clinical outcomes for root canal treatment if heat is applied to bioceramic sealers for warm obturation techniques compared to a cold obturation technique using bioceramic sealers and gutta percha.

R090 | COMPARISON OF SHEAR BOND STRENGTH OF DIFFERENT ADHESIVE SYSTEMS TO RESIN-MODIFIED GLASS IONOMER LINER AND CALCIUM SILICATE CEMENT

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AIM: This study aimed to compare the shear bond strength at restorative interface between composite resin with fast-setting calcium silicate cements (CSC) ((Biodentine (BD) and RetroMTA (RMTA)) and resin-modified glass ionomer liner, Fuji II LC (RMGI) respectively when different adhesive systems were used.

Methodology: Sixty resin blocks with central cavities were prepared and randomly assigned to one of three groups (n=20), with BD, RMTA, or RMGI, where RMGI served as the control group. Each group was further divided into two subgroups based on adhesive systems which were total-etch and self-etch. The adhesive was applied to the liner surface before composite placement. They were stored for 24 hours before shear bond strength testing. Results were analyzed using the Kruskal-Wallis test. The fracture surfaces were then examined under stereomicroscope to be categorized as adhesive, cohesive or mixed mode of failure.

Results: The mean shear bond strengths (MPa) of BD, RMTA and RMGI with the total etch were 8.326 MPa, 3.452MPa and 14.684 MPa respectively. For self-etch, they were 9.845 MPa, 5.551 MPa and 8.162 MPa respectively. The total-etch system showed better bond strength with RMGI, while the self-etch system performed better with CSC. However, the differences were not statistically significant ($P>0.05$). RMGI had the strongest mean bond followed by BD and RMTA regardless of the adhesive systems. The bond strength of RMGI and BD bond was significantly stronger than RMTA ($P<0.05$) but there was no significant difference between BD and RMGI ($P>0.05$). BD and RMTA displayed more mixed-mode of failure which was 55% and 60% while RMGI showed more cohesive failure which was 80%.

Conclusions (mandatory): BD and RMGI demonstrated a comparable bond strength to composite resin. Therefore, immediate placement of composite resin can be done directly over BD in vital pulp therapy. As for RMTA, a layer of RMGI is recommended before composite resin placement.

R091 | WHAT IS THE EFFECT OF CORONAL RESTORATION TYPES ON SURVIVAL OF ROOT FILLED TEETH: A COMMON STATISTICAL PITFALL

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AIM: To assess the effect of direct vs. indirect coronal restorations on survival of root filled teeth (RFT) using two different statistical approaches.

Methodology: During 2014-2019, 1216 patients received root canal treatment of one or more teeth at the Department of Dentistry and Oral Health, Aarhus University. In September 2024, the patients were consecutively invited to a clinical and radiographic follow-up examination. Information on coronal restoration was collected from patient files and the follow-up examination. The primary outcome was tooth survival. Cox regression was used for the statistical analyses. In one analysis, RFT restored with direct and indirect coronal restorations were compared directly, ignoring that teeth with indirect restorations could never be extracted prior to the indirect restorative treatment. The other analysis corrected for this immortality bias by using a time-dependent covariate such that all teeth started in the direct restoration group. Indirectly restored teeth were moved to the separate group at the time of indirect restoration.

Results: Presently, 77 patients (104 RFT) have been examined and included for analysis. Follow-up period was 8.23 (range 0.14, 11.00) years. At follow-up, 31 teeth had been extracted, 44 teeth had received an indirect restoration, and 60 teeth had received a direct restoration. Uncorrected analysis showed that the hazard ratio for extraction for directly restored RFT compared to indirectly restored RFT was 3.95 (CI 95 % [1.53, 10.18], p = 0.004). When correcting for immortality bias, the hazard ratio was 2.39 (CI 95 % [0.94, 6.12], p = 0.068).

Conclusions (mandatory): With no correction for immortality bias, indirectly restored RFT were associated with a significantly better survival compared to directly restored RFT. When corrected for immortality bias, the hazard ratio between restoration groups decreased substantially and was no longer statistically significant.

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R092 | DOES PRE-ENDODONTIC DENTIN SEALING IMPROVE LONG-TERM BOND STRENGTH TO CORONAL DENTIN? – AN IN VITRO STUDY

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AIM: To assess the microtensile bond strength (μTBS) to coronal dentin following the application of pre-endodontic dentin sealing (PEDS) and post-endodontic adhesion (PEA) restorative approaches, under different endodontic irrigation protocols, after aging.

Methodology: One hundred and twenty (120) intact human third molars were horizontally sectioned 4 mm below the occlusal surface to expose deep coronal dentin. Specimens were allocated into ten experimental groups according to the timing of adhesive system application – either before (PEDS) or after (PEA) irrigation – and the used irrigation protocol: distilled water (control), 3% sodium hypochlorite (NaOCl), 3% NaOCl followed by 17% ethylenediaminetetraacetic acid (EDTA), 3% NaOCl followed by 17% EDTA and 2% chlorhexidine, or a combination of 3% NaOCl and 9% etidronic acid (HEDP). Restorative procedures were performed using a self-etch adhesive system (Clearfil SE Bond 2, Kuraray). After microspecimen aging for six months, specimens (n=10) were subjected to μTBS testing. Fracture patterns were classified. Additionally, two specimens per group were analyzed using scanning electron microscopy (SEM) to characterize the adhesive interfaces. Data was statistically analyzed using a mixed linear regression model (α=0.05).

Results: PEDS groups demonstrated significantly higher μTBS (57.4-59.5 MPa) compared to PEA groups subjected to endodontic irrigation (33.3-40.8 MPa; $p<0.001$). No statistically significant differences were observed within PEDS groups, irrespective of the irrigation protocol ($p>0.05$). Adhesive failures were predominant in endodontically irrigated PEA groups, whereas cohesive fractures were primarily associated with PEDS and PEA/Control groups. SEM evaluation confirmed consistent hybrid layers in PEDS and PEA/Control groups, while PEA groups treated with endodontic irrigants displayed substantial resin-dentin interface variation and interfacial gaps.

Conclusions (mandatory): PEDS resulted in high and consistent long-term bond strength values regardless of the irrigation protocol, whereas PEA groups exposed to endodontic irrigation exhibited significantly lower μTBS. These findings support the predictability of the PEDS technique in enhancing bonding performance in endodontically treated teeth.

R093 | THE IMPACT OF TOOTH STRUCTURE PRESERVATION ON THE OUTCOME OF ENDODONTICALLY TREATED TEETH FOLLOWING CAD/CAM CUSPAL COVERAGE RESTORATIONS: A 6-YEAR FOLLOW-UP

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AIM: To evaluate the impact of tooth structure preservation on the outcome of endodontically treated teeth following CAD/CAM cuspal coverage restorations.

Methodology: A total of 122 endodontically treated posterior teeth (100 patients) were restored with either partial onlays or full crowns using nanohybrid ceramic CAD/CAM restorations and followed up for 6 years. The volume of tooth structure after preparation was measured using an intraoral digital scanner and the percentage volume remaining was calculated. The clinical performance of CAD/CAM restorations was evaluated using Fédération Dentaire Internationale (FDI) criteria and United States Public Health Service (USPHS) criteria, while both the survival of the tooth and restoration were recorded throughout the follow-up period. To assess differences in tooth structure preservation, an independent t-test was used to compare the mean remaining percentage volume between restoration types. The association between percentage volume after preparation and six-year tooth survival was analyzed using Fisher's exact test. Additionally, the survival of CAD/CAM restorations was evaluated using the Kaplan-Meier method.

Results: Onlay restorations preserved significantly more tooth percentage volume after preparation (63.27%) compared to full crowns (49.84%) ($p < 0.05$). Additionally, teeth with a volume less than 40% had significantly lower odds of survival than those with more than 40% volume, with a 98.7% reduction in survival odds (Fisher's exact test, $p < 0.05$, OR = 0.013; 95% CI, 0.001-0.134). Kaplan-Meier analysis also revealed significantly greater survival rates in 6 years for onlay restorations (82.3%) compared to full crowns (59.3%) (log-rank $p < 0.05$).

Conclusions (mandatory): Greater tooth structure preservation is associated with improved long-term tooth survival, with onlay restorations maintaining more tooth volume than full crowns. Furthermore, teeth with less than 40% remaining volume after preparation showed a significantly increased unfavourable outcome of the endodontically treated teeth.

R094 | THE INFLUENCE OF THE OCCLUSAL DESIGN OF LITHIUM DISILICATE ALL-CERAMIC ENDOCROWNS ON THEIR BIOMECHANICAL PERFORMANCE: A FINITE ELEMENT ANALYSIS

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AIM: Assess the influence of all-ceramic molar endocrowns thickness, cusp inclination angle, and a combination of these effects on the stress distribution and biomechanical behavior utilizing a finite element analysis.

Methodology: A total of 6-solid models representing two different heights of remaining tooth structure (1.5 and 3 mm), each with three different buccal cusps inclination angles (original cuspal inclinations, 10° shallower inclines and 20° flatter cuspal inclines) were generated to create geometrical models of endocrown restored teeth. Models were designated as: 1.5/O, 1.5/10°, 1.5/20°, 3/O, 3/10°, and 3/20°. All models were subjected to an oblique force of 400 N applied at the mid-lingual facing incline of the buccal cusps with an angle of 45° to the longitudinal tooth axis. The maximum principal stress, maximum shear stress at the interfaces of the resin cement layer, and factor of safety were calculated.

Results: The increase in the cusp inclination by 10° in endocrown models with a 1.5 mm tooth structure above CEJ (model 1.5/10°), resulted in a 20% stress reduction of the maximum principal stress in the remaining dentin. However, when the cusp inclination was increased by 20° (model 1.5/20°) the resultant comparable dentinal stress reduction (17%) is accompanied by a noticeable increase in the maximum shear stress at the cement interfaces. However, increasing the cusp inclination angle in models with a 3 mm dental structure above CEJ (models 3/10° & 3/20°) resulted in negligible maximum principal stress reduction in the cervical dentin, while causing a noticeable increase in the maximum shear stress at the cement interfaces. The factor of safety was least in models 1.5/original and 3/original, while highest in model 1.5/10°.

Conclusions (mandatory): Within the study limitation, endocrown occlusal design, namely height and cuspal inclination affect the biomechanical behavior of the tooth. Occlusal refinements can most likely result in clinical longevity.

R095 | EVALUATION OF SONIC ACTIVATION METHOD IN REMOVING NANO CALCIUM HYDROXIDE FROM ROOT CANALS

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AIM: To assess the efficacy of the sonic final irrigation agitation technique in enhancing dentinal tubule penetration of nanoparticle calcium hydroxide (NCH) dressing.

Methodology: Sixty single-rooted teeth were decoronated and instrumented using a One Reci file (35/0.04; Micro-Mega SA, Besançon, France). NCH was applied into the canals with a lentulo spiral. Specimens were randomly allocated into two groups (n=30 each) based on the final irrigation technique: conventional needle irrigation (CI) and sonic agitation (EDDY). After one week, the CI group was irrigated sequentially using a 30 gauge side-vented needles (NaviTips; Ultradent) placed 1 mm short of the working length with 5 mL of 2.5% NaOCl and 5 mL of 17% EDTA. The EDDY group underwent sonic activation using a 25/0.04 EDDY tip (VDW, Munich, Germany), positioned 1 mm short of the working length. Activation was performed at 6000 Hz with a 5 mm vertical oscillation amplitude with 5 mL of 2.5% NaOCl, followed by 5 mL of 17% EDTA. Both groups received a final rinse of 5 mL sterile distilled water. Roots were sectioned longitudinally and evaluated under a stereomicroscope (Olympus SZ61, Olympus Corp., Tokyo, Japan). Digital images were captured using a digital camera, and the residual NCH area was quantified using ImageJ software (National Institutes of Health, Bethesda, MD, USA). Statistical analysis was performed using an independent t-test.

Results: The mean residual NCH area was significantly lower in the sonic activation (EDDY) group (3.4 ± 1.9 mm²) compared to the conventional irrigation (CI) group (5.4 ± 2.3 mm²), with a statistically significant difference ($p = 0.013$).

Conclusions (mandatory): Sonic irrigation activation was superior to conventional needle irrigation in removing nanoparticle calcium hydroxide dressing from root canal dentin.

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R096 | THE ASSESSMENT OF CHLORINE CONCENTRATIONS IN SODIUM HYPOCHLORITE SOLUTIONS USED BY DENTAL PRACTITIONERS IN MOROCCO: A SURVEY

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AIM: The purpose of this survey was to assess the concentration of chlorine in sodium hypochlorite solutions (NaOCl) used as root canal irrigation solutions by the dentists in Marrakech, Morocco.

Methodology: A survey was carried out among 74 practitioners registered with the Moroccan Order of Dentists, of whom 36 (48.6%) were men and 38 (51.4%) were women. A self administration questionnaire was used. Among the questions, participants were asked about the number of treatments performed per week, the type of irrigation solution used, and the storage of the irrigation solution. After this interview, a 30 mL sample of that solution was sent to a laboratory to determine the amount of chlorine by iodometric titration. ANOVA and t-test were used to perform the statistical analysis ($P < 0.05$).

Results: All the practitioners except two used the NaOCl as an irrigant. Besides, 84.7% prepared their solutions. The solutions were stored 63.8% of the time in opaque containers. The mean percent of chlorine concentration was 0.95% ± 0.68%. The concentration was also higher in the ready to use solutions (1.39%) than those prepared in the office (0.87%). Moreover, this difference was statistically significant ($P = 0.01$).Furthermore, dentists who tended to use this type of solution utilized more the rubber dam during the root canal treatment, but the difference was not significant ($P = 0.08$). On the other hand, a significant difference was noted between the solutions prepared by the practitioners 1.16% ± 0.74% and those prepared by the assistants 0.77% ± 0.58% ($P = 0.021$).

Conclusions (mandatory): The results confirmed that the NaOCl is the solution that practitioners use mostly. The conditions of dilution and storage are inappropriate, and the concentration is very low at 0.95%.

R097 | EVALUATING SUB-MICRON DIAMOND IRRIGATION FOR IMPROVED BIOFILM REMOVAL IN ENDODONTIC TREATMENT USING SCANNING ELECTRON MICROSCOPY

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AIM: Biofilms formed by bacteria in root canals are resilient due to the protective extracellular polymers they secrete. The complex anatomy of root canal systems makes it challenging to clean inaccessible areas with instruments alone, so irrigants like sodium hypochlorite are utilized for their antimicrobial and tissue-dissolving properties. This study aims to explore the efficacy of sub-micron diamond irrigants activated by sonic and ultrasonic agitation in removing root canal biofilms, particularly those formed by Enterococcus faecalis, a common bacterium in failed treatments.

Methodology: The study involved 100 single-rooted premolars shaped with ProtaperGold® F2/#25 and incubated in an Enterococcus faecalis suspension to form biofilms. These were irrigated with a solution of 500 nm diamond particles mixed with saline or sodium hypochlorite, supplemented by sonic or ultrasonic agitation. Biofilm removal efficacy was assessed through colony-forming units, biofilm assays, and scanning electron microscopy. Removal efficiency was evaluated using a scoring system by Bhuva et al. (2010), classifying biofilm coverage into four categories based on percentage covered, followed by statistical analysis of coronal, middle, and apical sections using tests such as Kruskal-Wallis and Mann-Whitney U, setting significance at $p < 0.05$.

Results: Results indicate that traditional sodium hypochlorite irrigation combined with sonic/ultrasonic methods reduces biofilm presence by around 82%. However, 3% sodium hypochlorite with sub-micron diamond increases reduction to 86% ($p < 0.05$). Sub-micron diamond irrigation removes over 95% of smear layers and biofilm, outperforming traditional methods, which remove under 34% in apical areas.

Conclusions (mandatory): Our results showed that the sub-micron diamond sodium hypochlorite solution, assisted by sonic and ultrasonic agitation, significantly improves biofilm removal. This energy can effectively disrupt the biofilm structure within the root canal. Together with the bactericidal effects of sodium hypochlorite and the sub-micron diamond particles, this solution has promising potential for clinical application in root canal treatments.

R098 | REVOLUTIONIZING ENDODONTIC IRRIGATION: OZONE-DRIVEN NANO-BUBBLE WATER FOR SMEAR LAYER REMOVAL, BACTERIAL ELIMINATION, AND MEDICAMENT PENETRATION – AN IN VITRO STUDY

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AIM: To compare the efficacy of Nano-Bubble Water (NBW) with sodium hypochlorite (NaOCl) and EDTA in disrupting biofilms, removing the smear layer, and enhancing the penetration of Triple Antibiotic Paste (TAP) into dentinal tubules.

Methodology: Nano-Bubble Water was generated using a high-energy cavitation system, producing ozone-filled nano-bubbles. Ninety-six freshly extracted single-rooted human premolars were instrumented to size F5 and divided into three groups based on evaluation objectives. The first group assessed smear layer removal, with samples irrigated using 1.5% NaOCl + EDTA, NBW alone, or NaOCl + NBW, followed by analysis using Scanning Electron Microscopy at the coronal, middle, and apical thirds. The second group evaluated biofilm removal, where specimens were infected with endodontic pathogens for 21 days, irrigated with the same protocols, and analyzed using Confocal Laser Scanning Microscopy (CLSM) with LIVE/DEAD BacLight staining to assess bacterial elimination at different dentinal depths. The third group examined medicament penetration, where TAP was placed intracanal post-irrigation, and penetration depth into dentinal tubules was assessed using fluorescent stereomicroscopy. Data were analyzed using ANOVA with post-hoc Tukey tests ($p < 0.05$).

Results: NBW significantly enhanced smear layer removal compared to NaOCl alone, achieving near-complete dentinal tubule exposure in the coronal and middle thirds ($p < 0.05$), while residual smear layer persisted in the apical third. Biofilm analysis revealed that NBW + NaOCl achieved greater bacterial elimination than NaOCl alone, with comparable reduction at 50 microns ($p > 0.05$). TAP penetration was significantly deeper with NBW pre-irrigation compared to NaOCl alone ($p < 0.05$).

Conclusions (mandatory): NBW demonstrated superior smear layer removal, biofilm disruption, and enhanced medicament penetration, positioning it as a biocompatible alternative to conventional irrigants. Its ability to improve intracanal medicament delivery suggests potential applications in minimally invasive and regenerative Endodontics. Further research is needed to validate its clinical relevance.

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R099 | HPLC ANALYSIS OF FORMALDEHYDE RELEASE FROM READY-TO-USE ENDODONTIC IRRIGANTS

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AIM: To assess the formaldeyde release from commercially available, ready-to-use endodontic irrigant, EDTA-containing solutions by means of high pressure liquid chromatography (HPLC).

Methodology: The solutions tested were:
1. Endo Solution (Cerkamed, Stalowa Wola, Poland),
2. Largal+/ultra (Septodont, Saint-Mauer des Fosses, France)
3. CanalPro (Coltene Whaledent Altstätten, Switzerland) and
4. Labarak (Adipharm, Athens, Greece)
Suitable amount of each solution was reacted with dinitrophenylhydrazine (DNPH) in the presence of phosphoric acid (H3PO4) (15min, 60°C). Dichloromethane (CH2Cl2) was further added and the reaction product was selectively extracted, dried at room temperature and finally reconstituted with methanol (CH3OH). After filtration, HPLC analysis was conducted. Formaldehyde concentration (ppm) was measured after the generation of calibration curves. Statistical analysis was performed with SPSS (IBM, USA). Data did not follow normal distribution, hence non-parametric tests (Kruskal Wallis H test) was performed. The level of statistical significance was set at $p<0.05$.

Results: The endodontic solutions tested, revealed the presence of formaldehyde with concentrations that varied between 0.3-18.32 ppm.

Conclusions (mandatory): HPLC analysis effectively detected formaldehyde from ready-to-use endodontic irrigants in concentrations that varied according to the solution tested.

R100 | DOES THE USE OF GEL-BASED IRRIGANTS REDUCE HARD-TISSUE DEBRIS ACCUMULATION DURING ROOT CANAL SHAPING OF MANDIBULAR MOLARS?

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AIM: To evaluate the effect of different irrigant formulations — 2.5% sodium hypochlorite (NaOCl) solution, 2.5% NaOCl gel, and 2% chlorhexidine gel — on the hard-tissue debris accumulation during the preparation of mesial root canals in mandibular molars using micro-computed tomography (micro-CT).

Methodology: Thirty mesial roots of mandibular molars were scanned using micro-CT and paired based on anatomical parameters, including root length, canal volume, surface area, and three-dimensional morphology. The specimens were then allocated to three groups (n = 10) according to the irrigant used: 2.5% NaOCl solution, 2.5% NaOCl gel, and 2% chlorhexidine gel. All canals were prepared using the Reciproc Blue R25 instrument under standardized conditions, with the irrigant type as the only variable. In the NaOCl solution group, a total of 18 mL of irrigant was used per canal. In the gel-based groups, 9 mL of gel was alternated with 9 mL of saline solution, totaling 18 mL per canal. Following instrumentation, the specimens were rescanned, and the pre- and post-instrumentation datasets were co-registered. The volume of accumulated hard-tissue debris was quantified using Fiji software. Data were analyzed using parametric and non-parametric tests, with a significance level set at 5%.

Results: None of the tested irrigants completely eliminated debris from the root canals. No statistically significant difference in hard-tissue debris accumulation was observed among the groups (P = 0.387).

Conclusions (mandatory): Gel-based irrigants did not reduce hard-tissue debris accumulation in mesial root canals of mandibular molars compared to NaOCl solution.

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R102 | THE EFFICACY OF NOVEL REMOTELY-GENERATED ULTRASONIC ROOT CANAL IRRIGATION SYSTEM IN REMOVING INTRACANAL MEDICAMENT OF ARTIFICIAL ROOT CANAL SYSTEM WITH DENTINAL TUBULE SIMULATING WAFER

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AIM: To evaluate the performance of the novel irrigation device, RINSE (Remotely-generated Irrigation with a Non-invasive Sound field Enhancement) in different clinical settings.

Methodology: Porous silicon wafers (4mm) were designed as follows; each pore, representing the human dentinal tubule, was 5μm in width and depth. The distance between each pore was designed to be equally 10μm.
Two types of #15/0.02 resin blocks were prepared to mimic the different clinical situations; the first group with and the second group without the apical curvature. Based on the concept of minimally invasive endodontics, canal enlargement was not performed in the first experimental group. In contrast, canals were enlarged upto #30/0.04 in the second group to represent wide, straight canals of the traditional endodontic concept. For each resin block, trapezoidal space was formed to enable the insertion of sample wafers. Overall, 200μm of areas out of 4mm were exposed to the irrigant.
For each sample wafer, intracanal medicament, Calcipex was applied. Proper application of the medicament into each pore was confirmed through optical microscope.
A total of 40 samples were divided into two groups, based on the curvature of the root canal system. In each group, the samples were subcategorized according to the irrigation device or method used. (n=5). In group 1 (control), conventional irrigation was performed with 30G side-vented needle. In group 2,3, and 4, different devices, RINSE, Endoactivator and Irrisafe were used respectively. Images by light optical microscope and SEM were taken before and after the experiment to compare the efficacy of each group.

Results: The irrigation performance of RINSE system was the highest among the devices tested in both experimental settings. ($p<0.05$) The differences among the other devices were not statistically significant. ($p>0.05$)

Conclusions (mandatory): The novel irrigation device, RINSE, was effective in removing intracanal medicament in artificial root canal system of two different settings.

R104 | COMPARISON OF THE EFFICACY OF A NOVEL ER:YAG LASER-ACTIVATED IRRIGATION MODE, SONIC-ACTIVATED IRRIGATION AND CONVENTIONAL IRRIGATION IN THE REMOVAL OF PULP TISSUE REMNANTS FROM THE APICAL ISTHMUS AREA

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AIM: To evaluate the efficacy of the Er:YAG laser modality Shock Wave Enhanced Emission Photo-acoustic Streaming (SWEEPS), sonic-activated irrigation (SAI) and passive conventional irrigation (CI) in the removal of pulp tissue remnants (RPT) from root canal isthmus area in lower molars.

Methodology: The study included 46 freshly extracted human lower molars with a continuous isthmus between the mesiobuccal and mesiolingual canal, which had been selected based on CBCT scans and strict critera (canal curvature up to 30°, isthmus diameter smaller than the diameter of the root canals, initial size of mesial canals same or smaller than K-file size 10). The selected samples were randomly distributed into three experimental groups (n=12/each) based on the final irrigation (FI) techniques: Group 1. SWEEPS, Group 2. SAI (SmartLite Pro EndoActivator, Denstply Sirona); Group 3. CI. In the controls (n=10), no treatment was performed. In the experimental groups, the mesial root canals were firstly instrumented with a Path File instrument (13/.02) followed by ProTaper Ultimate up to the instrument F2 (25/.08), using 3% NaOCl as an irrigant. In the FI protocol, 3% NaOCl, 15% ethylenediaminotetraacetic acid (EDTA) and 3% NaOCl (30s) were used sequentially. After the demineralization procedure, histological sections of the isthmus region (3-4mm from the apex) were cut, and RPT was measured. The results were analysed using Kruskal-Wallis test and pos-hoc Dunn test (level od significance at 5%).

Results: There was no difference in the relative isthmus surface area between the groups ($p=0.249$). The least amount of RPT was measured in the SWEEPS group (median RPT 1.58%, four samples free from RPT) ($p<0.05$), followed by SAI and CI (median RPT 5% and 7.39% respectively), which did not differ significantly ($p=0.495$).

Conclusions (mandatory): The SWEEPS was the most successful technique in the removal of RPT from the apical isthmus area, and SAI and CI showed similar efficacy.

R106 | EFFECT OF FINAL IRRIGATION PROTOCOLS ON THE PENETRATION OF ROOT CANAL SEALERS: A CONFOCAL LASER SCANNING MICROSCOPY STUDY

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AIM: To evaluate the effects of different final irrigation protocols on the dentinal tubule penetration of two different root canal sealers.

Methodology: A total of 120 extracted single-rooted human teeth were prepared using ProTaper rotary files. The specimens were randomly assigned to two main groups based on the type of sealer applied: AH Plus bioceramic sealer or resin-based AH Plus sealer . Each main group was further divided into five subgroups according to the final irrigation protocol (n=12): Group 1 - distilled water, Group 2 - 5.25% NaOCl + 17% EDTA, Group 3 - 5.25% NaOCl + 17% EDTA + 0.1% Octenidine hydrochloride, Group 4 - 5.25% NaOCl + 17% EDTA + 2% CHX, and Group 5 - 5.25% NaOCl + 17% EDTA + 5.25% NaOCl. Root canal obturation was performed using a single-cone technique with gutta-percha and the corresponding sealer mixed with 0.1% rhodamine B dye. The roots in each group were sectioned horizontally at 5 mm from the apex. The percentage of sealer penetration at the 200 µm level was measured using confocal laser scanning microscopy. Statistical analysis was conducted using two-way ANOVA and post-hoc Tukey's test (p=0.05).

Results: No significant differences were observed among the different irrigation groups. However, the bioceramic sealer exhibited a significantly higher penetration percentage than the resin-based sealer ($p<0.001$).

Conclusions (mandatory): Conclusions: Within the limitations of this study, different irrigation protocols did not affect the dentinal tubule penetration of root canal sealers. The AH Plus Bioceramic sealer demonstrated superior tubule penetration compared to the AH Plus sealer, regardless of the irrigation protocol used.

R107 | PERIAPICAL HEALING OUTCOMES OF DIFFERENT FINAL IRRIGATION TECHNIQUES: A RETROSPECTIVE STUDY

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AIM: The purpose of this study was to compare the periapical healing outcomes of primary root canal treatment using two different final irrigation techniques.

Methodology: A total of 68 healthy patients with a minimum follow-up period of 12 months were randomly selected from a database of patients treated by two experienced endodontists at the Hacettepe University Department of Endodontics between 2017 and 2022. Among these, 45 teeth underwent final irrigation with 5% NaOCl alone (protocol 1), while 23 teeth received 5% NaOCl followed by 5% EDTA (protocol 2). Patient and treatment related factors were analyzed to assess their prognostic significance. The treatment outcome was evaluated based on clinical and radiographic findings, with teeth classified as, healing (success), or not healed (failure). Statistical analysis was performed using the Chi-square and Mann-Whitney U tests.

Results: The average follow-up period was 44 months for protocol 1 and 53 months for protocol 2. No statistically significant difference was observed in the periapical healing rates between protocol 1 (86.7%) and protocol 2 (82.6%) ($p > 0.05$). Additionally, tooth type, dental arch, unintentional sealer extrusion, and post-endodontic restoration had no significant impact on healing outcomes. However, the presence of a preoperative radiolucent lesion was associated with significantly lower healing rates ($p < 0.05$).

Conclusions (mandatory): Both final irrigation protocols demonstrated comparable periapical healing outcomes. However, the presence of a preoperative radiolucent lesion was significantly associated with lower success rates. These findings highlight the importance of preoperative assessment in predicting endodontic treatment outcomes.

R108 | HEALING ASSESSMENT OF PERIAPICAL LESIONS IN ENDODONTICALLY TREATED TEETH USING GENTLEWAVE AND SAFE ENDED SIDE VENTED SYRINGE IRRIGATION - A PILOT STUDY

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AIM: The aim of this pilot study is to perform a 3-dimensional volumetric evaluation and comparison, using CBCT, of the healing of periapical lesions with side-vented syringe irrigation versus the GentleWave® irrigation system.

Methodology: In this pilot study 20 patients presenting at our Dental School for endodontic treatment, showing periapical lesions in periapical radiograph examinations, after agreeing to take part in this study, were selected and were divided into 2 groups (n=10) based on the irrigation system used during their treatment.

- Group A - Irrigation with safe ended side vented syringe needle
- Group B - Irrigation with GentleWave (Sonendo, Laguna Hills, CA, USA) irrigation system

All treatments were subjected to the same endodontic treatment protocol for access cavity preparation, shaping of root canal anatomy with endodontic file system used, filling materials and obturation technique and same restorative protocol for access cavities.
The patients were scanned with Orthophos XG CBCT (Sirona Dental Systems GmbH) before and after 6 months of endodontic treatment.
The data from CBCT scans were exported as DICOM files and imported and processed into 3D Slicer software for 3D analysis measurements of the volumes of the periapical lesions pre and post treatments. We calculated and compared the percentages of volumes of healing for the two groups and the data were statistically analysed.

Results: The results of this pilot study show that there was no statistically significant difference between the two groups. The percentages of volumes of healing were similar between the irrigation with safe ended side vented syringe needle and irrigation with GentleWave system groups.

Conclusions (mandatory): The present pilot study showed that the percentages of healing volumes of endodontically treated teeth irrigated with GentleWave irrigation system were similar as the ones irrigated with safe ended side vented syringe needle.

R109 | INFLUENCE OF IRRIGANTS ON EFFICACY OF NEW SINGLE-FILE RECIPROCATION INSTRUMENTS

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AIM: The aim of the research is to assess the impact of two irrigants on the effectiveness of the Direct-R Gold system in root canal treatment in vivo.

Methodology: Endodontic therapy was performed according to the standard protocol and the latest ESE S3 guidelines for endodontic therapy. The root canal patency was assessed using an ISO #10.02 size file. For mechanical preparation of the root canal, Ni-Ti instruments Direct-R gold R25 (Direct Endodontics S.A.S, 91 Rue du Faubourg Saint-Honoré - 75008 Paris – France) and an endomotor X-Smart (Dentsply Sirona, Ballaigues, Switzerland) with reciprocal motion settings were used. The complexity of the root canal was measured by the passive insertion of the Direct-R gold R25 instrument into the root canal, measuring the necessary length to reach full working length. Root canals where the instrument passively penetrated 0-2mm from the full working length were considered simple, 3-5mm were medium difficulty, and those over 6mm were classified as difficult. During instrumentation, a 2.5% sodium hypochlorite or Dual Rinse® HEDP (Medcem GmbH, Vienna, Austria) solution was used for irrigation via a syringe and needle. 50 root canals were insturmented in each group. Mean values and standard deviations of all tests were then statistically analysed using chi-square test and multinomial logistic regression.

Results: Results showed there is no significant difference between difficulty of instrumentation and reaching the apex (p-value 0.2719). Comparison of used irrigant with reaching the apex also did not show significant difference (p-value 0.2109).

Conclusions (mandatory): The study showed that there is no difference in root canal instrumentation when using the dual rinse irrigant compared to sodium hypochlorite. Additionally, regardless of the difficulty of the root canal, Direct-R Gold successfully reaches the apex in patent root canals.

R110 | EFFICIENCY OF ENDODONTIC ASPIRATOR TIPS VERSUS PAPER POINTS IN DRYING SEVERELY CURVED ROOT CANALS

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AIM: This study aimed to compare the efficiency of paper points and endodontic aspirator tips in drying root canals following irrigation.

Methodology: Ninety transparent resin blocks with severely curved canals (>30°) were instrumented using the ProTaper Next system (Dentsply Maillefer, Ballaigues, Switzerland) up to an apical size of 30 (X3). The apical ends of the blocks were sealed with silicone, and the canals were filled with 1% methylene blue solution. The blocks were randomly divided into three experimental groups based on drying protocols: Group 1; 30.02 paper points (Meta Biomed, Chungbuk, South Korea), Group 2; 30.04 ProTaper Next paper points (Dentsply, Mailleffer), and Group 3; Surgitip-endo aspirator tips (Coltène/Whaledent, Altstätten, Switzerland) followed by 30.04 ProTaper Next paper points. Each drying instrument was applied for intervals of 5 seconds until the canal was completely dry. Paper points were examined under a dental loupe (Eighteeth, Changzhou, China) after removal from the canals. A power analysis confirmed an adequate sample size (power = 0.994). Data were analyzed with JASP software (version 0.19.3.0) using the Kruskal-Wallis test and Dunn's post-hoc comparisons, as the data distribution was non-normal (Shapiro-Wilk test, $p < 0.05$).

Results: Statistically significant differences were observed among all groups ($p < 0.001$, Holm corrected). Group 1 required significantly more paper points compared to the other groups ($p < 0.001$), while Group 3 required the fewest.

Conclusions (mandatory): The use of Surgitip-endo aspirator tips significantly reduced the number of paper points needed to achieve complete canal dryness. Incorporating aspirator tips prior to the application of appropriately tapered paper points optimized the drying process, enhanced clinical efficiency, minimized material usage, and reduced procedure duration. These findings suggest that aspirator tips represent a beneficial adjunct to endodontic drying protocols, potentially improving overall treatment outcomes.

R111 | ANATOMIC FEATURES OF THE MIDDLE MESIAL CANAL AND MESIAL ROOT OF THE MANDIBULAR MOLARS ANALYZED BY MICRO-CT

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AIM: The present study aimed to characterize the morphological features of the mesial root of mandibular molars with a middle mesial canal (MMC) using micro-CT imaging.

Methodology: A total of 469 mandibular molars with two roots and fully developed apices were randomly selected from a local tooth bank. The mesial roots with MMC (n=25) were evaluated for several morphological aspects, including the MMC configuration and the minimal periradicular dentin thickness measured 2 mm below the root furcation area.

Results: The prevalence of MMC was 5.33%, with the confluent configuration being the most common anatomical variation. Most specimens with MMC had three independent orifices at the pulp chamber floor (n=16, 64.00%), and this canal was most frequently located in the coronal third of the root.
At the 2-mm axial level below the furcation, the average periradicular dentin thickness was 1.25 mm for the mesio-buccal canal (range: 0.71–1.61 mm), 0.99 mm for the MMC (range: 0.78–1.29 mm), and 1.22 mm for the mesio-lingual canal (range: 0.78–1.53 mm).

Conclusions (mandatory): The micro-CT analysis of the mesial roots of mandibular molars with an MMC revealed considerable variations in internal root canal anatomy. The confluent configuration was the most prevalent anatomic variation, while an independent MMC was observed in only one specimen. The lowest average periradicular dentin thickness at the 2-mm level below the furcation was observed in the MMC, measuring less than 1 mm. Clinicians should be aware of these anatomical variations before initiating root canal treatment to minimize the risk of iatrogenic complications.

R112 | A CONE-BEAM COMPUTED TOMOGRAPHY ASSESSMENT OF MAXILLARY INCISORS' ROOT AND ROOT CANAL MORPHOLOGY

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AIM: To describe the root morphology and the root canal anatomy of maxillary incisors in a Lebanese population group using cone-beam computed tomography (CBCT).

Methodology: After ethical committee approval, at Faculty of Dentistry, Beirut Arab University, CBCT scans were retrieved from patients' clinical records (DenTrooper, SOLT). No scans were obtained specifically for the purpose of this study. The following parameters for maxillary incisors were evaluated: root canal configuration according to Ahmed et al. (2017) classification, mid-root cross-sectional shape based on Gellis and Foley (2021) classification, and differences according to gender and age groups.

Results: One hundred and fifty-one CBCTs were evaluated: 58 were males and 93 were females, with an age range of 11-79 years. The selected data included a sum of 378 teeth: 192 maxillary central incisors, and 186 maxillary lateral incisors. One root and one canal configuration was the most prevalent in both maxillary incisors. Regarding the gender, all males and females exhibited maxillary incisors with one root and a single canal, for the exception of two cases: one case presented a lateral incisor of type $^{1}22^{21}$ and one case presented a central incisor of type $^{2}11M^{1}D^{1}$, belonging to two different 22 years-old females. Concerning external mid-root morphology, globular shape was most prevalent for maxillary central incisors (92.5%), followed by elliptical shape (6.25%), and wedge shape (1%). The elliptical shape was dominant (67,8%) for maxillary lateral incisors, followed by globular (31.2%), and plate root forms (1%).

Conclusions (mandatory): Lebanese patients seem to show maxillary incisors configuration similar to other populations having one root and one canal, with some exceptions. Thus, it is important to have thorough and accurate knowledge of root and root canal configurations and possible variations in each population.

R113 | A CONE BEAM COMPUTED TOMOGRAPHY ASSESSMENT OF LOWER INCISORS' ROOT AND ROOT CANAL MORPHOLOGY

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AIM: To describe the root and root canal anatomy of mandibular incisors in a Lebanese population using Cone Beam Computed Tomography (CBCT).

Methodology: After ethical committee approval, CBCT scans were retrieved from Beirut Arab University Faculty of Dentistry patients' clinical records (DenTrooper Educational, SOL-T, Beirut, Lebanon). No scans were obtained specifically for the purpose of this study. The evaluated parameters were root canal configuration based on Ahmed classification 2017, mid-root cross-sectional shape based on Gellis & Foley classification 2021, and differences between genders and age groups.

Results: A total of 518 Mandibular Incisors (MI) from 166 CBCTs were screened. From the total 161 included patients, 104 (64.6%) females and 57 (35.4%) males, with an age range 11-79 years (mean 39 years). Type 1MI1 was most prevalent in lower centrals (LC) with 56.48% (135 LCs) followed by type 1MI1-2-1 with 39.75% (95 LCs). Similar results were found in lower laterals (LLs) with 58.42% (163 LLs) type 1MI1, and 36.2% (101 LLs) type 1MI1-2-1. Regarding the remaining configurations their presence was limited within mandibular incisors. Some variations were also detected such as 1MI1-2-1-2-1 and 1MI2-1-2-1. Males showed higher tendency to have double canals configurations in MIs compared to females, 47.75% (85 MIs) and 39.71% (135 MIs) respectively. Regarding age groups, 1MI1 was most prevalent in all categories. However, this prevalence was directly proportional with age. Older patients showing higher percentage of type 1MI1. As for external mid-root morphology, elliptical shape was the most prevalent in LCs (50.21%, 120 LCs), while kidney shape was the most prevalent in LLs (38.35%, 107 LLs).

Conclusions (mandatory): A detailed knowledge of root canal configurations and possible variations in each population is essential for clinicians in order to avoid missing canals during treatment. Lebanese patients seem to have a considerable two root canals anatomy of their mandibular incisors.

R114 | OBSERVATION OF GENDER DIFFERENCES IN ANATOMICAL VARIATIONS OF MANDIBULAR CANINES: A CONE BEAM COMPUTED TOMOGRAPHY ANALYSIS

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AIM: This study aimed to report gender distribution of the anatomical variations in mandibular canines, using Cone Beam Computed Tomography (CBCT) imaging among a group of Lebanese patients.

Methodology: Following Institutional Review Board (IRB) approval, CBCT scans of 100 lower canines (LC) with equal sample distribution between males and females, acquired from Beirut Arab University patient records among the Lebanese population, were used to assess the root canal morphology of mandibular canines and detect any variation. The data from these scans were classified based on Vertucci's and Ahmad et al. classification systems. Additionally, the findings were compared and categorized according to gender to explore potential differences in anatomical patterns between males and females.

Results: The study revealed that 94% of mandibular canines exhibited a single root with a Type I Vertucci configuration, while 3% demonstrated more complex anatomies such as Type III and 1% Type V configurations. Two roots canine were observed in 2% of cases. Based on Vertucci's classification, Type I was the most common configuration in both genders. However, females demonstrated a greater tendency toward complex anatomies, with higher frequencies of Type III (3 females vs. 0 male), Type V (1 female vs. 0 male), and canines with 2 roots (2 females vs. 0 male). According to Ahmad et al. system, type 1LC1 was most commonly seen 94%, followed by 1LC1-2-1, with 3%, and two roots 2LC B1L1 were present in 2% of cases, with females being the only gender showing variation in this study.

Conclusions (mandatory): The prevalence of a particular anatomical variation in females, as observed in the analyzed sample, does not exclude the possibility of the same variation occurring in males among the Lebanese population.

R115 | A CONE BEAM COMPUTED TOMOGRAPHY ASSESSMENT OF MAXILLARY MOLARS ROOT AND ROOT CANAL MORPHOLOGY

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AIM: To describe the root and root canal anatomy of maxillary permanent molars in a sample group of the Lebanese population using Cone Beam Computed Tomography (CBCT).

Methodology: After ethical committee approval, 50 CBCT scans of upper posterior quadrants were retrieved from Beirut Arab University Faculty of Dentistry patients' clinical records (Dentrooper Educational, SOL-T, Beirut, Lebanon). No scans were obtained specifically for the purpose of this study. Root canal configuration, mid-root cross-sectional shape, and differences between genders and age groups were evaluated.

Results: The 50 screened CBCTs had a total of 74 maxillary molars, belonging to 21 males (42.0%) and 29 females (58.0%), with an age range between 15–72 years. The sample comprised of 40 First Molars (FM), 29 Second Molars (SM), and 5 Third Molars (TM). Out of the 40 FM, 38 showed 3 roots (95%) and 2 (5%) showed 2 roots with 3 canals; both were males. Out of the 38 three-rooted FMs, 24 (63.16%) had 3 canals, while 14 (36.84%) showed 4 canals with 10 out the 14 FM having 3FMMB2-1DB1P1 configuration. Regarding the SMs, 20 presented with 3 roots; 16 SM (80%) had 3 canals, while the remaining 4 SMs (20%) had 4 canals (2 in females and 2 in males). A total of nine (31.03%) two-rooted SM were found (5 in females and 4 in males); 6 SMs (66.67%) of them were code 2SMB1P1 (4 in males and 2 in females), 2 had code 2SMB2-2P1 (both in female) and one had 2SMM2-2DB1 belonging to a female. Finally, three TMs had type 3TMMB1DB1P1, 1 had type 3TMMB2-2DB1P1 and only 1 was presented with code 1TM3-1.

Conclusions (mandatory): Lebanese patients studied exhibited a high prevalence of three-rooted maxillary molars with consistent single-canal palatal roots and variable mesiobuccal canal complexity, with almost equal gender distribution.

R117 | A RETROSPECTIVE STUDY ON ROOT CANAL ANATOMY AND MORPHOLOGY OF MAXILLARY PREMOLARS AMONG LEBANESE POPULATION

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AIM: To describe root canal anatomy and morphology of maxillary premolars in Lebanese population using cone beam computer tomography (CBCT).

Methodology: After Ethical Committee approval, a retrospective study on 122 CBCT were screened from Beirut Arab University Data System (DenTrooper Educational, SOL-T, Beirut, Lebanon). Maxillary 1st and 2nd premolars were screened in patient's aged 15 to 81. The evaluated parameters were related to root canal anatomy and morphology using Ahmad et Al classification system, mid-root cross sectional shape based on Gellis & Foley classification and differences between genders.

Results: A total of 139 maxillary 1st and 2nd premolars were screened among 74 patients and 48 CBCT were excluded due to missed premolars. Single rooted anatomy was present in 40.3% of maxillary first premolars while 59.7% of the cases screened presented 2 roots. For the canal configuration, 91% of the cases had 2 canals, 4.5% presented 1 canal and 4.5% presented 3 canals. Maxillary second premolar presented 1 root in 80.3% of the cases and 2 roots in 19.7% of the cases. Regarding canal configuration 45.5% of the cases presented with 1 canal and 54.5% had 2 canals. Regarding gender distribution, in maxillary first premolars, male have higher frequency of 2 roots (83.3%) while only 46.5% of females had the same configuration. Females have higher frequency of 1 root (53.5%). Regarding canals configuration of these teeth, no higher frequency was present predominant in cases of 1 or 2 canals. However, in cases of 3 canals, males have higher frequency (8.3%) than females (2.3%). Regarding maxillary second premolars, no predominance for gender was present.

Conclusions (mandatory): Root and root canal anatomy in Lebanese population seemed to be similar of most of what was reported in other populations. However, the studied samples showed prevalence for males to have extra root canal over females.

R119 | AN IN VITRO STUDY ON THE ANTIMICROBIAL EFFICACY OF A CALCIUM HYDROXIDE VERSUS A CALCIUM SILICATE BASED ENDODONTIC MEDICAMENT

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AIM: Intracanal medicaments support chemo-mechanical preparation in managing endodontic infections, but their antibacterial efficacy varies with microbial diversity. This study compared the long-term antimicrobial efficacy, metabolic activity, and pH of calcium silicate-based BC Temp (BC) and DEHP calcium hydroxide (CH) against four bacterial species.

Methodology: Antimicrobial activity was assessed using a direct contact test (DCT) against Enterococcus faecalis, Streptococcus mitis/oralis, Cutibacterium acnes, and Staphylococcus epidermidis, by quantifying colony-forming units (CFU). The metabolic activity and cell viability were measured using the colorimetric 2,3-Bis-(2-Methoxy-4-Nitro-5-Sulfophenyl) -2H-Tetrazolium-5-Carboxanilide (XTT) assay. The pH was examined over a 28-day period with and without freshly extracted tooth-root sections. Statistical analysis included two-way ANOVA with post-hoc Tukey's and Šídák's tests.

Results: Both BC and CH demonstrated effective antimicrobial activity, significantly reducing CFU compared to controls. CH showed superior efficacy against Cutibacterium acnes at 7–14 days, while BC sustained reductions at 21–28 days, particularly against Streptococcus mitis/oralis, Staphylococcus epidermidis, and Enterococcus faecalis. The XTT assay revealed reduced cell viability for both medicaments, with rapid declines in Streptococcus mitis/oralis viability within 48 hours. After 28 days, CH targeted Enterococcus faecalis and Cutibacterium acnes, while BC maintained viability below 50% across all groups. BC retained alkalinity up to 7 days and CH up to 14 days, and there was no difference when used with or without sectioned tooth-root surface. CH showed higher pH in HBSS (pH >12).

Conclusions (mandatory): BC intracanal-medicament exhibited long-term antibacterial effects when compared to traditional CH, thereby demonstrating enhanced antimicrobial activity against tested bacteria.

R120 | PHYSICOCHEMICAL PROPERTIES AND ANTIMICROBIAL ACTIVITY OF AN INTRACANAL MEDICAMENT BASED ON CALCIUM HYDROXIDE AND ITS ASSOCIATION WITH F18 BIOGLASS OR COPPER ION-DOPED BIOGLASS

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AIM: Ideal intracanal medication should present physicochemical properties, antimicrobial effect and bioactivity. Laboratory of Vitreous Materials (UFSCar, SP, Brazil)) has developed a bioglass, called F18 (BGF18), with high bioactivity, and a copper ion-doped bioglass (BGC) with greater antimicrobial effectiveness. These bioactive materials can be used in association with calcium hydroxide (CH). This study developed and evaluated CH-based intracanal medication and its association with BGF18 or BGC.

Methodology: Intracanal medications: experimental paste composed of CH, radiopacifier Zirconium Oxide and polyethylene glycol as vehicle - (HCEXP) and its association with BGF18 or BGC at 10 and 20%. Polyethylene tubes with the medications were immersed in distilled water to evaluate the pH after 1, 3, 7, 14 and 21 days and the solubility after 7 and 14 days. The modified direct contact test was performed with Enterococcus faecalis and Enterococcus faecalis + Candida albicans biofilm induced in bovine dentin blocks, and 24 hours of contact with medication eluate. Data were subjected to normality test and ANOVA and Tukey tests, with significance level of 5%.

Results: All medications promoted higher pH than control without medication ($p < 0.05$). At 14 days, HCEXP presented higher pH ($p < 0.05$). HC-BGF18 20%, HC-BGC 10% and 20% promoted lower pH ($p < 0.05$). Greater solubility was observed for HCEXP ($p > 0.05$). HC-BGF18 20% and HC-BVC 20% presented lower solubility ($p < 0.05$). HC-BGC 20% showed greater effectiveness against E. faecalis than the other medications and control group ($p < 0.05$). For dual biofilm, HC-BVF18 20% and BVC 10 and 20% showed greater effectiveness against E. faecalis and Ca than the other medications and control ($p < 0.05$).

Conclusions (mandatory): The incorporation of Bioglass doped with copper ions into the calcium hydroxide paste promoted a lower pH, reduced solubility and increased the antibiofilm effectiveness.

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R122 | CHELATING CAPACITY OF 0.1% CHITOSAN NANOPARTICLES AS A ROOT CANAL IRRIGANT

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AIM: To evaluate chelating capacity of 0.1% chitosan nanoparticles as root canal irrigant.

Methodology: Chitosan nanoparticles synthesis was made under ionic gelation method and where characterized with DLS, STEM, FTIR and DSC. Six unirradicular bicuspids were utilized, and a 1 mm disk was obtained, and each disk was cut into four fragments. Each fragment was in contact with one of the following irrigants: Group 1, 0.1% chitosan nanoparticles; and Group 2, 17% EDTA. All the samples were placed in contact with the corresponding irrigant for 0, 3, 5, and 10 min. Then, all fragments were digested with HNO3 and later analyzed using ICP to evaluate their mineral content.

Results: The diameter of the nanoparticles was 113.44 ± 11.05 nm with a PDI of 0.243 ± 0.042. The morphology of the nanoparticles was evaluated by STEM, and the “blackberry” shape characteristic of the chitosan nanoparticles was observed. The chitosan nanoparticles were characterized by FTIR, where changes were observed in the characteristic bands of the -OH and -NH2 groups in the spectrum with respect to low-molecular-weight chitosan. DSC showed a decrease in the glass transition temperature with respect to low molecular weight chitosan due to the change in molecular arrangement after crossover. Chitosan nanoparticles reduced the percentage weight of Ca from 3 to 10 min, showing similar results to EDTA.

Conclusions (mandatory): 0.1% chitosan nanoparticles could be an alternative to 17% EDTA as a chelating agent intended for root canal irrigants.

R123 | CYTOTOXICITY EVALUATION OF CHITOSAN NANOPARTICLES AS A POTENTIAL IRRIGANT FOR ROOT CANAL TREATMENT

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AIM: To evaluate the cytotoxicity of 0.1% chitosan nanoparticles (CsNPs) on fibroblast cell viability using the MTT assay, as a potential alternative irrigant for root canal disinfection.

Methodology: An in vitro study was conducted using fibroblast cell line L929 (ATCC, Manassas, VA, USA), which was cultured in Dulbecco's Modified Eagle's Medium (DMEM). The chitosan nanoparticles were prepared and inoculated at a predetermined concentration measured by an analytical balance. The MTT salt reagent was added to the 96-well plates, and after incubation, the formazan production was observed under a microscope. The absorbance was measured using a microplate spectrophotometer (Multiskan, ThermoFisher Scientific, USA) to assess fibroblast proliferation and survival.

Results: Chitosan nanoparticles appear to be biocompatible with L929 fibroblasts, and they appear to promote cell proliferation. However, as this is an in vitro study, further in vivo and clinical research is required before their implementation as an endodontic irrigant

Conclusions (mandatory): Chitosan nanoparticles appear to be biocompatible with L929 fibroblasts, and they appear to promote cell proliferation. However, as this is an in vitro study, further in vivo and clinical research is required before their implementation as an endodontic irrigant.

Acknowledgements (optional): This research was supported by a CONACYT grant.

R126 | ISOLATION OF FUSOBACTERIUM BACTERIOPHAGES FROM HUMAN SALIVA

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AIM: To isolate Fusobacterium bacteriophage from normal human saliva samples and strains held in our laboratory, for future work to determine if they could be used in endodontic treatment.

Methodology: Saliva samples from healthy individuals were collected, with ethical approval, and screened for the presence of Fusobacterium using standard microbiological techniques. Fusobacterium isolated from saliva samples along with three lab Fusobacterium animalis strains were treated to induce any potential phage hosed by these bacteria.

Results: From the 89 saliva samples Fusobacterium was present in only 6 samples, identifying three strains of Fusobacterium. These strains were F. nucleatum (present in one saliva sample), F. periodonticum (present in two saliva samples), and F. pseudoperiodonticum (present in three saliva samples). No phage were isolated from the 89 health subjects. However, phage were induced from three of the lab F. animalis strains. Despite phage being induced from all three F.animalis strains, all three phages were only active against one F.animalis strain.

Conclusions (mandatory): Phage can be induced from bacteria samples though a single phage may be limited to the bacterial strain it can act upon, and there may be localised phage resistance mechanisms at play preventing phage activity.

R127 | CHEMICAL CHARACTERIZATION, MINIMUM INHIBITORY AND BACTERICIDAL CONCENTRATION OF A HIGH AND LOW MOLECULAR WEIGHT CHITOSAN GEL

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AIM: Chitosan is a natural biopolymer extracted from the exoskeleton of arthropods and is a material with broad applications due to its antimicrobial, wound-healing, reparative, and bioactive properties. Therefore, this study aimed to evaluate the antimicrobial activity of a high molecular weight (HMW) and low molecular weight (LMW) chitosan gel against microorganisms involved in endodontic infections.

Methodology: Solutions of 5.000 µg/mL HMW and LMW were prepared in 1% acetic acid and used to determine the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) against Streptococcus mutans, Pseudomonas aeruginosa, Enterococcus faecalis, Staphylococcus aureus, and Candida albicans. The gel was characterized by FT-IR, pH, and viscosity.

Results: Both HMW and LMW chitosan had no antimicrobial effect against Candida strains. The MIC of LMW ranged from 156.25 µg/mL (P. aeruginosa, E. faecalis, S. aureus) to 625 µg/mL (S. mutans), while HMW ranged from 312.5 µg/mL (P. aeruginosa, E. faecalis, S. aureus) to 1,250 µg/mL (S. mutans). The MBC was equal to the MIC for all microorganisms with HMW chitosan, except for S. mutans (MBC = 1,250 µg/mL), whereas for LMW, only P. aeruginosa and S. aureus showed MBC values equal to MIC. LMW chitosan was more effective than HMW, showing lower MIC and MBC, with no difference in effect between Gram-positive and Gram-negative bacteria. The gel presented an acidic pH and higher viscosity for HMW chitosan.

Conclusions (mandatory): The antimicrobial potential of both HMW and LMW against oral microorganisms directs these substances toward different endodontic applications, such as irrigants, intracanal medication or even plasticiser agents of sealers to reduce microorganism numbers.

R128 | COMPARISON OF THE APICAL ROOT CANAL MICROBIOTA OF TEETH WITH POST-TREATMENT APICAL PERIODONTITIS USING TWO DIFFERENT SAMPLING METHODS

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AIM: To compare the apical root canal microbiota of teeth with post-treatment apical periodontitis sampled with sterile paper points and cryopulverized powder of the apical 5 mm root ends by 16S rDNA sequencing.

Methodology: Twenty extracted molar teeth with post-treatment apical periodontitis were used.The apical parts of the roots with the largest periapical lesion were sectioned. Two separate microbial samples were taken from each of the apical root canals. The first sample was taken with paper points and the second sample was taken with cryopulverized powder of the apical root segments.16S rDNA amplified samples from both sampling methods were sequenced using an Illumina Miseq device. Amplicon sequence variants obtained with the DADA2 algorithm were transferred to the QIIME2 system and mapped with the SILVA database. Richness and diversity of microbial composition in the sampling methods were investigated using Alpha diversity (Shannon, Simpson and Chao1) and beta diversity (unweighted and weighted UniFrac) indices. Linear discriminant analysis effect size (LEfSe) analysis was used to identify the most differentially abundant taxa between the sampling methods. Statistical significance of diversity parameters was analysed using Kruskal-Wallis, Wilcoxon signed rank tests and permutational analysis of variance (PERMANOVA).

Results: Samples from 15 teeth were positive for bacteria. According to the Chao1 index, there was no statistically significant difference in richness between the sampling methods (p=0.11). Shannon and Simpson indices showed similar diversity (p=0.46 and p=0.91, respectively), WeightedUniFrac and UnweightedUnifrac distance metrics showed similar community composition in both sampling methods (p=0.98 and p=0.21, respectively). LEfSe analysis showed that the taxa that differed between the sampling groups were f. Bacillaceae, g-Geobacillus, s-Geobacillus vulcani, f. Xanthomonadaceae, o. Xanthomonadales, g-Stenotrophomonas, c.Betaproteobacteria and o. Burkholderiales (LDA>2).

Conclusions (mandatory): The richness and diversity of the apical root canal microbiota were similar for the paper point and cryopulverization sampling methods. The pulverization method provided a reliable representation of bacterial sampling.

R130 | ACUTE DENTAL ABSCESSES REQUIRING HOSPITALIZATION IN AN ITALIAN POPULATION, CASE SERIES: CHARACTERISTICS OF THE PATIENTS AND TREATMENT REQUIRED

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AIM: To examine the characteristics of 27 consecutive cases of Italian patients hospitalized for the complications of an acute apical abscess.

Methodology: A total of 27 cases of patients with complicated dental abscesses were admitted through the emergency room (ER) and hospitalized at the University Hospital between the years 2023 and 2024. The ER, clinical, surgical and dental records were obtained, registered in a dedicated data base and analysed to see how many patients received emergency surgical procedures, which were the pharmacologic treatments administered, the days of hospitalization and whether these conditions correlated with the patients' medical history.

Results: The sample included 14 men and 13 women, with an average age of 51.9 ± 15.6 years (range: 22-75). The majority of patients (55.6%) presented at least one systemic condition, and hypertension (37%) and hypercholerestolemia (18.5%) were the most prevalent. The 46.2% of individuals were active smokers, and 19.2% were former smokers, while 55.5% reported regular alcohol consumption. The most common abscess pathways of spreading were submandibular and laterocervical (18.5% each), followed by mandibular (5.7%). Lower molars were the most frequently affected teeth (75%), in particular the second lower left molar (21.4%). The 84% of patients required surgical interventions which primarily involved cervicotomy (44%) and transoral approach (40%), with tooth extraction performed in nearly half of the cases. All the patients were admitted through the emergency department and had an average hospital stay of 6.6 ± 7.2 days (range: 0-33).The pharmacological approach includes the use of antibiotics, corticosteroids and gastro-protectants, in particular of Ceftriaxone (90.9%), Metronidazole (86.4%), dexamethasone (36.4%) and omeprazole (59.1).

Conclusions (mandatory): Patients' systemic conditions seem to be associated to the severity of the abscess. These findings highlight the importance of timely diagnosis and management of dental abscesses to prevent systemic complications.

R131 | AI-BASED PERIAPICAL LESION EVALUATION: DEVELOPMENT AND CLINICAL APPLICATION

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AIM: Despite the potential to preserve natural teeth through proper endodontic treatment, extraction followed by dental implant placement is frequently performed for apical periodontitis. General dentists, compared to endodontic specialists, are more likely to decide on extraction based on the size and location of apical lesions. This suggests that accurate assessment of apical lesions requires substantial experience, leading to a higher extraction tendency among general dentists. To address this issue, this study aims to develop an AI model capable of evaluating apical lesions at an expert level.

Methodology: This study was approved by the Institutional Review Board of Yonsei University Dental Hospital (Approval No. 2-2024-0064). Training data for the AI model were collected from the clinical database of patients who underwent nonsurgical root canal treatment or retreatment by endodontists at the Department of Conservative Dentistry, Yonsei University Dental Hospital, Seoul, between 2008 and 2015. Images were annotated by experts using specialized software to identify the target teeth and apical lesions for AI training. Subsequently, PAI scoring was performed on the annotated regions. The AI model was then trained using these annotated images and PAI scores through additional processing steps and coding-based logic.

Results: A total of 8,634 X-ray images were included in this study. The AI model was trained on annotated clinical images with corresponding PAI scoring. Its performance was evaluated using quadratic weighted kappa (QWK), which resulted in a score of 0.729.

Conclusions (mandatory): The AI model demonstrated a QWK of 0.729 in PAI scoring, indicating reliable performance in multiclass classification. These results suggest that AI can support the expert-level evaluation of apical lesions, potentially improving diagnostic consistency and aiding clinical decision-making in endodontics.

Acknowledgements (optional): This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government (MSIT) (No. RS-2023-00251473).

R132 | PREDICTION OF INTRACORONAL BLEACHING OUTCOMES USING ARTIFICIAL INTELLIGENCE

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AIM: This study aims to predict the outcomes of intracoronal bleaching treatment applied with the walking bleaching technique in the clinic using artificial intelligence (AI).

Methodology: 172 maxillary incisor teeth were collected and divided into Study group and Control group. Root canal treatment were performed on teeth. Gutta-percha was reduced to 2 mm below the canal orifices. Canal orifices were sealed with light-cured glass ionomer cement. Teeth were placed in 1.5 ml Eppendorf tubes containing blood for artificial staining and centrifuged at 3400 rpm twice daily for 15 minutes over two weeks. Color measurements of stained teeth were performed using spectrophotometer.
For intracoronal bleaching 35% hydrogen peroxide was placed in the pulp chamber, and cavities were sealed with a temporary filling material. Colors of the teeth on the 2nd and 4th days were recorded and the bleaching agent was renewed. After recording the colors on the 6th day the bleaching procedure was concluded. Collected data were then transferred to the AI program. The developed deep neural network (DNN) model was compared with control group's results. Performance assessment included accuracy rate, precision, recall, F1-score, AUC and kappa values. Independent t-test was utilized to observe whether there is a significant difference between the readings of study group and control group.

Results: Significance level was set at 5% (0.05). DNN model showed 85% accuracy rate with 0.83 recall, 0.85 F1-score, and 0.90 AUC values, supported by precision (0.81) and kappa (0.60) values. In this study, the ability to predict the outcomes of intracoronal bleaching treatments in advance provides patients with more predictable results regarding their treatment, making their treatment expectations more realistic.

Conclusions (mandatory): The study shows AI's potential in predicting intracoronal bleaching outcomes with 85% accuracy.
AI provides more reliable patient expectations for treatment effectiveness.
The model demonstrates high precision, recall, and AUC, proving its clinical value.

R133 | DESIGN AND IMPLEMENTATION OF IMAGE PROCESSING SOFTWARE FOR MEASURING TOOTH AND ROOT CANAL GEOMETRY IN 3D RADIOGRAPHIC AXIAL VIEWS

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AIM: Introduction
Calculating geometric parameters such as area, perimeter, centering point of teeth and root canal pulp, distances between tooth components, and changes before and after root canal preparation in axial CBCT images is essential in dental research. However, no specialized software exists for these calculations, and conventional methods are time-consuming and error-prone. Researchers often use AutoCAD or Romexis Viewer, manually placing multiple points and lines, leading to inaccuracies. In endodontics, rotary file performance is evaluated by calculating transportation and centroid changes in the root canal space, which involves measuring distances from the inner canal wall to the outer root surface before and after canal preparation. The complex geometry of root canals increases the risk of errors with these methods. To address these challenges, a new image processing software called Dentopc Axial Analyzer (DAA) was developed to calculate these parameters more accurately and efficiently.

Methodology: CBCT images from the mesial root of an extracted human first molar were analyzed. Initially, conventional methods measured the geometric characteristics of the pulp surface in the axial view before and after canal preparation using Romexis Viewer, revealing several limitations and errors. The DAA software was then designed and implemented, and the pulp space parameters were recalculated. Results from conventional methods were compared with those from the new image processing approach.

Results: Compared to the conventional methods, the DAA software measured the geometric parameters before and after the preparation of the root canal more accurately and with less time, and there was a difference between the results of the two methods.

Conclusions (mandatory): The image processing method improves measurement accuracy in axial views and is a viable alternative to conventional methods. Additionally, DAA has potential applications in other dental fields.

R134 | EVALUATION OF THE PRECISION OF CONTEMPORARY ARTIFICIAL INTELLIGENCE CHATBOTS IN ADDRESSING ENDODONTIC INQUIRIES

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AIM: To compare the accuracy of modern AI chatbots—Gemini 1.5 Flash, Gemini 1.5 Pro, ChatGPT-3.5, and ChatGPT-4—in answering endodontic questions and assisting clinicians.

Methodology: Three endodontics experts formulated 40 yes/no questions covering 12 different endodontic topics. These questions were posed to the AI models on the same day, with each question presented in a new chat session. Cohen's kappa (K) test was used to assess the agreement of responses, with statistical significance set at $P < .05$.

Results: ChatGPT-3.5 achieved the highest accuracy (80%), followed by ChatGPT-4 (77.5%), Gemini 1.5 Pro (72.5%), and Gemini 1.5 Flash (60%). ChatGPT-3.5 (K=0.5908) and ChatGPT-4 (K=0.5408) were classified as having "weak agreement," while Gemini 1.5 Pro (K=0.4388) exhibited "lower weak agreement," and Gemini 1.5 Flash (K=0.2099) showed "minimal agreement."

Conclusions (mandatory): Variations in response accuracy to endodontic questions were observed among the chatbots. While ChatGPT models outperformed Gemini, AI-based solutions alone should not be relied upon for clinical decision-making. Future research should address these limitations by incorporating more complex cases and conducting broader analyses in this field.

R135 | DEVELOPMENT OF A MOBILE APPLICATION INTEGRATING ARTIFICIAL INTELLIGENCE TO FACILITATE KNOWLEDGE ASSIMILATION IN RESTORATIVE DENTISTRY AND ENDODONTICS: EVALUATION AND PERSPECTIVES

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AIM: The aim of this study is to evaluate and develop a mobile application that integrates educational materials from the Collège National des Enseignants en Odontologie Conservatrice (CNEOC) reference sheets with artificial intelligence (AI) to facilitate knowledge acquisition among students in restorative dentistry and endodontics.

Methodology: CNEOC reference sheets were extracted using the Python library PyPDF2 and integrated into a mobile application developed with SwiftUI. The application's usability was assessed by measuring response generation times. A set of multiple-choice questions (MCQs) was collected from the Faculty of Dentistry in Lyon and supplemented with AI-generated explanations using ChatGPT-4 (OpenAI API).
To evaluate the consistency of AI-generated explanations, text embeddings (text-embedding-ada-002) were computed, and similarity was assessed by calculating the cosine distance between vectors. A hierarchical clustering algorithm (AgglomerativeClustering, metric='cosine', linkage='average') was applied to group the data into clusters, which were visualized in a two-dimensional space.
Textual analysis included measuring the average number of words and sentences per response using Python. Finally, experts assessed the scientific accuracy and relevance of the responses on a Likert scale ranging from -2 to 2.

Results: Development using SwiftUI enabled response times of less than 2 seconds. The robustness of AI-generated explanations was evaluated as moderate (mean score = 0.84), while a similarity score of 0.97 was observed between the first and second AI-generated explanations. Textual analysis revealed that both explanations were comparable in length, with an average of 68.12 words and 4.1 sentences per response.

Conclusions (mandatory): The results indicate that AI-generated explanations exhibit a high degree of internal consistency. However, the moderate robustness score suggests that further improvements in content generation may be necessary to enhance explanatory quality and ensure greater scientific accuracy.

Acknowledgements (optional): The authors express their gratitude to the educators of the Collège National des Enseignants en Odontologie Conservatrice (CNEOC) for their contributions and support.

R136 | ARTIFICIAL INTELLIGENCE FOR ROOT CANAL ORIFICE IDENTIFICATION USING DENTAL OPERATING MICROSCOPE IMAGES: A PRELIMINARY EVALUATION

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AIM: Introduction: The objective of this study was to evaluate the diagnostic performance of artificial intelligence (AI) in detecting root canal orifices using images captured with a dental operating microscope (DOM).

Methodology: Methods: A total of 80 human maxillary first and second molars were included in the study. After preparing traditional access cavities, root canal orifices were identified under a dental operating microscope (DOM) at 21.25x magnification. To ensure accurate identification, the number of root canal orifices was cross-verified by analyzing axial CBCT images. Following orifice identification, video recordings were obtained using the DOM, from which a total of 1,527 frames were randomly selected for analysis. The root canal orifices in these frames were manually labeled using CranioCatch labeling software (CranioCatch, Eskisehir, Turkey). A segmentation model for root canal orifice detection was developed using the YOLOv8x model and implemented with OpenCV, PyTorch, NumPy, Pandas, TensorBoard, and Seaborn libraries. A confusion matrix was employed to assess the model's diagnostic performance by comparing predicted outcomes with actual observations.

Results: Results: In the binary classification task, the system correctly identified 502 out of 526 root canal orifices, yielding an accuracy of 91%. There were 24 false negatives and 24 false positives. For the specific identification of the mesiobuccal 2 (MB2) canal, the algorithm detected MB2 in 63 out of 70 images, resulting in an accuracy rate of 80%. However, it missed MB2 in 7 images (4 false negatives) and misclassified 9 images, with surface irregularities mistaken for MB2 (9 false positives).

Conclusions (mandatory): Conclusion: The YOLO-based CNN demonstrated high accuracy and sensitivity in detecting root canal orifices from DOM images. This study highlights the potential of AI algorithms for real-time clinical assistance and their possible role in enhancing the training of dental students.

R138 | PERFORMANCE OF AN ARTIFICIAL INTELLIGENCE SYSTEM FOR DIAGNOSING PULPITIS IN ADULTS: AN EVALUATION USING A MODIFIED WOLTERS CLASSIFICATION

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AIM: To evaluate the performance of an artificial intelligence (AI) system in diagnosing pulp conditions in adult patients, using a modified Wolters diagnostic classification.

Methodology: A cross-sectional study was conducted, and data from 200 teeth of 200 patients were collected at the Universidad de los Andes dental clinic. A clinical evaluation was performed, and a dataset containing 21 diagnostic attributes was compiled. Pulpal diagnoses were classified using a modified version of Wolters' classification. Four machine learning models (Decision Tree (DT), Support Vector Machine (SVM), Multi-Layer Perceptron (MLP), and XGBoost) were trained using a 5-fold cross-validation approach. Hyperparameters were optimized, and model performance was assessed through precision, recall, f1-score, and area under the receiver operating curve (AUC). The final metrics were averaged over several iterations. To estimate model variability, bootstrap resampling was applied. Additionally, attribute importance was analyzed using the permutation method.

Results: The diagnoses were distributed in Normal Pulp (NP) (21.5%), Initial Pulpitis (IP) (13%), Mild Pulpitis (MIP) (21.5%), Moderate Pulpitis (MP) (25%), and Severe Pulpitis (SP) (19%). In cross-validation, SVM and XGBoost achieved the best performances (F1-score = 0.84 - 0.85). During testing, SVM and XGBoost maintained an F1-score of 0.85, with AUC higher than 0.96 for all diagnostic classes, highlighting NP and SP with perfect values. Bootstrap analysis (95% CI) confirmed that XGBoost was the most stable model, with the lowest variability and the best average values for precision (0.81), recall (0.81), and f1-score (0.80). On the other hand, pain to cold stimulus emerged as the most relevant attribute for diagnosis (0.46).

Conclusions (mandatory): The AI-based system demonstrated significant potential for pulp diagnosis, offering possible support to dentists for more objective diagnostic decisions. Pain intensity in response to thermal stimuli and spontaneous pain were crucial factors for correct classification, further emphasizing their importance in the overall diagnostic process.

RESEARCH POSTERS 03

R139 | BIOLOGICAL EFFECTS OF GENISTEIN ON HUMAN DENTAL PULP CELLS

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AIM: Genistein is an isoflavone subclass of flavonoids found in soybeans. It has been reported that genistein induces the activation of osteoblasts and possesses a variety of beneficial properties, including antioxidant and anti-inflammatory activities. However, little is known about the effect of genistein on human dental pulp cells (hDPCs). Therefore, this study aimed to investigate the biocompatibility and anti-inflammatory effect of genistein on hDPCs, as well as its odontogenic effects on hDPCs.

Methodology: Water-soluble tetrazolium salt (WST-1) assay was used to assess the cytotoxicity of genistein. Gene and protein expression of anti-inflammatory and odontoblastic differentiation markers were measured via quantitative real-time polymerase chain reaction (qPCR) and western blot analysis. Alkaline phosphatase and alizarin red S staining were performed to verify the formation of mineralized nodules. Statistical significance was determined by using a one-way analysis of variance (ANOVA), with $p < 0.05$ considered statistically significant.

Results: The WST-1 assay showed that genistein, at concentrations below 50 μM, did not significantly affect the viability of hDPCs. Lipopolysaccharide (LPS) upregulates inflammatory markers, while genistein downregulates these markers at both gene and protein levels in LPS-stimulated hDPCs. Genistein also promoted odontogenic differentiation, as evidenced by formation of mineralized nodules and upregulation of odontogenic markers at both gene and protein levels in LPS-stimulated hDPCs.

Conclusions (mandatory): Genistein downregulated expression of inflammatory cytokines in LPS-stimulated hDPCs. Additionally, the anti-inflammatory effects of genistein enhanced the mineralization characteristics of hDPCs. Therefore, genistein may be a potential material for use in regenerative endodontics, including vital pulp therapy.

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R140 | ADP-5 SUPPRESSES RECEPTOR ACTIVATOR OF RANKL-INDUCED OSTEOCLAST DIFFERENTIATION VIA AMP-ACTIVATED PROTEIN KINASE ACTIVATION

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AIM: Agents that inhibit osteoclast differentiation could serve as inhibitors of root resorption in teeth. Amelogenin-derived peptide (ADP-5) has demonstrated mineralization potential in human periodontal ligament (hPDL) cells and OCM.30 cells. However, the effects of ADP-5 on osteoclastic differentiation remain unclear. This study aims to evaluate the efficacy of ADP-5 in suppressing receptor activator of nuclear factor-κB ligand (RANKL)-induced osteoclast activity and to investigate its potential as a therapeutic agent for inhibiting root resorption.

Methodology: The viability of BMMs was assessed using a cell cytotoxicity test (EZ-Cytox). Osteoclast differentiation was evaluated using a TRAP staining kit (Cosmo Bio). Quantitative polymerase chain reaction (qPCR) was used to measure mRNA expression of NFATc1, c-Fos, TRAP, and CTSK. Western blot analysis was performed to detect proteins in the AMPK pathway as well as NFATc1, c-Fos, and CTSK. Osteoclast bone resorption activity was also assessed. Statistical significance was determined using one-way analysis of variance (ANOVA), with $p < 0.05$ considered statistically significant.

Results: There was no statistically significant difference in cell viability between various concentrations of ADP-5 and the control group. TRAP staining indicated that ADP-5 reduced osteoclast formation. qPCR analysis revealed decreased expression of mRNAs related to osteoclast differentiation (NFATc1, c-Fos) and resorption (TRAP, CTSK) in the experimental group. Western blot analysis showed an increase in p-AMPK protein levels, while NFATc1, c-Fos, and CTSK protein levels decreased. The bone resorption assay demonstrated a reduction in pit formation in the ADP-5-treated groups.

Conclusions (mandatory): ADP-5 inhibited osteoclast differentiation and reduced the expression of osteoclast-specific genes, including c-Fos, NFATc1, CTSK, and TRAP. It also enhanced the phosphorylation of AMPK in bone marrow-derived macrophages (BMMs), indicating that ADP-5 suppresses RANKL-induced osteoclast differentiation through AMPK activation.

Acknowledgements (optional): This study was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIP) (Nos. RS-2022-NR069575 and RS-2022-NR070738.

R141 | INFLUENCE OF RADIOPACIFIED CALCIUM SILICATE-BASED MATERIALS IMPLANTATION ON BLOOD PARAMETERS

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AIM: Radiopacified calcium silicate-based materials are widely used in endodontics and inevitably interact with connective and bone tissues upon placement. Studies have reported radiopacifier migration into systemic circulation with organ accumulation, primarily in the kidneys, highlighting the need for translational indicators of exposure. This proof-of-concept study aimed to assess potential changes in 21 blood parameters and the migration pattern of radiopacifiers in adjacent tissues following material implantation. The hypothesis tested was that radiopacifier migration alters blood parameters.

Methodology: After ethical approval, 55 twelve-week-old Wistar rats were divided into five groups based on the implanted material and site (subcutaneous or bone, n=5 per site). The materials tested were ProRoot MTA (bismuth oxide), White MTAFlow (tantalum oxide), MTA Repair HP (calcium tungstate), Biodentine (zirconium oxide), and pure tricalcium silicate (without radiopacifier). A negative control group (n=10) received no implantation. Polyethylene tubes (10x1 mm) with freshly mixed material were implanted subcutaneously, and cavities (3x1 mm) were drilled for bone implantation. After 30 days, all animals were euthanized, and intracardiac blood samples were collected for hematological and biochemical analysis. Adjacent tissues were analyzed for migration patterns using X-ray fluorescence (m-XRF).

Results: Although radiopacifier migration to adjacent tissues was observed with different patterns, the subcutaneous and bone implantation of calcium silicate-based materials for 30 days showed no statistically significant differences in most blood parameters compared to the negative control. Exceptions included indirect bilirubin in the subcutaneous tissue with MTA Repair HP ($p=0.017$) and in bone tissue with White MTAFlow ($p=0.049$), as well as alkaline phosphatase in the subcutaneous tissue with White MTAFlow ($p=0.038$).

Conclusions (mandatory): The results suggest that blood analysis is not a reliable indicator of the systemic burden from radiopacifier migration. Thus, the hypothesis was rejected, highlighting the need for direct organ analysis to assess the actual accumulation of bismuth, tantalum, tungsten, and zirconium.

Acknowledgements (optional): FAPESP 2022/03093-9

R142 | MORPHOLOGICAL CHANGES OF PERIODONTAL LIGAMENT FIBROBLASTS IN THE PRESENCE OF FLOWABLE HYDRAULIC CALCIUM SILICATE-BASED CEMENT LEACHATES

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AIM: The interaction of dental materials with periapical tissues is an important factor in endodontics. This study aimed to evaluate the effects of flowable hydraulic calcium silicate-based cement (fHCSC) leachates on the morphology of human periodontal ligament fibroblasts (PdLF) in vitro.

Methodology: Tested materials included MTA Flow White, BioRoot Flow, Totalfill BC Sealer, and ProRoot MTA White, with IRM as positive control group and growth medium (GM: DMEM with 10% fetal bovine serum and 1% streptomycin/penicillin) as a negative control group. Freshly mixed fHCSC disks were incubated in GM for 48 hours. The collected leachates were pH-measured, filtered, and diluted to 50%. PdLFs (5×10^3 cells/cm²; 2nd passage) seeded in 96-well plates, incubated for 24 hours in GM, and treated with leachates for another 24 hours. Cell morphology was assessed using an inverted phase contrast microscope, measuring cell width, length, and aspect ratio via ImageJ software. Statistical analysis included Shapiro-Wilk test and ANOVA (GraphPad Prism).

Results: pH values: GM – 8.36, IRM – 6.43, ProRoot – 9.02, MTA Flow White – 9.23, BioRoot Flow – 9.06, and Totalfill – 8.93. After 24 hours, fHCSC leachates influenced PdLF morphology, with variations depending on the type of fHCSC ($p<0.05$). ProRoot, MTA Flow White, and Totalfill groups showed higher cell counts than the negative control, while BioRoot Flow exhibited lower cell count. Cell width increased in all fHCSC groups compared to the negative control, with Totalfill-exposed PdLFs significantly wider than those in ProRoot and MTA Flow groups. No significant differences were found in cell length and aspect ratio.

Conclusions (mandatory): fHCSC leachates significantly altered PdLF morphology in a material-dependent manner. Variations in cell count and width suggest material-specific biological responses. Further research is necessary to determine the clinical implications of these findings.

R143 | BIODENTINE MODIFIED WITH MESOPOROUS BIOACTIVE GLASS EFFECT ON TGF-BETA1 RELEASE FROM HUMAN DENTINE

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AIM: Mesoporous bioactive glass (MBAG) and its variant doped with therapeutic ions Zn, Cu, Sr, and Mg (doped-MBAG) represent the latest generation of nano-dimension bioactive glasses. These materials are characterized by a high specific surface area that enhances bioactivity, with their porous structure facilitating the incorporation of biologically active substances. The therapeutic ions can improve specific biological responses, including antimicrobial, osteogenic, odontogenic, and angiogenic effects. This study aimed to evaluate the effect of incorporating MBAG and doped-MBAG into Biodentine™ on the release of transforming growth factor beta1 (TGF-beta1) from human dentin.

Methodology: Human extracted tooth were used to create dentin tubes with a wall thickness of 2 mm and a height of 3 mm. Each tube was halved to produce two samples. A portion of Biodentine™ powder (5-20 wt%) was replaced with an equal mass of either MBAG or doped-MBAG. Due to the nanoscale size and high specific surface area of the MBAG particles (386 m^2/g) and even more for doped-MBAG (691 m^2/g), additional distilled water was added to achieve the desired consistency. Materials were applied on dentin samples leaning to the inner diameter and section surfaces of the dentin samples. After setting, the samples were stored for two weeks at 37°C alongside cotton wool soaked in PBS solution. The materials were then removed from the dentin, and the samples were immersed in PBS to facilitate TGF-beta1 release, measured via ELISA after 24 hours. Each group contained 5 samples, and were statistically compared by One Way ANOVA.

Results: No statistically significant differences in TGF-beta1 level among MBAG/dop-MBAG groups comparing to Biodentine™ was noticed.

Conclusions (mandatory): It can be concluded that these nanoparticles exhibit a level of bioactivity comparable to that of Biodentine alone. These results support further investigation into MBAG-modified Biodentine™, especially if particles would be loaded with additional active substances.

R144 | BIOCOMPATIBILITY AND INFLAMMATORY RESPONSE OF HYDRAULIC CALCIUM SILICATE-BASED MATERIALS USED IN ENDODONTIC MICROSURGERY

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AIM: Compare the biocompatibility and inflammatory mediator secretion of hydraulic calcium silicate-based materials for endodontic microsurgery.

Methodology: Materials were inserted in polylactide supports with a calibrated volume of 77mm³ and randomly distributed according to the study groups (N=12): ProRoot MTA Dentsply (Group 1); MTA+Cerkamed (Group 2); NeoPutty Zarc (Group 3); Control group (Group 4).
Human fetal osteoblasts (hFOB 1.19 CRL3202) were cultured on these supports and their cell viability was assessed at 24h, 72h, 7days and 14days using a resazurin-based method (n=10). Cell morphology and adhesion were observed using scanning electron microscopy (n=2). The secretion of interleukin 1ß (IL1ß) and interleukin 8 (IL8) was assessed at 24h and 72h of culture using enzyme-linked immunosorbent assays.
The results were presented as mean ± standard deviation. Statistical analysis was performed by using one-way ANOVA or Kruskal Wallis test (Tukey's post-hoc test) with significance level $p<0.05$.

Results: At 24h, 72h no differences in cell viability were observed between groups. At 7 days Neoputty Zarc showed a lower viability compared to ProRoot MTA Dentsply ($p=0.012$). At 14 days MTA+Cerkamed showed higher viability values compared to NeoPutty Zarc ($p=0.007$). Neoputty Zarc had the lowest cell viability.
Scanning electron micrographs confirmed the viability findings, demonstrating typical osteoblast morphology and adhesion to materials.
At 3 days ProRoot MTA Dentsply showed significantly higher levels (2 to 3-fold comparing to other groups) of IL1B ($p=0.002$) and IL8/viability ratio ($p=0.029$). Neoputty Zarc had the lowest secretion in both timepoints.

Conclusions (mandatory): Although MTA-based products may induce higher cell viability over time, Neoputty Zarc elicited lower IL1 and IL8 secretion and thus may potentially lead to lower inflammatory responses.

Acknowledgements (optional): This work was partially funded by the national science foundation (FCT) through the pluriannual funding for R&D unit LIBPhys UIDB/04559/2020 and LA-REAL/P/0117/2020. Material Neoputty were sponsored by Zarc IPG Dental.

R145 | OSTEOBLAST VIABILITY AND INFLAMMATORY CYTOKINE SECRETION IN DIRECT CONTACT WITH DIFFERENT MATERIALS USED FOR RESTORING EXTERNAL CERVICAL RESORPTION DEFECTS

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AIM: To compare the osteoblast viability and inflammatory cytokine responses to different materials used for repairing external cervical resorptions (ECR).

Methodology: A monolayer culture of human osteoblasts (hFOB1.19) was placed in direct contact with different restorative materials stabilized in standard polylactic acid supports (n=10). The study groups were Biodentine, ProRoot MTA (ProRoot), BCUniversal, NeoPutty, SDR and FujiIX. Cellular viability was assessed at 1, 3, 7 and 14 days using a resazurin-based assay. IL-1β and IL-8 secretion was quantified by Enzyme-linked immunosorbent assay and cell morphology and adhesion were confirmed by scanning electron microscopy (1 and 3 days). Statistical analysis was performed using SPSS 30. Results were expressed as mean (±) standard deviation, and tested using one-way ANOVA or Kurskall-Wallis, as appropriate (Tukey's post-hoc test). Significance was set for $p < 0.05$

Results: At 3, 7 and 14 days, ProRoot viability presented no statistically significant difference from Biodentine (p=0.537, p=0.111, p=0.907, respectively). However, at 7 and 14 days, presented significant differences from NeoPutty, SDR and Fuji IX (p <0,05). Regarding Il-1β, at 1 day, no differences were observed between the experimental groups. At 3 days, ProRoot exhibited the highest levels of IL-1β, and showed significant differences from NeoPutty, BCUniversal, SDR and Fuji IX (p<0.001, p=0.044 , p=0.017 , p=0.002 , respectively). Regarding IL 8 secretion, at 1day, ProRoot showed no differences from Biodentine, SDR and Fuji (p= 0,295, p=0,935, p=0,545, respectively) and presented statistically significant higher secretion compared to NeoPutty, BCUniversal (p=0,026, p=0,011, respectively). At 3 days, ProRoot MTA presented a significantly higher secretion compared to NeoPutty, BCUniversal, SDR and Fuji (p=0,002, p=0,001, p=0,002, p=0,002, respectively). SEM images correlated with the cell viability results.

Conclusions (mandatory): ProRoot and Biodentine are the first-choice materials for pathological defects caused by external cervical resorptions. However, the remaining tested materials induced lower cytokine production, possibly leading to lower inflammatory processes.

R147 | EX VIVO-EVALUATION OF BIOCOMPATIBILITY AND BIOACTIVITY OF NEOMTA®2 COMPARED TO PROROOT® MTA AND TOTALFILL® BC RRM™ PUTTY IN HUMAN DENTAL PULP CELLS

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AIM: The purpose of this study is to compare NeoMTA®2 with ProRoot® MTA and TotalFill® BC RRM™ putty in terms of biocompatibility and bioactivity in human dental pulp cells (hDPCs).

Methodology: The biological material consisted of dental pulp from seven intact third molars scheduled for extraction from six patients aged 18–23. The study protocol was approved by the Ethics Committee of the School of Dentistry at the National and Kapodistrian University of Athens, with written consent obtained from all participants. Post-extraction, the teeth were cleaned and processed under aseptic conditions. The pulp was sectioned into small tissue pieces, cultured in DMEM supplemented with fetal bovine serum, antibiotics, and antifungal agents. The human dental pulp cells were cultured in contact with the materials. Cell proliferation was assessed via MTT colorimetric assay, gene expression was analyzed through real-time PCR at days 3, 5, and 7 and SEM analysis was performed at days 3, 5, and 7. Data were analyzed using one-way ANOVA and Kruskal-Wallis tests for normal and non-normal distributions, respectively.

Results: NeoMTA®2 showed the lowest MTT values, which were statistically significantly lower compared to ProRoot® MTA and the control group at 48 hours. Statistically significant changes over time were observed in all materials, which showed a strong increasing trend (p-value <0.001). Gene expression analysis showed NeoMTA®2 induced significantly higher ALP, OCN, RUNX2, DMP1, and NESTIN levels by day 7 compared to other materials. SEM images confirmed abundant, well-attached functional cells across all materials.

Conclusions (mandatory): NeoMTA®2 is a biocompatible and bioactive material that promoted similar or better cellular responses compared to ProRoot® MTA and TotalFill® BC RRM™ putty. NeoMTA®2 favored cellular proliferation, attachment, and gene expression related to mineralization and odontogenesis. Although promising, further laboratory and clinical studies on NeoMTA®2 are necessary.

R148 | PULPAL SENSITIVITY AND PERFUSION DURING ORTHODONTIC SPACE CLOSURE

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AIM: Orthodontic tooth movement (OTM) is a biological process that can affect the vascularisation of the dental pulp. The forces exerted on the teeth may increase the periapical pressure that could compress the arterioles, which in turn affects the pulpal blood flow (PBF). Direct or metabolic changes in the pulp may affect its sensitivity. The aim of this clinical study was to evaluate the sensitivity and pulpal blood flow of the dental pulp during the levelling and orthodontic space closure.

Methodology: 22 adolescent participants requiring posterior orthodontic space closure were enrolled in a prospective clinical study. The same sliding mechanics, wires and active elements were used. Patients were observed before OTM, after levelling and for 1 month during active space closure. PBF was measured with laser Doppler (LD) flowmetry. The pulp sensitivity threshold was measured using the electric pulp test (EPT). The measurement of interdental distances and the calculation of OTM velocity were made. The teeth were categorised according to position and tooth type.

Results: LD flow values decreased significantly during the observation period (two-way repeated measures analysis of variance, $P<0.001$). During orthodontic space closure, the most pronounced LD flow reduction was observed in single-rooted teeth closest to the residual space. A higher speed of OTM was associated with a greater reduction in LD flow on day 4 of OTM (Pearson correlation, $P = 0.0299$). EPT thresholds increased significantly during orthodontic treatment (one-sided RM-ANOVA, $P = 0.014$).

Conclusions (mandatory): The teeth that are closer to the interdental space and experience more OTM, as well as teeth that move faster during initial OTM, had a higher risk of reduced blood flow and reduced pulpal sensitivity during levelling and active space closure.

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R150 | PERSPECTIVES OF EXOGENOUS IL-33 IN BONE HEALING: A PILOT STUDY

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AIM: This study aims to evaluate the therapeutic potential of exogenous IL-33 in enhancing bone healing using a murine calvarial defect model, offering insights into its role in bone regeneration and its potential clinical applications. Recent advances in osteoimmunology have highlighted IL-33 as a key modulator of bone remodeling, inhibiting pathological bone loss and osteoclastogenesis by promoting anti-osteoclastogenic cytokines.

Methodology: Calvarial bone defects, 4mm in diameter, were created in two groups of inbred BALB/c mice, wild-type and ST2 knockout. The animals were further subdivided into groups with spontaneous healing of the bone defect, and groups treated with exogenous IL-33 locally. After eight weeks, radiographic imaging was performed, followed by the sacrifice of the animals and collection of bone samples for histological analysis. Obtained images were analyzed using Image J software.

Results: Our study demonstrated that the local administration of exogenous IL-33 led to enhanced and more structured bone formation in the calvarial defect model. Radiographic analysis revealed a significant increase in new bone density in IL-33-treated groups compared to spontaneous healing groups ($p < 0.05$), with a more uniform and continuous mineralization pattern. Histological examination showed a higher degree of newly formed woven bone, with increased osteoblast activity and a reduction in osteoclast-mediated resorption. Notably, IL-33 administration in ST2 knockout mice resulted in less pronounced bone regeneration compared to IL-33-treated wild type ($p < 0.05$).

Conclusions (mandatory): These findings suggest that exogenous IL-33 plays a crucial role in promoting bone regeneration by enhancing osteoblast activity and modulating osteoclastogenesis. The results underscore the importance of the IL-33/ST2 signaling pathway in effective bone healing. Further research is needed to explore its potential applications in clinical regenerative therapies and bone repair modalities.

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R151 | A PROSPECTIVE STUDY OF THE INCIDENCE OF PULPAL DISEASES FOLLOWING CROWN PREPARATION

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AIM: To determine the incidence of pulp diseases (irreversible pulpitis/ pulp necrosis) following crown preparations, performed by dental students at Jordan University of Science & Technology (JUST).

Methodology: A total of 361 teeth with vital pulps scheduled to receive fixed prosthesis (crowns and bridges) were included in this study. Teeth were prepared by undergraduate and postgraduate students at JUST. Teeth were examined by cold test, EPT, percussion and palpation tests before the start of treatment and before cementation. A periapical radiograph was taken preoperatively to assess the periapical status. Patients were evaluated clinically at 6 and 12 months after the cementation. Evaluation included cold testing, percussion, and palpation testing. Periapical radiographs were also taken at these follow up appointments. Teeth diagnosed with irreversible pulpitis/ pulp necrosis at any time during the treatment or during the follow-up period were referred for root canal treatment.

Results: During the first year of follow-up, the incidence of irreversible pulpitis/ pulp necrosis after crown preparation from all patients was 5.9%. A significant difference (p value= 0.019) was found between the undergraduate group and the postgraduate group.

Conclusions (mandatory): This study prospectively evaluated pulpal health for teeth scheduled for crown preparations, with a follow up period of 1 year following cementation. The incidence of irreversible pulpitis/ pulp necrosis of teeth following crown/ bridge preparations is noteworthy.

Acknowledgements (optional): This work was supported by the Deanship of Research at Jordan University of Science and Technology [grant number 2022/0536].

R153 | PATIENT SATISFACTION AND LONG-TERM OUTCOMES: A 7- TO 9-YEAR PROSPECTIVE COHORT STUDY OF ROOT CANAL TREATMENT IN THE SWEDISH PUBLIC DENTAL SERVICE

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AIM: To assess patient satisfaction with root canal treatment (RCT) 7 to 9 years after initiation in a general dental practice setting.

Methodology: A study population of 243 patients initiated RCT at 20 public dental clinics in the Västra Götaland Region, Sweden. One to three years later, 159 patients (67.4%) responded to an 8-item questionnaire assessing patient satisfaction with RCT and treatment results. The questionnaire was sent out again 7 to 9 years after treatment initiation. Descriptive and analytical statistics were used to compare respondents and non-respondents, tooth groups, and comparison over time.

Results: Of the 216 eligable patients, 156 (72.2%) responded; 82 women (52.6%) and 74 men (47.4%) with a mean age of 59.3 years (SD = 15.3). Non-respondents were significantly younger ($p < .001$). Most RCTs were completed with a root filling (n = 102, 65.4%), though fewer molars were completed (n = 43, 56.6%; $p < .001$). Sixty-six patients (63.5%) reported no current pain, and among those with pain, most described it as mild (n = 30, 90.9%). More than half of the root filled incisors were associated with pain (n = 15, 57.7%; $p < .009$). A total of 111 patients (76.0%) recalled the procedure as painful. Chewing ability received the highest satisfaction (mean = 1.3). Most patients (n = 114, 77.0%) would choose RCT again. Among the 17 who answered 'No', 13 had undergone extraction, and 3 reported persistent pain. Over time, extractions increased ($p < .001$), while pain intensity decreased, and retrospective satisfaction improved ($p < .001$).

Conclusions (mandatory): Seven to nine years after the initiation of RCT in a general dental practice setting, patient satisfaction remains high despite one-third of treated teeth being reported as extracted. These findings highlight the importance of incorporating patient-reported outcomes in the evaluation of dental procedures, including endodontic treatments.

R154 | THE EFFECT OF CALCIUM CHANNEL BLOCKER INTAKE ON HEALING OF APICAL PERIODONTITIS AFTER NONSURGICAL ROOT CANAL TREATMENT: A RETROSPECTIVE COHORT STUDY

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AIM: This study aimed to evaluate radiographic outcomes in patients taking calcium channel blockers (CCBs) compared to a control group, adjusting for confounders such as age, use of statins, ACE inhibitors, beta blockers, loop diuretics, alpha blockers, and other cardiovascular medications.

Methodology: A retrospective cohort study of 350 patients was conducted, with 175 CCB users and 175 controls. Radiographic outcomes were classified on a six-point scale. A subgroup analysis was conducted within the CCB group to evaluate the impact of other medications on radiographic outcomes. Patients were stratified based on the use of statins, ACE inhibitors, beta blockers, loop diuretics, alpha blockers, and other cardiovascular medications. Independent t-tests and Mann-Whitney U tests were performed to compare mean radiographic outcome scores between medication users and non-users. Descriptive statistics, independent t-tests, Mann-Whitney U tests, and multivariable regression models adjusting for age were performed to assess differences between groups. Subgroup analyses for confounders were conducted.

Results: The cohorts were balanced across age, tooth type and apical status. The control group had significantly better healing outcomes in patients with pre-existing periapical lesions ($p = 0.011$). Regression analysis adjusting for age confirmed this association ($p = 0.016$), while age itself was not a significant predictor ($p = 0.972$). Within the CCB group, no significant differences in radiographic scores among concomitant statin, ACE inhibitor, or beta blocker intake were found. However, loop diuretic users exhibited higher radiographic scores ($p = 0.042$), whereas alpha blocker users had significantly poorer outcomes ($p = 0.017$, Mann-Whitney $p = 0.006$).

Conclusions (mandatory): Patients taking CCBs exhibited significantly poorer healing in cases with pre-existing periapical lesions. This association remained after adjusting for age, suggesting a potential negative impact of CCBs on periapical healing. Further research is warranted to investigate underlying mechanisms and clinical implications of delayed apical healing in CCB users.

R155 | TREATMENT CHOICE FOR TEETH WITH EXTERNAL CERVICAL RESORPTION: A PROSPECTIVE STUDY

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AIM: To evaluate the follow-up status of patients with teeth with external cervical resorption (ECR).

Methodology: During 2014 to 2020, 194 patients (244 teeth) were referred to Section for Oral Radiology and Endodontics with ECR in one or more teeth. All teeth were examined using intraoral radiography (IO) and CBCT. ECR severity was assessed using the Heithersay classification (HS1/HS2/HS3/HS4). Information on patient sex, age, and tooth type (incisors/canines/premolars/molars) was also recorded. Reports on radiographic findings from IO and CBCT were sent to the referring dentists.

Follow-up data on the status of the included teeth was collected from the referring dentists and evaluated using descriptive analyses. Outcome was treatment choice (monitoring, treatment, extraction). Associations between H-class, tooth type and outcome were tested using Chi2.

Results: Follow-up was carried out 1-8 years after the radiographic examination. Overall, information on tooth status was available for 177 (91.2%) patients and 226 (92.5%) teeth. Information on survival provided a range from less than one month up to more than eight years (mean survival time was 37 months, range 0.47-94 months). Monitoring of the condition was performed for 104 teeth (42.6% in 82 patients). For 55 teeth (22.5% in 49 patients), treatment of the ECR was performed. Extraction of 67 teeth (27.5 % in 53 patients) was carried out.

Treatment of teeth with HS2 and HS3 was performed in 65% and 38%, respectively. For teeth with HS4, observation was the choice in 53% of the cases while 39% were extracted. A significant association was seen between H-class and follow-up outcome ($p<0.05$). No association was seen between tooth type and outcome ($p=0.714$).

Conclusions (mandatory): H-class affected the treatment choice significantly. Most often teeth with HS2 and HS3 received treatment while teeth with HS4 were monitored or extracted.

R157 | EFFICACY OF PLATELET CONCENTRATES ON VITAL PULP TREATMENT OF FULLY DEVELOPED AND IMMATURE PERMANENT TEETH. A SYSTEMATIC REVIEW PROTOCOL AND NETWORK META-ANALYSIS OF HUMAN CLINICAL TRIALS

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AIM: The purpose of this study was to compare the efficacy of platelet concentrates with traditional bioactive capping materials on vital pulp treatment (VPT) healing outcomes in permanent human teeth.

Methodology: The systematic review protocol (CRD4202461477) was conducted according to the PRISMA checklist. PubMed/MEDLINE, Web of Science, Scopus, ClinicalTrials.gov, and Cochrane (CENTRAL) were searched, until December 2024. Only controlled clinical trials, evaluating success rates of VPT treatment modalities using platelet concentrates versus bioceramics (control) in permanent human teeth, with a minimum follow-up period of 6 months were included. The data was analyzed through Network Meta Analysis (NMA) using the MetaInsight tool to assess multiple comparisons. Cochrane RoB2 assessed the risk of bias for the randomized and ROBINS-I tool for the nonrandomized trials.

Results: The search strategy identified 763 studies, of which 753 were excluded. In total, 10 studies encompassing 437 patients evaluating 2 different VPT intervention strategies and 3 treatment modalities met the inclusion criteria. Success rates of pulpotomy showed no significant differences either for the 6-month (LPC: RR= 1.00; 95% CI: 0.96-1.04, and PRF RR=1.00; 95% CI: 0.96-1.05) or the 12-month evaluation period (LPC: RR=1.02; 95% CI: 0.90-1.15 and PRF: RR=1.01; 95% CI: 0.96-1.07). For direct pulp capping only one study was included for the 6-month period while comparisons showed no differences for the 12-month period (PRF RR=1.03; 95% CI: 0.84-1.27 and PRP RR=1.02; 95% CI: 0.77-1.33). The best ranked treatments based on the probability of each treatment identified bioceramics as being the most effective in pulpotomy and direct pulp capping cases.

Conclusions (mandatory): The relative treatment effects remained stable across various follow-up periods, with platelet concentrates performing similarly to bioceramics at network and probabilistic analyses.

R158 | RADIOGRAPHIC AND CLINICAL SUCCESS OF VITAL PULP THERAPY IN PERMANENT TEETH WITH TRAUMATIC OR CARIOUSLY EXPOSED PULP: A PROSPECTIVE OBSERVATIONAL STUDY

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AIM: To evaluate the outcome of VPT in permanent teeth with traumatic or cariously exposed pulp and to evaluate the influence of pre- and intraoperative parameters on the outcome.

Methodology: 94 mature teeth with deep or extremely deep caries and two teeth with traumatically exposed pulp were eligible for inclusion in this prospective observational study. 36 teeth were excluded due to pulp necrosis, severe persistent bleeding, or the absence of pulpal exposure following caries removal. Partial or full pulpotomy was performed based on pre-operative diagnosis using sterile diamond burs. Hemostasis was achieved with cotton pellets soaked in 3% NaOCl, and the amputated pulp was covered with Biodentine. Teeth were restored with composite. 58 vital pulp therapies were conducted, including 38 full pulpotomies, 19 partial pulpotomies, and one selective pulpectomy. Pre- (pain level, pulpal and apical diagnosis and pocket depth, ...) and intra-operative (width of pulpal exposure, time until haemostasis, presence of slight bleeding prior to capping, ...) parameters were recorded. Clinical and radiographic evaluation was performed after 6 and 12 months.

Results: At six months, 40 patients were evaluated, showing an overall VPT success rate of 92.5%. Radiographic and clinical success rates were 97.5% and 95%, respectively, with a survival rate of 97.5%. At twelve months, 37 patients were evaluated, with a success rate of 89.2%. Radiographic and clinical success rates were 97.3% and 91.9%, respectively, with a survival rate of 97.3%. The success rates for full pulpotomy, partial pulpotomy, and selective pulpotomy were 84%, 100%, and 100%. Time until haemostasis (from 2 to 23 minutes) and slight seepage before pulp capping did not impact the outcome. No impact on the outcome was observed for any other pre- or intraoperative parameters.

Conclusions (mandatory): VPT achieved high success rates in permanent teeth with exposed pulps, comparable to those reported in similar studies and conventional endodontic treatment.

R161 | THE OUTCOME OF PULP REVASCULARIZATION OF NECROTIC MATURE PERMANENT TEETH WITH PERIAPICAL LESIONS USING PLATELET-RICH FIBRIN VERSUS INDUCED BLEEDING: A RANDOMIZED CLINICAL TRIAL

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AIM: Aime: Evidence on regenerative endodontic procedures (REPs) in mature teeth is promising but limited to few trials with heterogeneous protocols, warranting the need for randomized clinical trials. Therefore, the present study evaluated clinically and radiographically the effectiveness of REPs using platelet-rich fibrin (PRF) versus induced bleeding (IB) in treating mature necrotic teeth with periapical lesions.

Methodology: Methodology: Fifty patients with necrotic mature teeth with periapical lesions were randomly divided into two groups; Group 1, IB (n=25), and Group 2, PRF (n=25). Treated teeth were assessed clinically and radiographically at 6 and 12 months after treatment. An electric pulp tester (EPT) and cold test were used to assess the pulp sensibility. The results were compared using SPSS and JMP software. The significance level was set at $P < .05$.

Results:
Results: Clinical success was 98% at the end of the 12-month follow-up period, with no significant difference between the groups (P=.166). A statistically significant increase in periradicular healing was found in both groups at 6 and 12 months, compared to that at baseline ($P< .001$) with no significant difference between the studied groups ($P > .05$). The overall success rate was 95.8%. Ten teeth were responsive to cold test, and 38 were responsive to EPT at the end of 12 months, with no significant difference between the two groups ($P< .05$).

Conclusions (mandatory): Conclusions: REPs could be a viable treatment option for mature necrotic teeth and could be a more biologically oriented alternative than non-surgical root canal treatment. Both IB and PRF showed similar clinical and radiographic outcome data.

Acknowledgements (optional): The authors deny any conflicts of interest related to this study.
Supported by the deanship of research at Jordan University of Science and Technology, Irbid, Jordan (grant no. 600-2022).

R162 | LONG-TERM CLINICAL OUTCOMES OF REGENERATIVE ENDODONTIC TREATMENT WITH TAILORED FOLLOW-UP CARE: A PROSPECTIVE COHORT STUDY

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AIM: To investigate the long-term clinical outcomes of regenerative endodontic procedures (REPs) in a cohort with tailored follow-up care

Methodology: Clinical and radiographic data of a prospective cohort who underwent REPs and were followed up under tailored follow-up care for at least 5 years were evaluated to assess treatment outcomes. The healing outcomes and functional status of the tooth were investigated, with the surveillance protocol tailored to accommodate changes in functional scheme of the tooth over time.

Results: A total of 32 teeth (premolars, 40.6%; molars, 59.4%), with 28.1% (9 out of 32) referred due to failed REPs, were included for analysis. Median patient age was 14 years (range, 9-29 years), and median follow-up period was 100 months (range, 62-192 months). The healed and healing rates were 90.6% and 9.4%, respectively. Significant prognostic factor for healed within 1 year after treatment was root development stage ($p < 0.05$). Regardless of the preoperative pulpal and periapical status ($p > 0.05$) and postoperative pulp vitality test results ($p > 0.05$), 90.4% of the teeth exhibited increased root length and thickness with various extents of intracanal calcification. The teeth maintained functionality compared to the contralateral ($p > 0.05$) and adjacent teeth ($p > 0.05$).

Conclusions (mandatory): The teeth underwent REPs with surveillance tailored to maintain functional scheme demonstrated favorable long-term clinical outcomes.

Acknowledgements (optional): This work was supported by the New Faculty Startup Fund from Seoul National University (860-20230067). The study protocol was approved by the Seoul National University Dental Hospital (SNUDH) Institutional Review Board (CRI15010).

R163 | THE IMPACT OF ROOT CANAL TREATMENT AND PERIAPICAL DESTRUCTION ON MARGINAL BONE LOSS IN PATIENTS WITH MARGINAL PERIODONTITIS

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AIM: Endodontic disease may influence the periodontal condition, and vice versa. The purpose of this study was to compare marginal bone loss in root filled teeth and non-root filled contralateral teeth in individuals with marginal periodontitis, and to assess if signs of a periapical bone lesion associate to marginal bone loss.

Methodology: From a cohort of 1610 individuals (The PAROKRANK case-control study), 650 were radiographically diagnosed with marginal periodontitis according to defined criteria. Individuals who had at least one root filled tooth and a non-root filled contralateral tooth were identified. Using panoramic radiographs, two calibrated observers assessed marginal bone loss by calculating the proportion of remaining bone height in relation to the total root length on the most damaged tooth surface. Results were analysed using descriptive and analytical statistics. Regression models were consecutively adjusted for tooth characteristics (periapical bone lesion, jaw, and tooth group) and patient characteristics (age, sex, education, marital status, myocardial infarction, and family history of coronary artery disease).

Results: In total, 163 individuals provided 302 tooth pairs (1-5 tooth pairs per individual). Unadjusted difference in marginal bone loss between root filled and non-root filled teeth was 2.2 (95% CI 1.0-3.4) percentage points. Periapical bone lesions were more common in root filled teeth (29%) than in non-root filled teeth (8%). After adjustment for covariates, root filled teeth associated with, on average, more than eight percent higher percentage points of marginal bone loss compared to non-root filled teeth ($p < .0001$).

Conclusions (mandatory): Root filled teeth in a periodontally damaged dentition expressed more marginal bone loss compared to non-root filled contralateral teeth, regardless of periapical status. This suggests that root-filled teeth may be more likely to be adversely affected by periodontal damage and marginal bone loss.

R164 | 1201 VERTICAL ROOT FRACTURES, A DOZEN YEARS LARGE-SCALE INVESTIGATION: A RETROSPECTIVE STUDY

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AIM: The aim of this study is to analyze the prevalence, distribution, and clinical characteristics of vertical root fractures (VRFs) in a cohort large scale data study.

INTRODUCTION -
A vertical root fracture (VRF) is a partial or complete longitudinal crack in the root, originating from the coronal, middle, or apical portion and potentially extending along its length. Vertical root fractures most commonly occur in endodontically treated teeth and are a frequent cause of tooth extraction. (1)

Methodology: The research sample comprised a cohort of 1,195 patients, including 977 males and 224 females, with a mean age of 35.5 years (ranging from 18 to 71 years), encompassing a total of 1,201 teeth. Clinical and radiographic data was collected and documented. patients included in this study underwent a thorough examination and received a definitive diagnosis of VRF at the Department of Endodontics, Tel Hashomer, Sheba medical center, Israel, between the years 2009 and 2021.

Results: Among the examined teeth, 966 had undergone primary root canal treatment, while 144 were subjected to endodontic retreatment. The distribution of teeth diagnosed with VRF was as follows: mandibular molars (56%) with the mesial root most affected (72%), maxillary molars (20.8%) with the mesio-buccal root most affected (66%), maxillary premolars (13.5%), maxillary incisors (5.4%), mandibular premolars (3.5%), and mandibular incisors (0.5%).

Conclusions (mandatory): Our study aligns with 2016 research indicating that mandibular molars are the most frequently affected teeth by VRF. However, this contrasts with findings from the 1980s and 1990s, which predominantly identified maxillary premolars as the teeth most susceptible to VRF. Further research is needed to investigate the reasons contributing to this significant shift, one of which may be the widespread adoption of rotary instrumentation in endodontics over those decades.

R165 | IMPACT OF REPEATED USE ON THE CYCLIC FATIGUE RESISTANCE OF PROTAPER ULTIMATE FILES

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AIM: This study aimed to evaluate the changes in the number of cycles to fracture (NCF) of the ProTaper Ultimate (PTUL) files multiple uses.

Methodology: A total of 225 PTUL files were classified into three groups: Group 1 (new files), Group 2 (files used to shape two resin blocks), and Group 3 (files used to shape four resin blocks). A 16mm J-shaped resin block with a 35° curvature was shaped using the sequential (Slider, Shaper, F1, F2, F3) application of PTUL files. After shaping, cyclic fatigue resistance of each sequential file was assessed using a custom-made device with a simulated 35° curved canal by rotating at 400 rpm. Statistical analysis was performed using one-way analysis of variance (ANOVA) and Duncan's post hoc tests with a significance level of 95%.

Results: The Slider and Shaper files showed no significant changes in NCF across conditions ($P > .05$). In contrast, the F1, F2, and F3 files exhibited significant reductions in NCF with increased use. The F1 file showed a slight increase after two uses, but declined significantly after four uses ($P < .05$). The F2 file progressively decreased in NCF, with significant differences between the new and four-use conditions ($P < .05$). The F3 file experienced the most significant reduction in NCF across all conditions ($P < .05$).

Conclusions (mandatory): Repeated use of NiTi files reduces their cyclic fatigue resistance, but the degree of decline varies among file sequences. To minimize fracture risk, clinicians should consider using individualized usage guidelines for each file.

R166 | POTENTIAL RISK OF REPETITIVE AUTOCLAVING FOR MULTIPLE-USE ON CYCLIC FATIGUE RESISTANCE OF HEAT-TREATED NITI INSTRUMENTS

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AIM: This study investigates the effect of multiple usage and autoclave sterilization cycles on the dynamic cyclic fatigue resistance of heat-treated nickel-titanium (NiTi) instruments within a single file system.

Methodology: One hundred and eighty heat-treated NiTi files Protaper Ultimate: Slider, Shaper, F1 and F2 (Dentsply Sirona Endodontics) were tested and divided into 3 groups (n=60). In each group, files were tested for cyclic fatigue resistance either without usage (N), or after instrumenting two (US-2) or four canals (US-4). In the control group (N), the dynamic cyclic fatigue resistance was evaluated by measuring the baseline number of cycles to failure (NCF) at body temperature (37°C). In US-2 and US-4, files were used to prepare 2 and 4 J-shape simulated canals modelled in resin blocks (NISSIN Dental Products Inc.) of 16.5 mm length and 30-degree curvature. After each canal preparation, the files were sterilized in an autoclave (Steris Co., Mentor, OH, United States) at 132°C for 30 minutes. Files were tested for cyclic fatigue resistance and the time to fracture was recorded to calculate the mean NCF in each group. Fracture fragment lengths were measured using a digital microcaliper. Statistical analysis was conducted using SPSS (version 29.0; SPSS Inc., Chicago, IL, USA). The Kolmogorov–Smirnov test was used to evaluate the normality of the data using an independent t-test and multifactorial analysis of variance with 95% significance.

Results: The results demonstrated that the Slider consistently achieved a significantly higher NCF than the Shaper, F1, and F2 instruments in all the groups. Additionally, increased usage and sterilization resulted in a progressive reduction in NCF in US-4, as opposed to N and US-2.

Conclusions (mandatory): This study shows that repeated usage and autoclaving can reduce the cyclic fatigue resistance of heat-treated NiTi instruments, which can affect their structural integrity and clinical longevity.

R167 | THE REAL-TIME MEASUREMENT OF THE FORCE AND TORQUE OF THREE ENDOMOTORS: AN IN-VITRO STUDY

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AIM: Instrument separation is a mishap that can have an impact on treatment outcome. This occurs often from incorrect speed, torque or excessive force. These settings are controlled by a specific endomotor. In this study, three endomotors were compared in measuring the real-time force and torque values when operating a rotary file system during root canal shaping.

Methodology: Artifical models allocated (n=14) in three groups; VDW Gold (Dentsply, USA), Coltene Pro (MicroMega, France) and Cicada (Cicada, China). A sensor connected to the models read the real-time force and torque applied to PTN files (Dentsply, USA) onto the model during shaping. The files were operated in crown-down technique with 3 pecking movements, under 2 N/cm and 300 rpm with auto-reverse on and off. The force (F) and torque (N/cm) were recorded simultaneously for all strokes in all test groups. Files were discarded after each use. One-way ANOVA and Kruskal-Wallis were applied for comparison of means between test grousps with a significancy level set at p=0.05.

Results: The mean of force (N) recorded for CIC, COL and VDW was 1.1, 1.2 and 1.3 and the mean or torque (Ncm) was 1.2, 1.2 and 2.1, respectively. The sum of force (N) was 105,77, 112,6 and 9,66 with auto-reverse ON and 71,19, 83,88 and 157,09 when auto-reverse OFF. The sum of torque (Ncm) was 77,5, 72,8 and 12,7 when auto-reverse ON and 49,2, 53,9 and 118,1 when auto-reverse OFF. No significant difference were obtained between the means in both force (p=0.37) and torque (p=0.98).

Conclusions (mandatory): The transfer of force and torque from an endomotor into an endodontic file can differ in real-time than the appointed settings.

R168 | A SEM INSIGHT OF NICKEL-TITANIUM ENDODONTIC FILES FRACTURE PREDICTED BY ACOUSTIC EMISSION

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AIM: The aim of the study was to analyze the damage of nickel-titanium (NiTi) endodontic files until failure by study of acoustic emission (AE) and microstructural observations with a scanning electron microscope (SEM), in order to develop a device able to anticipate instrumental failure.

Methodology: The study consisted of performing tests designed to reproduce the instrumental fracture of nickel-titanium endodontic files. The tests were conducted under conditions that favored the damage of the instruments, which were used until fracture. The tooth analogical model was a J shape PMMA resin block (Dentsply, Ballaigues, Switzerland). The tests were repeated on the same file until fracture, the block being changed between each test. Broken files were then observed using a scanning electron microscope.

Results: The fracture systematically occurred within the canal curvature and was preceded by a reversal of the instrument's helix pitch. The files therefore broke according to a combined mode of torsion and cyclic fatigue. AE signals were much more numerous in the high-stress state (in the curvature) and just before fracture. An increase in the number of events, but of lower amplitude, was observed in tests where fracture occurred. Absolute energy values were higher in the fracture test than in the first test, particularly just before fracture. SEM images revealed surface defects near the fracture zone. Severe plastic deformation and cracks were also visible at the fracture zone.

Conclusions (mandatory): The microstructural defects observed by SEM reflect the acoustic emissions generated by crack growth and other material damage modes. As these defects are at the origin of instrumental fracture and AE increases particularly just before fracture, this study confirms the possibility of anticipating fracture of NiTi endodontic files using acoustic emission.

Acknowledgements (optional): We acknowledge the experimental facilities from LEM3 (Université de Lorraine - CNRS UMR 7239) and Halle technique en ingénierie dentaire (Université de Lorraine).

R170 | IN VITRO MECHANICAL TESTS OF NEW ROTARY INSTRUMENTS: A COMPARATIVE EVALUATION

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AIM: The aim of the present study to test and compare in vitro a new file system (Diamond, Edge Endo, Albuquerque, NM) with a well-known and widely used one (Protaper Gold, Dentsply Maillefer, Baillegues, Switzerland) utilizing three of the most widely used testing methods for NiTi rotary instruments: stiffness, torsional and cyclic fatigue tests

Methodology: Stiffness and torsional tests were conducted following ISO standards, while cyclic fatigue tests were performed using a methodology widely used in previous published articles. For each size and test, ten instruments were analyzed for each of the two brands and then the data were collected. Mean values and the standard deviations of all tests were then statistically analyzed using 1-way ANOVA followed by the post hoc Tukey test with significance set to a 95% confidence level.

Results: Results from the present study showed that the new Diamond instruments are more flexible than Protaper in size 25 (F2). On the contrary Protaper size 25 (F2) is more resistant to torsional stress when measuring torque at failure. All the other sizes show no statistically significant difference in the previously mentioned tests. On the contrary, statistically significant differences can be noted in all sized when evaluating torsional resistance using the deflection angle and in cyclic fatigue tests, with Diamond instruments providing the best results

Conclusions (mandatory): We may conclude that data of the present study suggest the clinical use of the new Diamond instruments for easy, safe and predictable root canal shaping procedures.

R171 | A COMPARISON BETWEEN CLINICAL OPERATIVE TORQUE AND IN VITRO TORSIONAL RESISTANCE

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AIM: The aim of the present study was to evaluate the “in vivo” operativa torque values of new Niti rotary instruments (I-file, Henry Schein Endodontics, China) and compare them with the in vitro torsional resistance of each instrument.

Methodology: 20 instruments for each of the following sizes (i-find 25.07, I-follow 15 .04 and I-finish. 25.04) were selected and divided in two groups. In the first group instruments were used clinically to prepare a molar case according to the manufacture’s IFU. Instruments were rotated by a new motor (EndoMaster, Perfect, Schenzen, China) which allowed recording of intracanal operative torque (MOT maximum operative torque). Overall 10 cases were completed, using new instruments in each case. Instruments of the second group (n=10 for each size) were tested for torsional resistance (MTAF maximum torque at failure) following ISO standard 3630-1. Mean values and standard deviations of all tests were then statistically analyzed using 1-way ANOVA followed by the post hoc Tukey test with significance set to a 95% confidence level.

Results: Mean values and SD for MOT were the following: I-find 0,84N (SD 0,15), I-follow 0,26N (SD 0,005) and I-finish 0,54N (SD 0,1) respectively. Mean values and SD for MTAF were the following: I-find 1,14 N/cm (SD 0,2), I-follow 0,56 N/cm (SD 0,01) and I-finish 0,82 N (cm(SD 0,1) respectively. Results showed a statistically significant difference amongst the three files with both tests, but a similar behavior. The operative torque was significantly higher for the instruments (I-find) which exhibited the in vitro highest resistance. The operative torque was significantly smaller for the instruments (I-follow) which exhibited the in vitro smallest resistance. No instrument showed intracanal deformation or breakage.

Conclusions (mandatory): The study confirmed an ideal distribution of intracanal operative loading amongst the files inside the proposed sequence.

R172 | ABILITY OF APEX LOCATOR INTEGRATED ENDODONTIC MOTORS IN PRESERVING THE APICAL CONSTRICTION: A MICRO-CT STUDY

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AIM: To compare the accuracy of the auto apical reverse function of apex locator integrated endodontic motors to that of the conventional method of working length determination, in preserving the apical constriction (AC), using micro-CT.

Methodology: Single rooted teeth were subjected to low-resolution micro-CT scans to select 60 teeth that matched predefined criteria. Teeth were mounted onto custom-made models and micro-CT pre-scans were performed. AC topographies of the samples were determined and a stratified distribution was carried out. Teeth were randomly assigned to three study arms: Rooter Universal (RU), Tri Auto ZX II (TA) and Control (C). Mechanical instrumentation was carried out for teeth in the RU and TA groups with an auto-reverse setting at 0.5. Meanwhile for the C group, a standalone electronic apex locator and an endodontic motor were used. Teeth were then subjected to post-scans. Superimposition of the pre- and post-instrumentation images was carried out. Preservation of the AC was determined through two surrogate measures: the change in diameter of the AC after preparation and the distance of the preparation limit to the AC.

Results: Overall, the AC was preserved in only 28.3% of samples. Whereas, in the remaining 71.7%, the diameter of the apical constriction was enlarged showing lack of its preservation. Both in the RU and TA groups, the AC was preserved in 5.0% of the teeth and was not preserved in the remaining 95%. For the C group, 75.0% of teeth showed preservation and the remaining 25.0% showed lack thereof. A post-hoc Tukey test for mean diameter after preparation showed a significant difference ($p < 0.05$) between RU/C groups and for TA/C groups.

Conclusions (mandatory): The visual control of working length was better at working length determination and AC preservation as compared to the auto-reverse function of the RU and TA set at the 0.5 mark.

R173 | COMPARISON OF THE SHAPING ABILITY AND PERFORMANCE OF CONTEMPORARY INSTRUMENTS: PROTAPER ULTIMATE® VERSUS EDGETAPER PLATINUM

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AIM: This study aimed to compare root canal shaping abilities of ProTaper Ultimate (PTUL; Dentsply Sirona) and EdgeTaper Platinum (ETP; Edge, Henry Schein) systems using micro-computed tomography (microCT). Working time and the presence of plastic deformation of the instrument flutes after shaping were also determined.

Methodology: Twenty mandibular molars presenting a mesial root with 2 independent root canals and moderate curvature were selected and radiographed. A preoperative microCT scan was performed (CT-SCAN XT H-160, Nikon) at 16 µm resolution. Each root canal in the same mesial root was randomly assigned to one of the two rotary systems to reduce individual variability. An expert endodontist with more that 25 years of experience in rotary shaping performed canal preparation under an operating microscope. A postoperative micro-CT was then obtained; changes in canal volume and surface area, percentage of shaped canal walls and degree of canal transportation were calculated and compared with Student's t-tests. Working times were compared with Mann-Whitney U tests. Preoperative and postoperative photographs of instruments were taken with 40X magnification. A calibrated evaluator registered the presence of unwinding and the location of the deformation. The number of fractured instruments was also recorded. Data was compared with Chi-squared test.

Results: No instrument fractures and no gross preparation errors were observed, except for one apical perforation in ETP group. No statistically significant differences were detected in root canal geometry parameters between groups. PTUL resulted in significantly shorter total preparation time ($p = 0.02$). Plastic deformation was significantly higher for ET ($p = 0.009$), with 34.4% of the instruments unwinding after a single use and no deformation recorded for PTUL.

Conclusions (mandatory): Both PTUL and ETP rotary systems produced an adequate postoperative geometry when used in a single root canal; however, PULT instruments were faster and more resistant to plastic deformation than ETP instruments.

Acknowledgements (optional): Funding source: This study was founded by Dentsply-Sirona

R174 | MULTIPLE STERILIZATION AND INSTRUMENTATION CYCLES REDUCE ROTARY FILES' CUTTING EFFICIENCY

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AIM: To compare the instrumentation time for rotary endodontic files sizes S1, S2, F1 and F2 ProTaper Gold (PTG) during the shaping of J-shaped resin canal blocks after three instrumentation and two sterilization cycles.

Methodology: Rotary nickel-titanium endodontic files sizes S1, S2, F1 and F2 [ProTaper Gold (PTG), Dentsply Tulsa Dental Specialties, USA] were used in sequence as a set (n=10/size) to instrument J-shaped canal blocks (Endo Training Bloc, Dentsply Maillefer, Switzerland; n=30 total). Each set of files underwent three instrumentation cycles, and the time of instrumentation was recorded for each instrument size. The instruments were sterilized in an autoclave (SciCan Statim 2000; temperature 270ºF, pressure 32PSI). Each instrumentation cycle was performed on an unused block. Instrumentation times were statistically analyzed using one-factor General Linear Models and Student-Newman-Keuls post-hoc test (α=0.05; SAS software).

Results: The third cycle had the longest mean time of instrumentation, whereas the first and second cycles were not statistically significantly different from each other but were statistically different from the third cycle ($p=0.0094$). Instrumentation time for PTG sizes S1 and F1 were statistically different from sizes S2 and F2 ($p<0.0001$), where S1 had the highest and F1 the lowest mean times of instrumentation. None of the files fractured during instrumentation.

Conclusions (mandatory): When instrumenting J-shaped canals in sequence with PTG file sizes S1, S2, F1 and F2 up to three times with prior sterilization, the cutting efficiency was significantly reduced after the second instrumentation cycle, but not after the first sterilization cycle.

Acknowledgements (optional): This study was supported by the J. Dean Robertson Society, University of Oklahoma Foundation, Inc. and the University of Oklahoma College of Dentistry Student Research Program.

R176 | A CLINICAL APPROACH USING TEETH ALREADY SCHEDULED FOR EXTRACTION TO VALIDATE AN IN VITRO METHOD TO ASSESS THE PERFORMANCE OF THE EALS

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AIM: This study aimed to validate a commonly used in vitro methodology of testing the performance of the EALs. For that, teeth already scheduled for extraction and micro-CT technology were used in the validation process of the in vitro method. As a secondary aim, the accuracy and precision of the Root ZX II apex locator were assessed in both clinical and laboratory settings.

Methodology: In a clinical setting, the working length of 11 root canals already scheduled for extraction was established using the Root ZX II apex locator. Subsequently, these teeth were extracted and scanned with the file in place using micro-CT technology to determine the real canal length. The working length of the extracted teeth was thus obtained through the alginate in vitro model. Datasets were co-registered, and the accuracy and precision of both in vivo and in vitro measurements were compared by determining the distance from the file tip to a tangential line crossing the major foramen margins. Statistical comparisons were performed using Friedman post hoc Related Samples Sign and Bland-Altman tests with a significance level set at 5%.

Results: Statistical analysis revealed no significant difference between the accuracy ($P = 0.368$) and precision ($P = 0.761$) measurements obtained in both in vivo and in vitro conditions. Additionally, the Bland-Altman analysis revealed an agreement between in vivo and in vitro ($P > 0.05$).

Conclusions (mandatory): The agreement between in vivo and in vitro readings validated the alginate model to test the EALs in the lab setting. The Root ZX II apex locator demonstrated comparable accuracy and precision in determining the position of the apical foramen in both clinical and laboratory settings.

R177 | COMPARISON OF APICALLY EXTRUDED DEBRIS AND PREPARATION TIME AMONG PROTAPER ULTIMATE, TRUNATOMY, RECIPROC BLUE, AND XP-ENDO® RISE ROTARY FILE SYSTEMS: AN IN VITRO STUDY

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AIM: This in-vitro study aimed to assess the amount of apically extruded debris and the preparation time associated with four rotary file systems: TruNatomy (TN), ProTaper Ultimate (PTU), Reciproc Blue (RCB), and XP-endo® Rise (XP)

Methodology: A total of 80 mandibular molars with straight mesial roots (<5° curvature) were randomly allocated into four experimental groups (n = 20) corresponding to the tested file systems. Mesiobuccal root canal instrumentation was performed at body temperature, and the extruded debris was collected in pre-weighed Eppendorf tubes. Following desiccation, the mean weight of extruded debris was determined for each group. Additionally, the total preparation time required for instrumentation was recorded. Statistical analysis was conducted using the Kruskal-Wallis test, with a significance threshold set at $P < .05$.

Results: The findings revealed no statistically significant differences in the amount of apically extruded debris among the four file systems ($P > .05$). While RCB exhibited the highest debris extrusion, followed by PTU, the differences were not statistically significant when compared to TN and XP. In terms of instrumentation time, the XP system demonstrated significantly faster preparation compared to the other groups. TN and RCB exhibited comparable preparation times, whereas PTU required the longest time for canal preparation ($P < .001$).

Conclusions (mandatory): The ProTaper Ultimate, TruNatomy, Reciproc Blue, and XP-endo® Rise rotary file systems exhibited comparable performance regarding apically extruded debris, with no statistically significant differences observed. However, the XP-endo® Rise system demonstrated superior efficiency in terms of instrumentation time. These findings offer clinical insights for endodontists in selecting rotary systems based on efficiency and debris extrusion.

R178 | APICALLY EXTRUDED DEBRIS USING MANUAL AND ROTARY INSTRUMENTATION TEHNIQUES DURING ROOT CANAL RETREATMENT

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AIM: The aim of this study was to examine and compare the amount of apically extruded debris during endodontic retreatment of teeth using hand files and two different rotary systems in in vitro study. Procedural errors were also recorded.

Methodology: The study included 45 human single root teeth that were extracted for reasons unrelated to this study. Access cavities were prepared using high-speed diamond burs under water cooling. Apical patency was verified using a size-10 K-file (Dentsply Maillefer, Ballaigues, Switzerland). The working length was set 1 mm shorter than the point at which the size-10 K-file became visible at the apical foramen. Canal preparation was carried out using the Reciproc Blue system with an R25 file. The canals were obturated with gutta-percha and AH Plus sealer (Dentsply De Trey, Konstanz, Germany) using technique of lateral condensation.
The samples were randomly divided into three groups (n=15) depending on the retreatment technique: Hedstrom files (FKG Dentaire, La Chaux-de-Fonds, Switzerland); Reciproc (VDW, Munich, Germany); Race Evo (FKG Dentaire SA, La Chaux de Fonds, Switzerland). Apically extruded debris was collected in pre-weighed Eppendorf tubes and the assessment was performed using an analytical balance. Procedural errors in the form of steps, perforations and instrument fractures were recorded. Data were statistically analyzed using analysis of variance (ANOVA) and Scheffé post-hoc test.

Results: There was no statistically significant difference in the amount of extruded debris between the examined groups. However, the highest amount of apically extruded debris was recorded with the Hedstrom files (0.0046 g), and the lowest with the Reciproc system (0.0035 g). During retreatment, 3 Hedstrom files fractured.

Conclusions (mandatory): The research showed that apical extrusion was present in all examined retreatment techniques. The tested rotary systems produced less extruded debris compared to hand files. The differences between two tested rotary systems, were not statistically significant.
R178 |

R179 | ANTIMICROBIAL EFFECT OF 2.5 % SODIUM HYPOCHLORITE BOOST WITH THE 445 NM DIODE LASER – A PROOF OF CONCEPT

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AIM: To evaluate the efficacy of a novel 445 nm blue diode laser in enhancing the antimicrobial action of 2.5% sodium hypochlorite rinse against E. faecalis biofilms in root canals – in vitro.

Methodology: Twenty-five extracted single-rooted human teeth were prepared with Protaper Next X1-X3 rotary instruments sequence (Dentsply Maillefer, Ballaigues, Switzerland), sterilized, contaminated with E. faecalis and incubated for 14 days at 37 °C. The samples were randomly distributed into 3 groups: G1 – negative control, G2 – 5 mL 2.5 % NaOCl rinse, G3 – 1.5 W (CW) 445 nm laser assisted 2.5 % NaOCl rinse; canals were filled with the NaOCl, laser fiber was then inserted in still wet canals and activated for 60 s in a standard moving action (1mm/s). SEM imaging (Jeol JSM-7000F, Japan) was done for each group. The number of viable microbes in each sample was determined by the colony-forming unit count technique (CFU).

Results: A Mann-Whitney U test (significance level 5%) was chosen for the analysis. The numbers show a statistically significant reduction of microbial cultures after both treatments (G2 - 99,9993%, G3 - >99,9999%) and G3 performed best. SEM images confirmed the results.

Conclusions (mandatory): The 445 nm diode laser sodium hypochlorite irradiation protocol has improved antimicrobial effectiveness compared to only 2.5% sodium hypochlorite root canal rinse against E. faecalis biofilms. Results suggest possible routine clinical use of the protocol. Further researches are needed to evaluate the protocol in detail.

R180 | MICRO-CT EVALUATION OF THE SHAPING ABILITY OF PROTAPER ULTIMATE AND WAVEONE GOLD IN MODERATELY CURVED CANALS

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AIM: To evaluate and compare the shaping performance of rotary systems ProTaper Ultimate™ (PTUL, Dentsply Sirona) and WaveOne Gold® (WOG, Dentsply Sirona) in moderately curved mesial canals (10°–30°) of mandibular molars by assessing volume change, percentage volume change, canal transportation, and the centering ratio.

Methodology: Ten mandibular molars with two separate mesial canals (total = 20 canals) were selected. After confirming a curvature of 10°–30°, the canals were randomly assigned to two groups (n = 10): PTUL or WOG. Preoperative and postoperative micro-CT scans were obtained using a micro-CT scanner (SkyScan 1176; Bruker®, Kontich, Belgium). Analysis was performed to calculate the absolute and percentage differences in canal volume before and after instrumentation. Canal transportation and centering ratio were measured at 3mm, 5mm, and 7mm from the apex following the method of Gambill et al. (1996). Normality was assessed with the Shapiro-Wilk test; independent samples t-tests ($p<0.05$) were used to compare PTUL and WOG.

Results: No statistically significant difference was found between PTUL and WOG in absolute volume change (mean difference = 0.27mm³, $p = 0.436$) or percentage volume change (mean difference = 23.82%, $p = 0.506$). Transportation values at 3mm ($p = 0.087$), 5mm ($p = 0.314$), and 7mm ($p = 0.637$) showed no significant difference. Similarly, centering ratios did not differ at 3mm ($p = 0.647$), 5mm ($p = 0.164$), and 7mm ($p = 0.806$). Both systems preserved canal shape effectively, with no statistically significant differences.

Conclusions (mandatory): Within the limitations of this study, PTUL and WOG exhibited comparable shaping performance in moderately curved mesial canal of the mandibular molar. Neither file system showed significant canal transportation or a less favorable centering ratio, suggesting that PTUL performs comparably to WOG in maintaining canal integrity during root canal preparation.

R181 | THE INFLUENCE OF APICAL ENLARGMENT ON THE DANGER ZONE DENTIN THICKNESS OF THE MESIAL ROOT CANALS OF MANDICULAR FIRST MOLARS

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AIM: This study evaluated the impact of apical enlargement on danger zone dentin thickness in mesial root canals of mandibular first molars using micro-CT imaging.

Methodology: Ten mesial root canals from five mandibular molars were instrumented sequentially until ProTaper Next X2 (25/.06v), X3 (30/.07v) and X4 (40/.06v) (Dentsply). A micro-CT scan (SkyScan 1275) was conducted pre-operatively and after each one of the final enlargements. The danger zone dentin thickness assessment was evaluated using a two-dimensional analysis with DataViewer software (Bruker). Using the software ruler, the dentin wall thickness of the danger zone (distal wall) in the mesial roots of the molars was measured at 2-, 3- and 4-mm levels below the furcation. Three measurements were taken for each assessment and the average was calculated (in millimeters). ANOVA with Bonferroni correction test was used for comparisons ($p=0.05$).

Results: The dentin thickness of the distal part of the mesial root (danger zone) in the mesiobuccal canal at the 2-mm level below the furcation decreased from 1.00 mm (±0.20) (preoperative) to 0.80 mm (±0.19) (instrumentation to 25/.06v), 0.70 mm (±0.23) (30/.07v) and 0.60 mm (±0.19) (40/.06v) ($p<0.05$). In the mesiolingual canal, dentin thickness in the danger zone at the 2-mm level below the furcation decreased from 1.00 mm (±0.25) (preoperative) to 0.70 mm (±0.20) (25/.06 V), 0.70 mm (±0.20) (30/.07 V) and 0.60 mm (±0.20) (40/.06 V) ($p<0.05$). The same trend of decreasing dentin thickness was also observed for both mesial canals at the 3- and 4-mm levels. In addition, the thickness after each successive preparation size tended to decrease more at the 2-mm level than at the 3- or 4-mm level.

Conclusions (mandatory): In conclusion, dentin thickness in the danger zone decreases apically, with the most significant reduction at 2 mm and 3 mm below the furcation, particularly in the mesiobuccal canal.

R182 | EFFECT OF DIFFERENT APICAL ACTIONS ON POSTOPERATIVE PAIN

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AIM: This clinical study aims to evaluate the postoperative pain, 3 days after the root canal preparation using the different apical action modes of apex locator integrated endodontic motors.

Methodology: Sixty-six systemically healthy patients aged 18 to 49 exhibiting moderate pulpitis symptoms and requiring intervention were enrolled. The patients were assigned to three groups (n=22). The intervention groups were defined as Continuous Rotation, Apical Reverse, and Apical Slow-down. The preoperative (Day 0) and post-preparation (Day 3) Visual Analog Scale (VAS) questionnaire was administered for spontaneous and percussion pain. Rotary preparation was made with rotary files until size #35. The standardized preparation method was five active pecking motions and irrigation intervals. No medication was prescribed but the patients have been advised to take analgesic measures in excessive pain cases. Three days later, before the obturation, the second VAS questionnaire was made and the root canal treatment was completed. Shapiro Wilk test was used for normality distribution and repeated measures analysis of variance was applied for differences between groups.

Results: Groups were normally distributed. The analysis yielded no statistically significant differences between the experimental groups.

Conclusions (mandatory): The findings of the present trial demonstrate that the apical actions of continuous rotary instrumentation exert no effect on postoperative pain following root canal preparation. Associating the pain with apical extrusion caused by the kinematics, the results are consistent with the in vitro study*, which demonstrated no difference between the groups in terms of apical extrusion.

*Effect of different apical actions of new integrated endodontic motors on apical debris extrusion: An in vitro study. Aust Endod J. 2024; 50: 110–114. https://doi.org/10.1111/aej.12814

R183 | IMPACT OF HEAT TREATMENTS ON THE MECHANICAL PROPERTIES OF 50.8%NI-NITI ALLOY WIRES: A LABORATORY STUDY

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AIM: Nickel-titanium (NiTi) alloys are widely used in endodontic files due to their superelasticity which enabled practitioners to perform root canal preparations even in the presence of very marked curvatures. Recently, heat-treated NiTi files have replaced conventional ones, as heat treatments (HT) induce microstructural changes that greatly modify their mechanical properties. This study aims to compare the mechanical behavior of NiTi wires subjected to various heat treatments.

Methodology: NiTi wires (50.8 at% Ni, 1.2 mm diameter) were cut into 5 mm segments, polished, and cleaned. They were heat-treated at 400°C, 500°C, or 600°C for 10 or 20 minutes, either as a single or combined treatment, followed by air-quenching. Differential scanning calorimetry (DSC) and three-point bending tests were performed at both room temperature and 37°C. Microstructural analysis was conducted using transmission electron microscopy on selected samples.

Results: DSC analysis revealed that HT at 400°C increased the austenite finish (Af) temperature and promoted the R-phase. HT at 500°C enhanced the martensite-to-R phase transformation, whereas HT at 600°C reduced the Af temperature and diminished R-phase presence. In bending tests, 400°C HT samples exhibited reduced stiffness and an early, stable plateau, likely due to R-phase formation. HT at 500°C resulted in a stiffer initial response while maintaining a stable plateau and near-complete shape recovery. HT at 600°C produced the highest stiffness and the most significant residual deformation upon unloading.

Conclusions (mandatory): Heat treatments significantly influence the mechanical properties of NiTi wires. Understanding these effects is crucial for designing endodontic files with optimized performance.

R184 | A COMPARATIVE CUTTING EFFICIENCY TESTING ON TWO DIFFERENT NITI SEQUENCES

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AIM: The goal of the present study was to compare in vitro progression of two different NiTi systems (Edge Diamond vs Protaper Gold) in order to evaluate cutting efficiency and screwing-in effect.

Methodology: Testing was conducted using a custom-designed testing system, consisting of a sample holder, an endodontic motor and a sensor located under the sample holder.
The rotational speed of the instruments was set according to the manufacturers' specifications: 300 rpm for Protaper Gold (PG Maillefer, baiilagies, CH) and 500 rpm for Edge Diamond (ED Albuquerque, NM) . The axial advancement and axial speed were standardized at 1mm per stroke and 0.30 mm/s, respectively, for both instrument systems to ensure a fair comparison.
Two parameters were recorded to assess cutting efficiency: axial force and torque.
• Axial force corresponds to the force applied by the practitioner to advance the instrument within the canal. Torque represents the resistance encountered by the instrument during cutting.
• The smallest instrument in each sequence was tested on a new block, while subsequent instruments from the same sequence were used on the same block. This approach simulated the progressive removal of material in a clinical setting. Data were collected and statistically analyzed using one way ANOVA post hoc Tukey tests with significant level set at 5%.

Results: Results showed statistically significant differences between the two tested system in all the three tested parameters. ED required less torque to progress but more axial force was applied, Furthermore screwing in effect was lower in ED. These significant differences were found in all the four instruments of the sequence.

Conclusions (mandatory): Hence we may conclude that in vitro testing may be helpful to analyze advantages and disadvantages related to progression of NiTi rotary instrument to working length in simulated canals, which could be described also as cutting efficiency.

R185 | IN VITRO EVALUATION OF NEW ENDODONTIC INSTRUMENTS

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AIM: XP Endo 4d is a new rotary instrument system which is designed to maximize the contact between blades and cutting walls, allowing a proper and customized three dimensional shaping, using a minimal invasive principle. The functioning of the system is basically different from traditional Ni- Ti rotary instrumentation because the unique design of the files allows a low-torque high speed instrumentation. The specific design has non centered spirals with an eccentric rotation movement that permits to clean the root canal walls without an excessive dentine removal.
The purpose of the present study was to confirm this features by analyzing operative torque during instrumentation of easy canals and medium-difficult canals in extracted teeth.

Methodology: The specimens were analyzed with a preoperative CT scan and then assigned to two groups: easy (Group A) and difficult (Group B) root canal anatomy, based on the volume of root canals and on the curvature of the roots, each Groups was made of 20 teeth. Minimum, Average and Maximum operative torque values were analized with a customize endodontic motor, data were recorded and statistically analyzed with ANOVA one-way ($P<0.005$).

Results: Results show a statistically significant difference between the different Groups ($P<0.005$) for Minimum, Average and Maximum operative torque values, even if the overall operative torques was generally low if compared with traditional NiTi files with not specific geometry. No fractures or failures of instruments were recorded during the preparation of the specimens in both the Groups.

Conclusions (mandatory): We may conclude that the new design allows proper low torque high speed shaping both in easy and medium difficult root canals.

R187 | PHYSICOCHEMICAL AND MECHANICAL PROPERTIES OF VARIOUS RATIOS OF HYDROXYAPATITE-INCORPORATED PROPOLIS AS A POTENTIAL PULP-CAPPING MATERIAL

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AIM: Incorporation of high compressive strength, biocompatible hydroxyapatite (HA) with antibacterial, anti-inflammatory, and antioxidant-rich propolis from Heterotrigona itama (HI) species creates a promising material for dental applications such as pulp capping material. This study aims to determine the pH, mixing time, working time and compressive strength of hydroxyapatite-incorporated propolis (HAP) in comparison with mineral trioxide aggregate (MTA).

Methodology: HI propolis and nanopowder of HA will be incorporated into four different concentrations of HI propolis powder (2.5%, 5%, 7.5%, and 10%), by weight. Polyacrylic acid (PAA) will be used as a binder. The ratio of powder to liquid PAA is 1:2. The pH was assessed with a pH meter. The mixing time and setting time were determined according to methods recommended by the International Standard (ISO 6876). The compressive strength of different concentrations of HAP will be tested using a Universal Testing Machine (UTM) on cylindrical samples (6 mm diameter, 4 mm height) set for 30 minutes, 1 hour, 3 hours, 24 hours, and 72 hours.

Results: HAP exhibited near neutral pH, where the higher concentration of propolis (7.5% and 10%) is mildly acidic, while the lesser concentration (2.5% and 5.5%) of propolis is slightly alkaline. The mixing time for all groups is around 30 seconds to ensure uniform consistency, while the working time is approximately 15 minutes. The compressive strength increases over time. HA incorporated with 2.5% propolis recorded high compressive strength after 24 hours to 72 hours comparable to MTA.

Conclusions (mandatory): This research highlights the differences in physicochemical and mechanical properties of various HAP ratios, the findings suggest that HA with 2.5% HI propolis demonstrates promising potential for dental applications, particularly as a pulp capping material.

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R188 | IN VIVO IMMUNOHISTOLOGICAL EVALUATION OF THE ANTIBACTERIAL ACTION AND BIOCOMPATIBILITY OF A COPPER-BASED NANOSTRUCTURED MEDICATION IN AN ENDODONTIC REGENERATION MODEL

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AIM: This study evaluated the antibacterial activity and biocompatibility of a copper-based nanostructured hydrogel in an in-vivo endodontic regeneration model with dentine infected by a mature multispecies biofilm.

Methodology: With the approval of the ethics committee (N°. CEC-SSC 20-10-55), thin serial sections (5 mm wide) embedded in paraffin were obtained from extracted molar roots implanted into the tibiae of Sprague Dawley rats. One month post-surgery, implants and surrounding bone were fixed, demineralised, and analysed histologically. Root implants were divided into five groups:

- Experimental Group 1: Final endodontic irrigation (1.5% NaOCl, 17% EDTA, 0.9% NaCl, each for 1 min with ultrasound) + hydrogel for 7 days.
- Experimental Group 2: Final endodontic irrigation only.
- Experimental Group 3: Final endodontic irrigation + calcium hydroxide.
- Control Group 1: Non-inoculated, non-disinfected.
- Control Group 2: Inoculated, non-disinfected.

Fibroblasts, osteoclasts, inflammatory markers (CD14, CD68), dentine resorption, osteoid tissue, and angiogenesis were evaluated. Newly formed tissue was classified as Type 1 (no inflammation/resorption) or Type 2 (inflammatory markers, osteoclasts, resorption).

Results: Connective tissue, bone, and migratory cells at the dentine-tissue interface were assessed within 5 mm of the dentine.

- Control Group 1: Type 1 reaction with connective tissue, bone integration, and angiogenesis.
- Control Group 2: Type 2 reaction with inflammation, CD68/TRACP-positive cells, and dentine resorption.
- Experimental Groups 3 & 4: Type 1 reaction with healthy tissue and minimal lymphocytic infiltration.
- Experimental Group 5: Type 1 reaction with abundant bone formation.

A significant correlation was observed between osteoclasts, inflammatory markers, and resorption.

Conclusions (mandatory): The expression of biomarkers in relation to the implanted blocks, alongside the absence of inflammation or resorption, supports the antibacterial activity and biocompatibility of the copper-based nanostructured hydrogel when used as a medication in regenerative endodontic therapy.

Acknowledgements (optional): FONDECYT-IN-11201236

R189 | A LABORATORY-FORMULATED HYDROGEL AS A POTENTIAL SOLUTION FOR AVULSED TEETH PRIOR REPLANTATION

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AIM: To evaluate the cytotoxicity of a laboratory-formulated hydrogel on human periodontal ligament fibroblasts (HPdLF) and assess its potential utility as a transport medium for avulsed teeth prior to replantation.

Methodology: A hydrogel sample was formulated using distilled water and gelling agent, followed by 24 hours of maceration. The cytotoxicity of the hydrogel was subsequently evaluated employing the indirect contact method (agar overlay). HPdLF cells were covered with a layer of agar prepared from the culture medium (DMEM+10% FBS +1% antibiotic-antimycotic). A volume of 0.1 ml of the tested hydrogels was then injected directly onto the agar, while the control group received no injection. The cells were subsequently incubated for 3 and 6 hours under these conditions. The viability of HPdLF was determined by replacing the hydrogels and agar with fresh liquid medium containing the PrestoBlue reagent (Thermo Fisher Scientific). Viability measurements were conducted in accordance with the manufacturer's guidelines. The experiment was replicated four times, and average viability values were analysed. Statistical evaluation was performed using a Student's t-test.

Results: Hydrogel effectively preserved the viability of HPdLF cells, demonstrating no statistically significant differences when compared to the control culture medium. After a 3-hour incubation period, cell viability was measured at 117.23%. At the 6-hour time point, cell viability further increased to 131.37% compared to the control group. Notably, there were no significant differences in HPdLF cell viability observed between the 3-hour and 6-hour time points within the hydrogel environment.

Conclusions (mandatory): Hydrogel demonstrate the capacity to maintain the viability of human periodontal ligament fibroblast (HPdLF) cells for a minimum duration of six hours, thereby representing a promising approach for the storage of avulsed teeth prior to replantation.

Acknowledgements (optional): This study was funded by Research Council of Lithuania (LMTLT), Nr. S-MIP-24-126.

R190 | CLINICAL TIPS FOR SAFE AND EFFECTIVE ROOT CANAL TREATMENT UNDER INTRAVENOUS SEDATION WITH MIDAZOLAM

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AIM: This article provides clinical recommendations to help provide safe root canal treatment (RCT) under intravenous (IV) sedation with midazolam.

Methodology: Clinical tips are presented to provide safe and effective RCT under IV sedation with midazolam.

Results: Several factors should be considered while undergoing RCT under IV sedation with midazolam. However, these factors can be categorized to
A. Preoperative assessment visit
B. On the day of RCT and prior IV sedation
C. During RCT under IV sedation
D. Post IV sedation and prior to discharge

Conclusions (mandatory): RCT under IV sedation with midazolam is useful for anxious and special care patients. However, clinicians should be knowledgeable and aware of all possible risks that could be experienced during dental treatment under IV sedation. This article provides brief clinical tips for novice sedationists or endodontists in delivering successful RCT under IV sedation with midazolam.

R192 | DETECTION, IDENTIFICATION AND DISTRIBUTION OF THE NERVE SYSTEM AROUND AND WITHIN PERIAPICAL CYSTS; AN IMMUNOHISTOCHEMICAL STUDY

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AIM: To detect the existence, type, morphology and distribution of the nerve system that surrounds and/or penetrates inside periapical cysts, via the immunohistochemical expression of the neuronal marker S100 as well as the expression of nerve receptors trkA & p75.

Methodology: 16 paraffin-embedded lesions histologically diagnosed as periapical cysts were included. New sections were cut and stained immunohistochemically for S10, trKA & p75. The presence of nerve bundles and fibers was recorded for the wall of the cysts, the divided into the periphery attached to the surrounding bone and an inner layer, between the periphery and the epithelium.

Results: Interestingly, an organized network of nerve bundles was detected in the periphery of all cysts. All bundles were strongly S100-positive, and most of them also were trkA-positive (13/16 cases); p75 were also expressed although less frequently. Another network, this time of individual, myelinated, S100-positive nerve fibers was spotted inside the cystic wall (15/16 cases) and less frequently in the periphery of the cysts (8/16 cases), in contrast to the distribution of the bundles. Chi square test showed that this difference between the distribution of nerve bundles and fibers is statistically significant ($p<.05$). A consistent expression of trkA in the basal membrane of the cystic epithelium was also recorded, in 14/16 cases. S100 and p75 showed no expression at all in the basal membrane.

Conclusions (mandatory): A complex nerve system seems to interact with a periapical cyst; the system displays both organized bundles around the lesion, as well as individual fibers penetrating it. Their phenotype and exact function is not fully known; this will require further research.

R193 | THE MANAGEMENT OF PULP EXPOSURES AMONG GENERAL DENTAL PRACTITIONERS AND SPECIALISTS IN SINGAPORE

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AIM: To compare the preferred management method for mature and immature permanent teeth with carious pulp exposures among general dental practitioners (GDPs), endodontists and pediatric dentists.

To evaluate patient, operator and tooth related factors influencing the clinician's treatment choice in the management of such teeth.

Methodology: A questionnaire was distributed to a group of randomly selected GDPs and all the endodontists and pediatric dentists in Singapore. Respondents provided information on their treatment approaches of pulp exposures in six different clinical scenarios, the use of diagnostic methods prior to treatment of a carious tooth and the reasons influencing their treatment of choice.

Descriptive statistics were used to summarize the information collected.

Pearson's Chi-Square test or Fisher's Exact Test were used to investigate if the differences in the background of dental practitioners are associated with differences in treatment approaches and practice preferences.

Results: 350 dentists were surveyed, including 276 randomly selected GDPs, 49 endodontists and 25 pediatric dentists. An overall response rate of 60% was achieved.

GDPs (66.0%) and pediatric dentists (82.4%) preferred selective caries removal technique in extremely deep carious lesions whereas endodontists (82.4%) preferred non-selective caries removal.

Practice of pulpotomy among GDPs was low (37.2%), with most (59.6%) performing only direct pulp cap (DPC) procedures in the management of pulp exposures. Fear of peri-operative pain, perception that pulpotomy has a lower clinical success rate than RCT and the lack of training with the technique were the main reasons why GDPs avoid pulpotomy.

Regardless of specialty, most dentists were less likely to perform DPC and pulpotomy in cases of irreversible pulpitis or with periapical lesions.

Conclusions (mandatory): The preferred treatment of pulp exposures in mature and immature teeth with reversible or irreversible pulpitis differ largely among GDPs, endodontists, and pediatric dentists in Singapore.

Acknowledgements (optional): National University of Singapore, Faculty of Dentistry, MDS Research Proposal Grant

R194 | REGULATORY MECHANISMS AND THERAPEUTIC IMPLICATIONS OF DDR1 IN EXTERNAL ROOT RESORPTION PROGRESSION VIA MITOCHONDRIAL BIOGENESIS

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AIM: The regulatory mechanisms underlying external root resorption (ERR) remain unclear, despite its recognition as one of the most severe complications, alongside significant loss of dental tissue driven by odontoclasts, induced by trauma, pulpal infection, and orthodontic treatment. Previous studies have identified a notable increase in the expression of Discoidin Domain Receptor 1 (DDR1), a collagen-binding cell surface receptor, in clinical ERR samples and animal models. This study aims to investigate the role of DDR1 in the pathogenesis of ERR, providing a potential therapeutic target to hinder the progression of this condition.

Methodology: Clinical samples from patients with external root resorption (ERR) were collected for RNA sequencing (RNA-seq) and analyzed in comparison to normal periodontal ligament tissues. Additionally, a post-replantation ERR animal model was established to assess DDR1 expression. In vitro, the function of odontoclasts and alterations in the mitochondrial quality control system were evaluated following DDR1 inhibition. Furtherly, the therapeutic potential of the DDR1-specific inhibitor DDR1-IN-1 was assessed in the ERR animal model to monitor its effect on the pathological progression.

Results: In vivo, DDR1 exhibited significant upregulation in both ERR patient tissues and animal models. In vitro, DDR1 interference suppressed the mineral resorption capacity of odontoclasts, which was closely associated with impaired mitochondrial functionality. Specifically, mitochondrial biogenesis was inhibited following DDR1 interference, resulting in compromised energy supply and subsequent impairment of odontoclast differentiation and functional activity. The application of DDR1-specific inhibitor in the ERR animal model significantly attenuated the resorption capacity and suppressed the functional activity of odontoclasts.

Conclusions (mandatory): These results above align with our previous study indicating that DDR1 regulates matrix metalloproteinases (MMPs) such as MMP-1, MMP-2, and MMP-13, which are crucial in the pathogenesis of ERR. Collectively, these insights underscore the critical role of DDR1 in ERR and highlight its potential as a therapeutic target to mitigate ERR.

R195 | EVALUATION AND COMPARISON OF ENDODONTIC TREATMENT QUALITY AND MISHAPS PERFORMED DURING PRIMARY ENDODONTIC TREATMENT BY UNDERGRADUATE DENTAL STUDENTS, GENERAL DENTAL PRACTITIONERS AND ENDODONTISTS

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AIM: Evaluation and comparison of the level and homogeneity of root canal filling and endodontic mishaps performed during primary endodontic treatment depending on the operator's level of experience, based on radiological evaluation.

Methodology: The medical and radiological records of 753 patients treated at the University Dental Clinic of the Pomeranian Medical University in Szczecin, Poland were analyzed. The analysis focused on the evaluation of endodontic treatment of 753 teeth, encompassing 1,206 root canals, categorized into three distinct study groups: Group 1 - teeth treated endodontically by undergraduate dental students, Group 2 - teeth treated by general dental practitioners, and Group 3 - teeth treated by endodontists. The study's design involved the categorization of all teeth into three distinct categories: anterior, premolar, and molar teeth. The method of root canal preparation was also included in each group and was divided into hand and rotary instrumentation. The evaluation of the quality of endodontic treatment took into account endodontic treatment parameters such as the degree of root canal filling (root canal filled to full length, underfilled and overfilled root canal), homogeneity of filling, and the presence of treatment complications. The collected data was subjected to statistical analysis.

Results: There was a significant correlation ($p<0.001$) between root canal preparation method and operator experience in the group of teeth with adequate filled canals, overfilled canals, homogeneously filled canals and non-homogeneously filled canals. Furthermore, the utilization of hand instrumentation for canal preparation during endodontic treatment was associated with an elevated risk of complications, as evidenced by an odds ratio of 1.75 among students and 1.57 among general dentists.

Conclusions (mandatory): The quality of endodontic treatment, as determined by the proper filling of root canals, is influenced by the operator's experience. The use of rotary instruments during root canal preparation has been shown to reduce the incidence of treatment complications.

R196 | COLOUR CHANGE OF TEETH FOLLOWING APPLICATION OF RUBBER DAM FOR UP TO 240 MINUTES

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AIM: To measure colour change of teeth following rubber dam application for different time periods up to 4 hours and during rewetting up to 7 days.

Methodology: 20 front teeth with sound buccal surfaces were available for this study. To simulate rubber dam usage, teeth were put in a wet florist foam brick equipped with a perforated rubber dam on top to enable dry conditions for the crowns of teeth and wet conditions for the roots. Grey silicone moulds and a custom-made measuring device enabled reproducible positioning of the teeth within colour measurements using a Vita Easyshade V colorimeter. Colour measurements were carried out before and after rubber dam simulation for 60, 90, 120, 150 or 240 minutes, and following time periods of 1, 2, 3, 4, 24, 48 and 168 hours of rewetting for each group. Data for L, a, b was collected, δE, δL, δa and δb calculated and data analysed using SPSS 28.0. Controls regarding the effect of storage were available from a previous study.

Results: Colour change of teeth depended significantly on the duration of rubber dam usage: δE(60min) = 3.6, δE(240min) = 6.2; δL(60min) = 1.6, δL(240min) = 3.5; δb(60min) = 2.8, δb(240min) = 4.5 (Mann-Whitney-tests, $p < .01$). Means of δa did not exceed 1 in any of the groups at any time point. Recovery of tooth colour depended on duration of rubber dam usage (Kruskal-Wallis-tests, $p < .01$). All specimens returned to original colour within 24 hours.

Conclusions (mandatory): The use of rubber dam resulted in a lighter and yellower tooth colour. In contrast to a preliminary study, the teeth achieved a normal colour within 24 hours. Within the limits of this study, rubber dam usage for up to 240 minutes, like it may be necessary for some endodontic procedures, did not cause ongoing problems regarding tooth colour.

R197 | IMMEDIATE PRE-ENDODONTIC DENTIN SEALING (IPDS): ENHANCING BOND STRENGTH AND DENTIN INTEGRITY

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AIM: Introduction
Immediate dentin sealing (IDS) is a well-established technique, enhancing the adhesion of restorations. A less commonly discussed but equally important concept in endodontics is immediate pre-endodontic dentin sealing (IPDS). This technique protects dentin before root canal treatment, optimizing its bonding potential for final restorations.

Methodology: Clinical Protocol
IPDS involves applying an adhesive system to freshly cut dentin before initiating root canal therapy.
The steps include: Dentin Preparation - After caries removal and access cavity preparation, exposed dentin is cleaned and dried. Adhesive Application - A dentin bonding agent is applied, following the manufacturer's instructions. Sealing Layer - A thin layer of flowable composite or resin is placed to protect the hybrid layer. Endodontic Treatment - Root canal therapy is performed with precautions to avoid disrupting the sealed layer.

Results: Objective
During root canal treatment, irrigants like sodium hypochlorite (NaOCl) and ethylenediaminetetraacetic acid (EDTA) are essential for disinfection but can compromise dentin structure. These solutions demineralize dentin, degrade collagen, and reduce its ability to form strong adhesive bonds. Additionally, prolonged exposure to irrigants dehydrates dentin, making it more susceptible to micro-cracks and reduces bond strength by 70%. By sealing the dentin before endodontic procedures, its integrity can be protected, reducing the negative effects of irrigants and preventing bacterial contamination. This leads to improved adhesion for subsequent restorative materials. The only way to achieve similar bond strength by omitting these steps is to reprepare dentin 0.5mm deep using a diamond ultrasonic tip in preparation for the final restoration. In this case we have to sacrifice more sound tooth structure of an already weakened tooth.

Conclusions (mandatory): Conclusion
Utilizing IPDS in endodontic protocols can preserve dentin integrity and enhance bonding of restorations. As awareness grows, IPDS may become a standard approach in modern endodontics.

R198 | CAN DIABETES INFLUENCE THE ENDODONTIC INFECTION STATUS RELATED TO THE PATTERN OF APICAL PERIODONTITIS?

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AIM: This clinical study was conducted to describe the endodontic microbiological profile of teeth with apical periodontitis in patients with type 2 diabetes mellitus (T2DM), concerning the bacterial count and endotoxin levels found in primary infection, in addition to the size of periapical lesions, determined by cone beam computed tomography (CBCT) analysis.

Methodology: Thirty-four patients were selected and divided into two groups: 17 with T2DM and 17 non-diabetic patients as controls. Anamnesis, clinical and radiographic examination were performed. Root canal samples were collected using sterile/pyrogen-free paper tips. Endotoxins were quantified using limulus amoebocyte lysate (LAL) assay, and bacterial counts (colony forming units CFU/mL) were determined using anaerobic culture techniques. The periapical status of the teeth was assessed using the CBCT periapical index (CBCTPAI). Data were analyzed using Pearson correlation, simple linear regression, and t-test ($P < .05$).

Results: A larger size of periapical lesions (CBCTPAI >4) was observed in patients with T2DM (64.8%) compared to controls (17.7%) ($P < .05$). There was a significant increase in the number of bacteria by culture and endotoxin levels in diabetic patients. A positive correlation was observed between high levels of endotoxins and the diameter of periapical lesions ($P < .05$).

Conclusions (mandatory): This study reinforces the hypothesis that T2DM is associated with a greater microbial load and endotoxins amount, increasing the severity of periapical bone destruction, which may impact the outcome of endodontic treatment in these patients.

Acknowledgements (optional): Foundation to support research in the state of São Paulo (FAPESP) process number 2023-10972-1

R199 | MAPPING OF GLOBAL RESEARCH IN ENDODONTICS FROM 2004 TO 2023: A BIBLIOMETRIC ANALYSIS

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AIM: To analyse the publication trends and key features of endodontic research published over the past 20 years.

Methodology: A quantitative bibliometric search was made from the Web of Science database from 2004 to 2023. The following bibliometric parameters: like breakdown of research and citations by year, type of journals, types of documents, top publishing journals, countries, institutions, authors, most cited articles, and top keywords were recorded. Statistical analysis was conducted with Pearson Chi square test & VOSviewer software was used to conduct a network analysis for co-occurring key terms.

Results: The search strategy grasped 23,894 of the 34,680 documents. The selected articles were cited with an average of 20 citations per article, recording an average annual growth of 8.92%. Two journals, the Journal of Endodontics and the International Endodontic Journal published about one fourth (n=5859; 24.52%) of the articles. Brazil produced most of the research (n=3,976; 16.64%), while the United States contributed the research with the highest citation impact. The University of São Paulo produced the greatest number of articles, while the University of Zurich gained maximum citation impact. Six authors from Brazil made up the top 10 most prolific authors, and the 10 most cited articles received an average of 692.30 citations each. Most influential keywords identified were Endodontics, Enterococcus faecalis, and Cone-beam computed tomography. VOSviewer software revealed 5 interconnected clusters with 20 common key words. Articles published in dental journals; closed access articles & review articles showed a higher citation impact & significant difference were observed ($p<0.001$).

Conclusions (mandatory): Bibliometric analysis highlighted the significant developments in endodontic research during the previous 20 years, revealing a substantial increase in research productivity and citation impact. Researchers and clinicians in the field of endodontics would benefit from the findings of this study.

R200 | DETERMINANTS OF POST-OPERATIVE PAIN AND QUALITY OF LIFE FOLLOWING ROOT CANAL TREATMENT: A PROSPECTIVE CLINICAL STUDY

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AIM: To evaluate (i) the incidence of post-operative pain after root canal treatment (RCT) at 24 hours, 48 hours, and 7 days, (ii) factors influencing post-operative pain, and (iii) patients' post-operative quality of life (PoQoL) over the same period.

Methodology: A total of 162 patients underwent single-visit or multiple-visit RCT or retreatment at the Restorative Department. Post-operative pain was assessed via phone calls using the Numeric Rating Scale (NRS) and Modified Verbal Rating Scale (MVRS). PoQoL was evaluated based on pain-related effects on chewing, speaking, sleeping, daily activities, social relations, and overall QoL. Descriptive analysis determined pain incidence and PoQoL effects, while ordinal logistic regression identified prognostic factors.

Results: Post-instrumentation pain was mostly mild (24 hours: n=24, 48 hours: n=23) to moderate (24 hours: n=13, 48 hours: n=13) and subsided by day 7. Post-obturation discomfort peaked at 24 hours (n=41), decreasing at 48 hours (n=31) and 7 days (n=11). Most patients required analgesics only in the first 48 hours. Pain did not significantly impact overall PoQoL, although chewing difficulty was noted within 24 to 48 hours. Pre-operative pain was a predictive factor for post-instrumentation pain, while molars were 2.5 times more likely to experience post-obturation pain.

Conclusions (mandatory): Post-operative pain was common within 24 to 48 hours but decreased by day 7. Pain was typically mild to moderate, effectively managed with analgesics, and had minimal impact on the PoQoL, aside from temporary chewing difficulties.

Acknowledgements (optional): Funding:
Partial funding from the postgraduate research fund, Edinburgh Dental Institute.

R201 | A DECISION-ANALYTIC APPROACH COMPARING THE COSTS ASSOCIATED WITH TWO DIFFERENT ENDODONTIC RETREATMENT DECISION-MAKING CONCEPTS IN SWEDEN

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AIM: A successful outcome of root canal treatment is defined by the Strindberg Concept (SC) as the absence of symptoms and no periapical radiolucency. Hence, other outcomes are deemed unacceptable and should render retreatment, or extraction. However, empirical as well as experimental studies within the area of endodontic decision-making have repeatedly challenged the position of the SC among clinicians. A fundamentally different clinical approach is a conservative concept (CC), which is to prescribe treatment only if new or persistent symptoms (exacerbations) occur in order to keep the patient asymptomatic. The aim in this study is to compare the expected costs of SC versus CC, depending on varying risk of exacerbation and outcome of the interventions.

Methodology: Decision trees were constructed with the main branches representing treatment strategies SC or CC. Estimated costs for both treatment strategies were calculated using the 2025 Swedish Dental and Pharmaceutical Agency's reference pricelist. Outcomes of ortho- and retrograde retreatment were based on data in recently published high-quality reviews. A one-way sensitivity analysis varying the likelihood of exacerbation was performed.

Results: Preliminary results
To strictly adhere to the SC in the Swedish population would render a cost of approximately €2.50 billion. Setting the probability of exacerbation to 10%, it would be at least 11 times as expensive to pursue the SC strategy compared to the CC. The sensitivity analyses revealed that it is not cost-effective to choose the SC in favour of the CC strategy unless the probability of exacerbation exceeds 80–90%.

Conclusions (mandatory): Within the limitations and assumptions of this study, strictly adhering to the SC in the Swedish population is an expensive strategy that risks blocking other urgent dental care.

Acknowledgements (optional): Funding source: Uppsala County Council, Sweden

R202 | WHITE PETROLATUM AS A POTENTIAL VEHICLE FOR TRIPLE ANTIBIOTIC PASTE : PHYSICOCHEMICAL ASSESSMENT

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AIM: This study aims to analyze the chemical composition and pH stability of triple antibiotic paste (TAP) prepared with white petrolatum as a potential vehicle, using Fourier Transform Infrared Spectroscopy (FTIR) and pH meter. FTIR analysis was conducted to identify functional groups and possible interactions between the antibiotic components, which is ciprofloxacin, metronidazole, and minocycline. Additionally, pH analysis was performed over time to assess the alkalinity or acidity of TAP in solution, which can influence its antibacterial efficacy and biocompatibility.

Methodology: For the preparation of triple antibiotic paste, sugar coating of tablet metronidazole and ciprofloxacin were removed, triturated and powder from the minocycline capsule was utilized. The paste was prepared with a 100mg mixture of antibiotics and 10mg of white petrolatum.
For FTIR analysis, a thin film of the antibiotic paste was applied to the cassette, which was subsequently positioned within the FTIR spectrometer. For pH assessment, pH value of the deionized water solution containing TAP were measured using pH meters.

Results: For FTIR study, the results revealed characteristic peaks corresponding to the individual antibiotics, indicating their chemical stability within the mixture.
Additionally, pH measurements demonstrated inclined features, suggesting potential hydrolysis or degradation of specific components.

Conclusions (mandatory): The current vehicle used to prepare TAP in the REPs are macrogol and propylene glycol. Macrogol or polyethylene glycol, like any other material, poses a risk of allergy, and there have been documented cases of allergic reactions to macrogol. White petrolatum is a potential vehicle for the preparation of TAP as it is readily available, does not require additional steps for the preparation, and despite its widespread use, rare cases of allergic reactions have been reported.

R203 | COLD PULP TESTING IN THE NATIONAL DENTAL PBRN: DIAGNOSTIC ACCURACY AND INFLUENCING FACTORS

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AIM: To assess (i) diagnostic accuracy of cold testing, and (ii) influence of symptoms and individual- and tooth-related characteristics on diagnostic accuracy, in teeth undergoing RCT in National Dental Practice-Based Research Network practices (PBRN; NationalDentalPBRN.org)

Methodology: In a prospective cohort study, 1,696 PBRN patients treated by 153 dentists (104 GDPs, 49 endodontists) each contributed one tooth undergoing non-surgical RCT. Sensitivity, specificity, positive (PPV) and negative (NPV) predictive values, and overall test accuracy were evaluated for pre-operative cold pulp test (index test) with non-bleeding (non-vital) pulp upon access cavity preparation as the reference standard.
Background factors including dentist training level and age, case characteristics (demographics, tooth type, clinical and radiographic findings, symptoms, pain medication intake) and psychosocial variables were analyzed for their influence on test validity. Generalized estimating equations (GEE) assessed differences between subgroups at $p<0.05$ significance level.

Results: The prevalence of non-vital pulp in the sample was 52% (886/1,696). The overall accuracy of the cold test to identify a non-vital pulp was 78% (76%–80%); sensitivity 74% (95% CI 71%–77%), specificity 84% (81%–86%), PPV 83% (80%–85%), and NPV 74% (72%–77%).
GEE models indicated that psychosocial and pain-related variables (treatment fear, and severe worst pain the previous week, screening positive for TMD), individual- and tooth-related variables (patient age, palpation tenderness, molar teeth, teeth with crown) and dentist-related variables (training, age) affected the accuracy measures significantly in various directions (adjusted means; ranges -18% to 14% and ORs 0.30 to 3.05; $p<0.001$–0.04). Overall accuracy was higher for endodontists but lower for dentists aged 65+ and in patients with severe pain.

Conclusions (mandatory): Cold testing, when performed in PBRN practices, correctly identified the vitality status of about 8 of 10 pulps. A complex interaction between patient, tooth/disease, and dentist factors influences test validity and need to be considered when interpreting a test result.

Acknowledgements (optional): Supported by NIH grants U19-DE-22516 and U19-DE-28717.

R204 | VALIDITY AND RELIABILITY OF A NEWLY DEVELOPED ENDODONTIC ANXIETY SCALE

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AIM: To assess the validity and reliability of a newly developed Endodontic Anxiety Scale (EAS).

Methodology: Patients undergoing endodontic treatment were asked to complete a questionnaire comprising of ten questions to assess their anxiety levels in relation to the endodontic intervention. Responses were recorded using a Likert rating scale, and the total score correlated to whether a patient was deemed 'anxious' or 'not anxious'. Additionally, demographic data were collected to assess whether specific gender or age groups exhibited higher levels of anxiety.

Results: Of the 120 patients sampled, 114 responded and completed the questionnaire. Overall, the results indicated that 44% of patients were classified as 'less anxious', 40.5% as 'moderately anxious', and 15.5% as 'extremely anxious'. An independent t test ($p < 0.05$) revealed a statistically significant difference between male and female patients in terms of anxiety ($P = 0.018$), with female patients displaying higher levels of anxiety. However, the one-way ANOVA ($p < 0.05$) with Tukey HSD test indicated no statistically significant difference in anxiety levels between the three age groups (0-30 years, 31-60 years, 61 years +) ($P = 0.344$). The reliability of the data was assessed using the Cronbach Alpha test, which demonstrated strong internal consistency (alpha = 0.924).

Conclusions (mandatory): There is a significance difference in dental anxiety levels between genders, emphasising the importance and need to consider gender-specific approaches when it comes to managing patients' anxiety towards endodontic treatment. The high reliability of the data reinforces the validity of these findings. Implementing the EAS enables clinicians to assess and identify the specific factors that contribute to patients' anxiety and allows for tailored interventions that can enhance their overall experience of endodontic treatment.

JOHN WITHWORTH POSTER AWARD

EP04 | OBSERVATION-BASED LEARNING IN ENDODONTICS: EFFECTS ON SELF-CONFIDENCE AND CLINICAL READINESS

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AIM: This study investigated the impact of experience gained through different observation methods on the self-confidence of third-year dental students who had successfully completed the endodontic simulation laboratory in performing endodontic procedures.

Methodology: A total of 48 third-year dental students, randomly selected from a pool of 102 students, were assigned to four groups: V (verbal discussion observation), S (silent observation), A (active assistance observation), and N (No observation). The study assessed self-confidence in endodontic diagnosis and treatment through 22 questions, comprising 11 clinical procedures, 4 tooth region-specific evaluations, 3 advanced endodontic procedures, and 3 emotional aspects. Data were collected using a 5-point Likert scale and analyzed using the Chi-square test (Chi^2 test). Pairwise comparisons were conducted for variables demonstrating significant differences ($p<0.05$).

Results: No significant differences were found among the groups in diagnosis and treatment planning, periapical radiography, targeted tooth region, cavity preparation, rubber dam application, length determination, root canal preparation, master cone selection, and root canal filling ($p>0.05$). However, Group A showed significantly different confidence levels in anesthesia administration ($Chi^2(12)=32.47$, $p=0.001$) and intracanal medication application ($Chi^2(12)=17.28$, $p=0.044$) compared to other groups. Additionally, Group A exhibited significantly lower motivation than Groups V and S ($Chi^2(9)=22.81$, $p=0.006$). Significant differences were found in stress and readiness for real-patient treatment, with Group N experiencing the highest stress and lowest readiness ($Chi^2(12)=22.22$, $p = 0.035$; $Chi^2(12)=23.64$, $p=0.005$).

Conclusions (mandatory): This study highlights the role of observation methods in shaping students' confidence and clinical readiness. While most procedures showed no differences, Group A improved confidence in anesthesia and intracanal medication but had lower motivation. Group N experienced the highest stress and lowest readiness, underscoring the limits of simulation-based learning. These findings emphasize the value of hands-on experience and structured observation in bridging the gap to clinical competence.

Acknowledgements (optional): We extend our sincere gratitude to all third-year dental students.

EP07 | EVALUATION OF THE APPROACHES OF DIFFERENT SPECIALTIES AND ARTIFICIAL INTELLIGENCE SYSTEMS ON TRAUMATIC DENTAL INJURIES

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AIM: This study evaluates and compares the knowledge of three artificial intelligence (AI) systems and specialists from three dental specialties on traumatic dental injuries and their treatment.

Methodology: The study was conducted using an online survey consisting of two sections. The first section included 5 questions to determine the socio-demographic characteristics of the experts, while the second section comprised 30 multiple-choice questions based on the guidelines of the International Association of Dental Traumatology (IADT) and the current literature. The survey was delivered via email to specialists (endodontics, pediatric dentistry, and oral and maxillofacial surgery) through the Turkish Dental Association database. For AI systems (ChatGPT-4o, Gemini Advanced, DeepSeek-V3), the second section of the survey was presented three times daily over 10 days, and the responses were recorded. Consistency and reliability were assessed using Cronbach's alpha and the intraclass correlation coefficient (ICC), while statistical analyses were performed using one-way ANOVA and independent sample t-tests ($p<0.05$).

Results: A total of 95 specialists participated in the study (64 females, 31 males). Female participants demonstrated a significantly higher correct response rate compared to male participants. Participants with an excellent level of knowledge had significantly higher correct response rates compared to those with acceptable or low knowledge levels. A significant difference was observed among the specialty groups, with pediatric dentistry specialists achieving a higher correct response rate than other specialists. The mean correct response rate for all expert participants was 0.7098 ± 0.1560. AI systems performed as follows: ChatGPT-4o (0.8600 ± 0.03204), Gemini Advanced (0.7933 ± 0.03755), and DeepSeek-V3 (0.7267 ± 0.04324).

Conclusions (mandatory): AI systems outperformed participants in overall accuracy; however, case-specific evaluation is essential, as some questions led to misleading responses. Further studies are needed.

EP11 | CHATBOT VERSUS LECTURE IN THE TEACHING OF ENDODONTIC DIAGNOSIS FOR UNDERGRADUATE

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AIM: This study compared a chatbot with an expository interactive lecture as a tool for teaching pulpal and periapical diagnosis in undergraduate dental education.

Methodology: A chatbot and an expository interactive lecture were used to deliver the topic of pulpal and periapical diagnosis based on the American Association of Endodontics guidelines. A total of 24 second-year students in a 4-year undergraduate program were enrolled. An initial test (test A) with 10 multiple-choice questions was applied to all students. Then, the students were randomly assigned to 2 different groups: Lecture (control) and Chatbot (experimental). The Lecture Group attended an expository interactive lecture delivered by an endodontist. Simultaneously, in the Chatbot Group, the chatbot was delivered to the students through the Telegram Messenger application. After 50 minutes, both groups were submitted to the same test (test B). Subsequently, the Control Group used the chatbot, while the Experimental Group attended a lecture by the same faculty. After the split activity, all the students replied to a questionnaire with their perceptions regarding both activities. Statistical analysis was performed with the significance level set at 5%.

Results: Twenty-two students replied to the questions. Both Lecture and Chatbot groups showed significant grade improvement (Lecture: from 6.18±2.08 to 8.45±1.28; Chatbot: from 5.55±1.63 to 7.91±1.58). No difference in the initial and final average grades was detected between the groups. Overall, the chatbot was considered more fun and simpler while the lecture was preferred for understanding ($p<.05$). Chatbot was rated 4.95/5 for ease of use.

Conclusions (mandatory): The chatbot was as effective as an interactive lecture in delivering the basic content of pulpal and periapical diagnosis. The students' perception was that the chatbot was simpler and more fun than the lecture; however, the interactive lecture is a better tool to fully understand the topic. The professor is irreplaceable when discussing the content.

EP15 | EXPLORING THE INFLUENCE OF MUSIC ON ANXIETY CHANGES AND TASK PERCEPTION IN SIMULATION PRACTICE: A STUDENT-REPORTED STUDY

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AIM: This study investigates the effect of music on anxiety changes and perceived difficulty among third-year dental students with varying State-Trait Anxiety Inventory (STAI-T) levels during a simulation-based endodontic practice.

Methodology: A total of 102 third-year dental students who met the inclusion criteria were stratified into high anxiety (HA) and low anxiety (LA) groups (cut-off score: 44) and randomly assigned to one of three conditions: listening to Mozart (MOZ), no music (NON), or individually selected music (IND). Baseline anxiety was assessed using the STAI-T, and state anxiety (STAI-S) was measured before and after a simulated root canal treatment to determine anxiety change. Perceived difficulty was evaluated using an eight-item questionnaire. Data were analyzed using the Kruskal-Wallis test and Bonferroni-adjusted pairwise comparisons (p=0.05)

Results: A significant difference was found among groups for anxiety change ($H(5) = 14.795$, $p = 0.011$) and perceived difficulty ($H(5) = 11.452$, $p = 0.043$), but pairwise comparisons did not identify differences between specific groups ($p > 0.05$). The HA-NON group had the highest anxiety fluctuations (Mean Rank = 65.73), while the LA-IND group had the lowest (Mean Rank = 32.33). Additionally, the HA-MOZ group showed the second-lowest anxiety change (Mean Rank = 49.09). In terms of perceived difficulty, the HA-NON group ranked highest (Mean Rank = 59.5), indicating greater difficulty perception, while the LA-IND group ranked lowest (Mean Rank = 31.35), suggesting the easiest perception.

Conclusions (mandatory): Students with high baseline anxiety who did not listen to music exhibited the greatest anxiety variability, while those with low anxiety who listened to individually selected music showed more stability, suggesting a beneficial effect of personalized music. HA-NON students perceived the procedure as most difficult, whereas LA-IND students reported it as easiest. Furthermore, Mozart music may have had a partial regulatory effect, particularly for high-anxiety individuals.

Acknowledgements (optional): Grateful to third-year students, Yaren Çam, Eren Pektas.

EP26 | AN EVALUATION OF THE CURRENT STATUS OF ENDODONTIC EDUCATION IN THE UK: A CROSS-SECTIONAL SURVEY OF NEW GRADUATES AND THEIR EDUCATIONAL SUPERVISORS

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AIM: To evaluate the current status of endodontic education in UK dental schools by assessing the preparedness of new graduates for clinical endodontic practice and gathering opinions from educational supervisors on their strengths and weaknesses.

Methodology: A cross-sectional survey was conducted among newly qualified dental graduates practising in the UK and their educational supervisors during the foundation training year (n = 217). The survey focused on trainee and supervisor perspectives regarding preparedness, confidence, and the level of support required in core endodontic procedures, with particular emphasis on molar endodontics. Data were collected via an online questionnaire, and statistical comparisons were performed using the Friedman test.

Results: Graduates reported confidence in basic endodontic procedures but felt less prepared for tasks such as molar endodontics, case selection, tooth restorability, and vital pulp therapy.
Trainees rated their level of independence in completing stages of molar endodontic treatment. Analysis revealed that access, canal identification and working length determination were perceived as significantly more challenging than other procedural stages ($p < 0.0001$). Confidence in canal identification was significantly lower than both access and length determination ($p = 0.004$ and $p = 0.012$, respectively).
Educational supervisors noted wide variation in trainee knowledge and skills, with many requiring support in both molar endodontics and clinical decision-making. Supervisor confidence also decreased significantly as case complexity increased from Tier 1 to Tier 3 ($p < 0.0001$).

Conclusions (mandatory): This survey highlights a direct link between undergraduate endodontic experience and confidence in managing molar endodontic cases during foundation training. Trainees frequently relied on educational supervisors for support in completing cases, while supervisors themselves expressed reduced confidence in managing complex cases. Enhanced undergraduate and postgraduate training is essential to ensure future general dental practitioners are equipped to manage endodontic disease effectively.

Acknowledgements (optional): This work was supported by the British Endodontic Society. No external funding was received.

EDUCATIONAL POSTERS 01

EP01 | THE EFFECT OF HANDS-ON TRAINING ON DENTAL STUDENTS' STRESS, CONFIDENCE, AND PERFORMANCE OF COMPLETE PULPOTOMY

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AIM: To evaluate the impact of practical training using a simulated teeth model on dental students' stress levels, confidence, and knowledge in performing complete pulpotomy as a vital pulp therapy procedure. Additionally, students' procedural performance was assessed.

Methodology: This study involved fifth- and sixth-year dental students at King Abdulaziz University. Data were collected through two time-point surveys, one administered before the practical training (S1) and the same repeated after the training (S2). Stress and confidence levels were measured using a Visual Analogue Scale (VAS). Various factors and their relationships with stress, confidence, and knowledge were analyzed, including demographic and educational variables. The Mann-Whitney U test was used to evaluate the medians of two independent groups and the Wilcoxon signed-rank test was used to evaluate two dependent groups. Kruskal-Wallis test and Spearman's rank correlation were used to evaluate the relationship between variables.

Results: The sample comprised 131 students. Students reported significantly lower stress levels post-training ($p = 0.007$). Gender, year of study, and previous clinical experience significantly influencing stress levels. Confidence levels improved significantly at S2 across most questions. Previous practical training, prior clinical experience, and interest in endodontics significantly influenced students' confidence levels. However, knowledge scores showed no significant improvement ($p = 0.053$).
Performance assessment revealed an average score of 74.40% for pulpotomy procedures. Spearman's rank correlation indicated no significant association between stress or confidence levels and performance scores. Female students outperformed male students ($p = 0.033$), and 6th-year students achieved significantly higher scores than 5th-year students ($p = 0.001$). Additionally, students with prior clinical pulpotomy experience performed significantly better than those without ($p = 0.025$).

Conclusions (mandatory): Practical training using a simulated teeth model significantly reduced students' stress and improved their confidence in performing pulpotomy. However, additional strategies may be needed to enhance theoretical knowledge and ensure performance improvement.

EP03 | UNDERGRADUATE DENTAL STUDENTS' CONFIDENCE AND ANXIETY LEVELS IN ENDODONTICS: DOES CLINICAL EXPERIENCE MATTER?

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AIM: To evaluate self-reported confidence and anxiety levels among undergraduate dental students related to various endodontic procedures and to analyze the opinion of educational factors.

Methodology: The study involved 72 dental students from 3rd, 4th, and 5th grades who completed the endodontic stage or laboratory successfully. Participants completed a 34-item questionnaire assessing their confidence in general and advanced endodontic procedures, anesthesia administration, and procedures involving anterior and posterior tooth regions, along with their perceptions of educational quality. Additionally, anxiety was measured using the State-Trait Anxiety Inventory (STAI). Data were analyzed using Cronbach's alpha, one-way ANOVA, Tukey post-hoc, Spearman correlation, and Chi-square tests (alpha=0.05).

Results: Cronbach's alpha indicated good reliability (alpha=0.817-0.953), except for education quality (alpha=0.457). ANOVA showed significant differences between grades in confidence scores for general endodontics, posterior tooth, anterior tooth, anesthesia (all $p<0.001$), and advanced endodontics ($p=0.001$), with 5th-year students reporting the highest scores. Anxiety (STAI) did not significantly differ among groups ($p=0.140$) but correlated weakly yet significantly with confidence in general endodontics ($r=0.391$, $p<0.001$), posterior ($r=0.414$, $p<0.001$), and anterior tooth procedures ($r=0.320$, $p=0.006$). Satisfaction with theoretical education was high across all grades (3rd: 79.2%, 4th and 5th: 66.7%), though differences were not statistically significant ($p=0.605$). Satisfaction with practical education was consistent (50-58.3%; $p=0.596$). Instructor satisfaction varied, with 3rd graders predominantly 'satisfied' (70.8%), while 5th graders reported higher 'very satisfied' rates (54.2%; $p=0.124$).

Conclusions (mandatory): The findings suggest a progressive increase in students' confidence across educational levels, especially in anesthesia administration and anterior tooth procedures. Interestingly, third- and fourth-year students showed similar confidence levels in advanced endodontic procedures, indicating a potential need for targeted training at these stages. While anxiety levels did not significantly differ, their inverse correlation with self-confidence highlights the importance of addressing student anxiety in dental education.

Acknowledgements (optional): We extend our sincere gratitude to all third-, fourth-, and fifth-year dental students.

EP05 | USE OF 3D SIMULATED TOOTH AND PULP MODELS FOR VITAL PULP THERAPY TRAINING

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AIM: To evaluate the impact of 3D simulated tooth and pulp models on enhancing perceived confidence and knowledge in treating deep caries and pulp exposure among dentists with varying levels of clinical experience.

Methodology: General dentists with varying levels of clinical experience were invited to attend a lecture on vital pulp therapy (VPT), followed by a hands-on workshop one week later using either extracted teeth (ET) or 3D simulated tooth and pulp models (3D). Participants completed a pre-lecture survey (T0) to assess their knowledge and confidence in performing VPT, and the same survey (T1) was administered before the workshop. After the workshop, a post-training survey (T2) was conducted to evaluate effectiveness of the hands-on training. There were 3 groups of participants. Group 1 (G1) involved dentists with <5 years of clinical experience who used ET. Group 2 (G2) involved dentists with <5 years of clinical experience who used 3D. Group 3 (G3) involved dentists with >=5 years of clinical experience who used 3D. Statistical analysis was performed with SPSS® and independent t-tests were used to compare the difference between survey scores.

Results: The groups consisted of 18-25 participants each. All groups showed significant improvement in knowledge in almost all survey domains between T0 and T1. There was also perceived improvement in dexterity in managing VPT procedures at T2. 3D provided better simulation for VPT training compared to ET ($p<0.05$), particularly for less experienced dentists ($p<0.05$). Knowledge consolidation improved more for those who trained with 3D than ET across all levels of clinical experiences ($p<0.05$), with significantly greater gains for less experienced dentists ($p<0.05$).

Conclusions (mandatory): 3D simulated tooth and pulp models improved knowledge consolidation across dentists with varying levels of clinical experiences and can be beneficial for continuing education programmes in VPT.

EP06 | THE IMPACT OF CASE-BASED LEARNING (CBL) ON UNDERGRADUATE DENTAL STUDENTS PERCEPTION OF CONFIDENCE IN PERFORMING ENDODONTIC TREATMENT

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AIM: To assess the impact of CBL on dental students' confidence in performing endodontic treatment.

Methodology: Fourth year dental students were invited to take part in the study. This consisted of a two hour teaching session. All students took a pre teaching survey assessing their perceived confidence in performing endodontic treatment. This survey employed closed questions for each stage of endodontic treatment and scaled responses using a Likert scale. The scale ranged from 1 (not confident at all) to 10 (extremely confident). The students then received a two hour CBL seminar. This used a clinical case of endodontic treatment of an upper molar. The case was broken into stages of diagnosis, treatment planning and technical skills. Following the completion of the teaching session, students retook the survey to assess their perceived confidence.

Results: Prior to the teaching session most students (46/50) ranked their confidence between 3 and 6, with the lowest scores in confidence being access cavity preparation and working length determination. Four of the students ranked their confidence between 5 and 7. Following the teaching session all fifty (50/50) of the students had ranked their confidence between 5 and 8. The general feedback from the student group was that the clinical photography and videos used during the cases were valuable in explaining technical skills like orifice location, straight line access and apical gauging.

Conclusions (mandatory): This study shows that CBL could be a valuable tool if utilized during undergraduate education. It allows students to apply their theoretical knowledge to the clinical environment before practicing on a patient. It also allows for educators to detail the common issues that Dentists face during endodontic treatment eg extrusion, short fills or ledge creation. By being able to explain these with real examples, students can be shown how to try avoid them or how to rectify them.

EP08 | DIGITAL TOOLS AND ARTIFICIAL INTELLIGENCE IN ENDODONTIC EDUCATION

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AIM: To assess the integration of innovative digital tools, including artificial intelligence, in endodontic educational programmes and to investigate the ways in which these advanced technologies can contribute to more interactive learning.

Methodology: A review of the literature from a decade up to January 2025 was conducted using Pubmed, Google Scholar and ResearchGate databases.

Results: 108 studies were examined, but only 18 were found to be relevant to the current literature review's scope. Based on existing literature, digital tools and artificial intelligence have been successfully used to improve many aspects of endodontic education, such as treatment planning, case difficulty assessment, preclinical training and advanced clinical simulation. For example, the use of 3D-printed models and haptic training with mixed reality can reproduce different clinical situations providing case-based training.

Conclusions (mandatory): There have been a number of literature reviews investigating the benefits and drawbacks of digital tools in general dental education; to the researcher's current knowledge, however, there has been very little research focused on assessing the use of digital tools within specialised endodontic training. Based on the limited research already conducted, the incorporation of digital tools in endodontic education has benefited students by providing them with interactive and personalized educational experiences that can better equip them with the necessary skills needed to deal with unique and demanding clinical cases.

EP09 | LAUNCHING OF SIMPLIFIED ENDODONTIC PROGNOSTIC AND CASE DIFFICULTY ASSESSMENT FORMS FOR GENERAL DENTAL PRACTITIONERS

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AIM: To compare among Finnish dentists the usefulness of Endodontic Case Difficulty Assessment Form (ECDAF; published in 1999) to its simplified modification (S-ECDAF) and Dental Practicality Index (DPI; published in 2020).

Methodology: The study was carried out during training sessions aimed at launching a new version of Finnish Current Care Guidelines for Endodontic Treatment, held in seven cities in Finland by specialists in endodontology. After each the training session, the attending dentists were invited to participate in a survey collecting participants' background information (gender; working experience 10 years / 10 years; participation in endodontic continuous education within 12 months, yes/no) and their attitudes towards using the assessment forms. Previous use of ECDAF and anticipated use of DPI and S-ECDAF were analysed with relation to demographic factors using McNemar's test and Chi-square test.

Results: Of the attending dentists, 96 participated in the survey. Only 9% (9/96) of the dentists reported having used ECDAF ever. This was significantly less than the anticipated use of DPI (66%, 63/93, $p<0.001$) and that of S-ECDAF (68%, 65/96, $p<0.001$, McNemar's test). Dentists who had taken part in endodontic continuous education within 12 months had used ECDAF significantly more often than the rest of the participants (17% vs. 0%, $p=0.004$, Chi-square test). Gender and working experience did not associate with the use of ECDAF. Neither did gender, working experience or participation in endodontic continuous education associate with the anticipated use of S-ECDAF or DPI.

Conclusions (mandatory): Recent participation in endodontic continuous education associated with previous use of ECDAF. There is a clinical need and potential for more simplified assessment forms like DPI and S-ECDAF for general dental practice.

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EDUCATIONAL POSTERS 02

EP10 | DOES THE USE OF A TMD SCREENING TOOL AID IN THE DIAGNOSIS OF TEMPOROMANDIBULAR DISORDER IN ENDODONTIC PATIENTS?

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AIM: To evaluate the accuracy of the 6 Question TMD screener when used to diagnose temporomandibular disorders (TMD) in patients seeking management for endodontic symptoms.

Methodology: An electronic database search was conducted for the purpose of systematic review using the Pubmed and Ovid via Medline databases and additional citations were manually searched through reference lists. The citations were then reviewed for relevance to this systematic review and selected according to inclusion and exclusion criteria. Data was extracted from these studies to assess the accuracy of the 6 Question TMD screener. The Newcastle-Ottawa Scale was used to determine the risk of bias of the selected articles.

Results: Following review of the records retrieved from the database search, it was found that only three publications met the eligibility criteria. Heterogeneity was detected amongst the three studies, however two of the studies were found to have low risk of bias and one study had moderate risk of bias. Overall, it was found that the sensitivity of this screening tool for detecting all types of TMD pain versus odontogenic pain ranged from 0.85 to 0.94, whereas the specificity ranged from 0.52 to 0.61. In addition, the range for the positive predictive value was 0.68 to 0.72, and for the negative predictive value was 0.75 to 0.89.

Conclusions (mandatory): Due to the high prevalence of TMD pain in endodontic patients, it is essential that clinicians screen these patients for TMD to establish a comprehensive pain diagnosis. The data presented in this systematic review suggests that the 6 Question TMD screener may be an accurate method for detecting TMD pain in patients seeking management for endodontic symptoms. Thus, the 6 Question TMD screener could be recommended as part of the initial clinical assessment of patients who present for endodontic pain consultation.

EP12 | ASSESSMENT OF 3D-PRINTED ENDODONTIC TRAINING MODELS IN PRECLINICAL EDUCATION: A STUDENT PERSPECTIVE

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AIM: To evaluate the feasibility of three different 3D-printed endodontic training models in preclinical endodontic education from the perspective of undergraduate students.

Methodology: Three commercially available 3D-printed endodontic training models of mandibular first molars, each with distinct material compositions, were acquired. A total of 54 undergraduate students from Hacettepe University Faculty of Dentistry, who had completed their preclinical endodontic training, performed endodontic procedures (cavity preparation, root canal instrumentation, and obturation) on each model. A structured questionnaire assessed students' perceptions of the models' resemblance to natural teeth. The evaluated parameters included occlusal anatomy, pulp chamber anatomy, root canal configuration, root canal diameter, material hardness, apical resistance sensation, endodontic file manipulation, debris accumulation, radiopacity, crack formation and suitability for practice in the models. Statistical analysis was performed using Friedman's Two-Way Analysis of Variance.

Results: Model 1(Ancorax) received significantly lower ratings for occlusal anatomy resemblance ($p<0.05$). Model 3 (EduDent) demonstrated significantly higher ratings for dentin hardness resemblance and apical resistance sensation ($p<0.05$) and achieved the highest scores in anatomical and mechanical resemblance to natural teeth ($p<0.05$). Model 1(Ancorax) showed significantly higher ratings for radiopacity ($p<0.05$), while Model 2 (Btech) received significantly lower scores for the realistic representation of root canal diameter ($p<0.05$). A high percentage of students (%94,7) reported the need for additional practice on extracted teeth.

Conclusions (mandatory): From the students' perspective, Model 3 achieved the highest scores in most evaluated parameters for its resemblance to natural teeth, except for radiopacity. However, its inadequate radiopacity limits its applicability as a full replacement for natural teeth in preclinical training. The findings suggest that 3D-printed endodontic training models can serve as a valuable complementary tool alongside natural teeth.

EP13 | ARTIFICIAL INTELLIGENCE IN ENDODONTIC EDUCATION: A REVIEW OF AI-DRIVEN LEARNING AND DECISION SUPPORT TOOLS

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AIM: Artificial Intelligence (AI) is transforming medical and dental education, particularly in specialized fields such as endodontics. This review explores how AI-driven tools enhance diagnostic training, decision-making, radiographic interpretation, and personalized learning in endodontic education. The objective is to summarize current AI applications and their impact on student learning and skill development.

Methodology: A systematic literature review was conducted using PubMed, Scopus, Web of Science, and Google Scholar, analyzing peer-reviewed articles from 2015-2024. The search included keywords such as “Artificial Intelligence in Endodontics,” “Machine Learning in Dental Education,” and “AI-driven Decision Support in Endodontics.” The review focused on AI applications in radiographic analysis, virtual learning platforms, adaptive education models, and clinical decision-making support. Studies were included based on relevance, methodological quality, and impact on student education.

Results: AI-powered machine learning models have demonstrated high accuracy (85-97%) in detecting periapical lesions, fractures, and variations in root canal morphology from radiographs, surpassing manual interpretation in speed and consistency. AI-assisted diagnostic support systems provide real-time feedback, reducing diagnostic errors by up to 30% among postgraduate students. Virtual reality (VR) and augmented reality (AR) simulators enhance hands-on training, improving procedural efficiency and reducing preclinical training time by 40%. AI-driven adaptive learning platforms personalize education by analyzing student performance, leading to 25% higher knowledge retention rates and better clinical decision-making confidence.

Conclusions (mandatory): AI in endodontic education improves diagnostic accuracy, procedural skills, and personalized learning experiences. Its integration into curricula enables data-supported decision-making and interactive training that bridges the gap between theory and practice. Future research should focus on expanding AI-based simulations, addressing ethical considerations, and making AI-driven tools more accessible to optimize endodontic training globally.

EP14 | PERCEPTIONS OF UNDERGRADUATE AND POSTGRADUATE STUDENTS REGARDING A COST-EFFECTIVE 3D-PRINTED SIMULATOR FOR ENDODONTIC MICROSURGERY

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AIM: Endodontic surgery requires a specific set of technical skills that must be acquired and assessed in a preclinical setting before being performed on patients. Three-dimensional (3D) printing has emerged as a powerful tool for creating precise and reproducible surgical simulators. However, the cost-effectiveness and fidelity of different 3D printing technologies can vary. This study aims to evaluate the perceptions of undergraduate and postgraduate students regarding a custom-made, cost-effective 3D-printed simulator designed for training in endodontic microsurgery.

Methodology: A 3D-printed model was developed, comprising gingiva, teeth, and a bone base featuring apical lesions on three teeth targeted for surgical procedures. The components were printed using a Form 3BL (Formlabs), post-processed, and assembled. Forty students participated in a training session using these models and subsequently completed a structured questionnaire assessing their perceptions. The responses were analyzed statistically using a Mann-Whitney test.

Results: Overall, students were satisfied with the training session and considered the simulator an effective tool for acquiring fundamental endodontic surgical skills. Most components were perceived as providing a realistic clinical feel, except for the gingival material, which received lower scores for incision and suturing. The majority of participants believed that such a simulator would have been a valuable addition to their training curriculum.

Conclusions (mandatory): While this 3D-printed simulator does not perfectly replicate clinical conditions, it provides a sufficiently realistic environment for basic endodontic surgical training. Its affordability, ease of production, and accessibility make it a promising educational tool for preclinical training in endodontic surgery.

EP16 | CONFIDENCE THROUGH CONVERSATION: ENHANCING PRE-SURGICAL COUNSELLING IN ENDODONTIC MICROSURGERY VIA ROLE-PLAY SIMULATION

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AIM: Effective pre-surgical counselling is critical in Endodontic Microsurgery (EMS) to ensure patient understanding and informed consent. However, dental residents often struggle with communication and managing patient expectations. This study evaluates the impact of role-play on EMS pre-surgical counselling, examining residents' confidence and perceptions of the simulation experience through qualitative analysis.

Methodology: Residents in their surgical training participated in a role-play workshop that included four clinical scenarios: EMS on a maxillary incisor, maxillary molar, mandibular premolar, and mandibular molar. The residents analyzed each case and provided pre-surgical counselling to a standardized patient, followed by feedback from peers and facilitators. Reflective debriefing was done using the Promoting Excellence and Reflective Learning in Simulation (PEARLS) debriefing framework to foster critical reflection.
Post-workshop, focus group discussions (FGDs) were held using a semi-structured guide. Audio transcripts were analyzed using thematic analysis, with codes refined into broader themes and subthemes through iterative discussions.

Results: Eleven residents with varied surgical experience (minimal to moderate, but no prior EMS experience) participated in the workshop. Four key themes emerged:
1. Enhancing Communication and Consultation Skills: Role-play improved residents' ability to structure consultations and communicate effectively.
2. Realism and Authenticity in Role-Play: While the scenarios were comprehensive, real patients often presented more complex concerns.
3. Psychological Pressure and Peer Observation: Peer and facilitator observation heightened stress, but residents' ability to manage patient interactions under pressure improved with time.
4. Learning Through Observation and Reflection: Observing peers provided insights into diverse communication styles, enabling residents to refine their approaches.

Conclusions (mandatory): Role-play significantly enhances residents' communication skills and confidence in EMS pre-surgical counselling. Incorporating more dynamic patient interactions and observation opportunities could improve training effectiveness and better prepare residents for real-world clinical challenges.

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EP17 | ASSESSMENT OF RADIOGRAPHIC ERRORS AND REPETITION RATE IN UNDERGRADUATE ENDODONTIC EDUCATION: A RETROSPECTIVE CLINICAL STUDY

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AIM: Abstract
Aim: The aim of this study was to assess the frequency of radiographic retake during endodontic procedures among undergraduate dental students at Ajman University (AU), identify common imaging errors, and propose strategies to enhance radiographic accuracy to minimize unnecessary exposure.

Methodology: Material and Methods: A retrospective analysis was conducted on 4,786 intraoperative periapical radiographs taken by fourth-year dental students during root canal treatment. The incidence and causes of repeated radiographs were examined based on tooth type and treatment step. Imaging errors were categorized, the chi-square and one-way analysis of variance tests were performed.

Results: Results: The overall repeat rate was 37.2%, with the highest frequency occurring during the master cone trial (54.6%) and working length determination (47.4%). The most prevalent error leading to repetition was missing apical area (38%), which showed a statistically significant association with radiographic repetition ($p = 0.0001$). Other common errors included incorrect working length adjustment (9.6%) and master apical cone positioning (20%). There was no significant difference in overall repeat rates between maxillary and mandibular teeth ($p > 0.05$).

Conclusions (mandatory): Conclusions: The high radiographic repetition rate highlights the need for enhanced radiographic training, improved faculty supervision, and greater reliance on electronic apex locators (EALs) to reduce unnecessary imaging. Implementing structured radiographic education and promoting the use of paralleling devices can enhance students' diagnostic accuracy. Clinically, reducing radiographic repetition minimizes radiation exposure and improves procedural efficiency.

EP18 | IDENTIFICATION AND IMPLEMENTATION OF THRESHOLD CONCEPTS IN THE UNDERGRADUATE EDUCATION IN ENDODONTOLOGY

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AIM: Threshold concepts are concepts that, when grasped, will promote mastery of a subject by leading to proper understanding of its most central features. Some features of threshold concepts are that they are transformative, troublesome, irreversible, integrative, and bounded. The aim of this study is to report on the development and initial assessment of threshold concepts introduced in undergraduate endodontic education at Malmö University.

Methodology: By systematically reviewing published literature we evaluated how threshold concepts affect students' experiences in dental or medical education. Through collegial discussions three central concepts were identified: "Physical and physiological barriers", "Gradual disease development" and "Localization of inflammation/infection". These concepts were then integrated into all theoretical learning activities in Endodontology.

At the written examination, the students replied in short essays to questions about pathogenesis regarding pulpal and periapical disease. Through systematic text condensation (Malterud 2012) the answers were analyzed to discover whether their arguments indirectly or directly reflected the threshold concepts.

Results: The systematic review failed to identify studies evaluating how threshold concepts affect students' experiences in dental education. Four papers from medical education reported that threshold concepts act as tools to overcome obstacles and foster new ways of thinking.

The systematic text condensation identified four main themes: "Barrier functions and their role in the pulp defense", "Inflammation and infection in the pulp and surrounding tissues", "Clinical approach to endodontic diagnostics" and "Details of disease development". These main themes were then further divided into subthemes. The results showed that the students reflected well on the central concepts of Endodontology and showed good understanding of the meaning of threshold concepts.

Conclusions (mandatory): The identified concepts were integrated into the learning activities and seem to have affected the students' ability to grasp central concepts within Endodontology.
Further studies are needed to confirm whether learning the concepts also promoted retention of knowledge over time.

EDUCATIONAL POSTERS 03

EP19 | EFFECT OF MASTER APICAL FILE RADIOGRAPHS ON SINGLE CONE HYDRAULIC ROOT CANAL FILLING BY PREDOCTORAL STUDENTS: A DOUBLE-BLINDED STUDY

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AIM: To compare the competency in root canal filling quality between two verification sequences for predoctoral students: using both the master apical file radiograph (MAF) and master cone fit radiograph (MC) versus using only the MC and excluding the MAF.

Methodology: In a predoctoral endodontic clinic, 34 patients and 58 canals were evaluated for root canal therapy (n=58). After determining patient eligibility, cases and students were randomly assigned to Protocol 1 (n=28), which included both MAF and MC, or Protocol 2 (n=30), which included only the MC. After consent, students were blinded until the canals were fully prepared. All students used a crown-down technique with 0.04 tapered Vortex Blue rotary files (Dentsply Sirona) at 500 rpm and 1.8 Ncm torque, along with a TRITON irrigation system (Brasseler, USA). All root canals were filled using BC sealer (Brasseler, USA) with single cone hydraulic method. Final radiographs were evaluated by a blinded investigator for fill quality, density, shape, and overall grade, considering tooth type (anterior/premolar and molar). Data were analyzed using two-way ordinal regression to compare the effects of protocol, tooth type, and their interaction on root canal filling competency.

Results: Protocol 1 resulted in significantly higher overall grades ($P<0.05$). The inclusion of MAF radiographs led to denser root canal fillings than Protocol 2 for all tooth types ($P<0.05$). Molar teeth showed significantly lower grades with Protocol 2 ($P<0.0005$). Protocol 2 produced better fill than Protocol 1 for anterior and premolar cases ($P<0.05$). Canal preparation shape was unaffected by the protocol.

Conclusions (mandatory): The inclusion of both MAF and MC radiographs is recommended in predoctoral endodontic protocols. Excluding MAF negatively impacted molar treatments, with overall outcomes improved by the inclusion of MAF radiographs. While improved clinical techniques to maintain a consistent working length could reduce the need for MAF radiographs, current protocols do not support their exclusion.

EP21 | ENHANCING CLINICAL REASONING IN ENDODONTICS: A REVIEW OF CASE-BASED LEARNING AND DIGITAL COLLABORATIVE PLATFORM

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AIM: This literature review aims to explore the effectiveness of case-based learning (CBL) and collaborative online platforms in enhancing endodontic education. It investigates how these educational tools support the development of clinical reasoning, skill acquisition, and student engagement, with a focus on endodontic procedures.

Methodology: A comprehensive review of peer-reviewed studies published in the last decade was conducted. The selected articles focused on the integration of CBL and digital platforms in dental education, particularly in the context of endodontics. The review examined outcomes related to student performance, engagement, and the quality of learning experiences, as well as the benefits and challenges of these educational approaches.

Results: The review reveals several important findings regarding the integration of Case-Based Learning (CBL) and collaborative online platforms in endodontic education. CBL has been shown to significantly improve critical thinking and clinical decision-making by presenting students with realistic, complex cases that closely mirror real-world scenarios. Collaborative online platforms enhance communication among students, foster peer discussions, and provide immediate feedback, all contributing to higher engagement and a deeper understanding of the material. Studies indicate that these methods improve both theoretical knowledge and practical skills, such as diagnosis and treatment planning in endodontics. Furthermore, student feedback has been overwhelmingly positive, with many expressing a preference for the interactive and flexible nature of these digital learning tools.

Conclusions (mandatory): Case-based learning and collaborative online platforms significantly enhance endodontic education by improving clinical reasoning, student engagement, and practical skills. The integration of these tools into dental curricula offers a more interactive, flexible, and effective way of teaching endodontics. Further research is needed to optimize these platforms and assess long-term learning outcomes in clinical practice.

EP22 | ECO-CONSCIOUS ENDODONTICS: EVALUATING ENVIRONMENTAL SUSTAINABILITY CURRENT PRACTICE, KNOWLEDGE AND BARRIERS IN POSTGRADUATE ENDODONTICS PROGRAMS

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AIM: The integration of Environmental sustainability (ES) into healthcare, including dentistry, is gaining recognition, addressing the ecological impact of clinical and non-clinical practices. Endodontic procedures, due to their reliance on resource-intensive materials and energy, may present an environmental concern. While undergraduate dental curricula in Europe have started to adopt ES principles, postgraduate endodontic education remains unexplored in this context. As future specialists, postgraduate students bear a pivotal role in driving change, necessitating the integration of ES practices to routine patient care. This study aims to assess ES incorporation in postgraduate endodontics programs, to identify current practices, knowledge, teaching, potential barriers and future plans that enhance curriculum development

Methodology: A cross-sectional questionnaire was designed and distributed to program leads and directors of full time three-years duration postgraduate Endodontic programmes, in the UK and Europe via Online Surveys. It contained questions on knowledge levels, current curriculum content, barriers to sustainability integration, and plans for future implementation.

Results: At present, data analysis is underway. Analysis will focus on identifying trends and gaps in ES learning within Postgraduate endodontics programs. Preliminary observations suggest variability in current practices and teaching approaches to deliver ES. A complete analysis of findings, including statistical trends and thematic insights, will be presented upon conclusion of the study.

Conclusions (mandatory): This study is expected to provide valuable insights into the current state of ES education in Postgraduate Endodontics programs. By identifying strengths and areas for improvement, the findings aim to support curriculum enhancements that prepare future endodontists to adopt environmentally conscious practices. The study underlines the importance of implementing ES in dental education to address Eco-considerate practices.

EP24 | ORAL HEALTH KNOWLEDGE AND BEHAVIOUR AMONG MEDICAL AND DENTAL STUDENTS AT THE UNIVERSITY OF LJUBLJANA

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AIM: This study aimed to evaluate the differences in oral health knowledge and behaviour between medical and dental students at the Medical Faculty of the University of Ljubljana (UL) and to assess the influence of academic progression on their understanding of oral health.

Methodology: A cross-sectional survey was conducted among medical and dental students (years 1–6) at the UL in the academic year 2023/24. Participants completed an online questionnaire that included 36 questions on demographics, knowledge of dental caries, endodontic and periodontal health, relationship between oral and systemic health, and oral health maintenance habits. Statistical analyses included t-tests, chi-square tests and linear regression.

Results: A total of 392 students participated (239 medical students, 153 dental students), with a response rate of 65% and 42%, respectively. Significant differences ($p < 0.05$, chi-square test) were found between the groups in terms of oral health behaviour, general knowledge of oral health, risk factors for poor oral health and knowledge of the links between oral and systemic health. Dental students demonstrated better knowledge about oral health (mean score: 13.2/20) compared to medical students (mean score: 11.4/20) ($P = 0.000$, t-test). A linear regression analysis showed that knowledge increased by 0.83 units for each additional year of study for medical students and by 1.36 units for dental students.

Conclusions (mandatory): The results show significant differences in oral health knowledge and behaviour between medical and dental students, with oral health knowledge improving progressively over the years of study for both groups. This emphasises the importance of integrating oral health education more comprehensively into medical curricula and promoting interdisciplinary collaboration between medical and dental students to enhance overall patient care.

Acknowledgements (optional): Supported by the Slovenian Ministry of Science and Education (P3–0374).

EP27 | THE MOST IMPORTANT FACTORS INFLUENCING SELF-ESTEEM, CONFIDENCE AND EFFECTIVENESS IN ENDODONTIC TREATMENT AMONG DENTISTRY STUDENTS DURING FINAL YEARS OF THEIR EDUCATION.

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AIM: To evaluate the chances of improvement and maximize the effectiveness of endodontic treatment among undergraduate students.

Methodology: An online survey was conducted among 5th-year students who had performed endodontic treatment.

Results: The study included 56 students who were asked about the number of endodontic treatments they performed and the types of teeth treated. Respondents reported performing 224 primary and 15 secondary root canal treatment, with molars (89) and premolars (75) being the most common. In the subsequent part of the survey, respondents were asked about their subjective feelings regarding root canal treatment. Students identified the most challenging stages as canal filling (62.5%), canal preparation (51.8%), and cavity opening (48.2%). The most time-consuming aspect was obtaining a straight-line path for instrument insertion without excessive resistance (53.6%) as well as the correct location of the access point (37.5%). The main factor that increased students' confidence was teacher support (83.9%). A significant portion of the respondents (57.1%) indicated that working under magnification, preclinical training, and theoretical preparation, as well as positive cooperation with the patient (42.9%), contributed to building their confidence. The greatest sources of stress included limited visibility of the operative field (67.9%), lack of practical knowledge (62.5%), and difficulties in achieving proper access (46.4%). It is worth emphasizing that none of the respondents used a microscope during the treatment.

Conclusions (mandatory): Root canal treatment is one of the most stressful dental procedures for undergraduate students due to tooth anatomy complexity, limited operation area, and a multitude of activities, devices, and materials involved. Obtaining a straight-line path for instrument insertion and ensuring proper access were the most time-consuming aspects, highlighting the importance of mastering these steps to improve efficiency. While thorough training, including studying literature and practicing in preclinical settings, forms the foundation of effective endodontic education, the support of teachers remains the most crucial factor.

PARIS

CHALLENGES, OPPORTUNITIES AND NEW PERSPECTIVES IN ENDODONTOLOGY

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