DEVELOPMENT OF NEW MATERIALS FOR ROOT CANAL IRRIGATION IN ENDODONTICS: "ENDOGEL"

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Aim: the idea behind the study project comes from research carried out on materials in the aesthetic field for facial scrubbing, that penetrate the skin pores to eliminate impurities.
The goal is to create an irrigation root canal gel based on HA, SiO2 and biguanide agents, capable of drastically reducing the microbial load while simultaneously improving the performance of the mechanical reaming, in respect of the biological tissues and the organism.
Methods: significant differences among groups were assessed through two-way ANOVA by using GraphPad Prism 8.0, and the comparisons between the means were calculated by the student t-test. The data are expressed as means ± standard deviation (SD) of three independent experiments.
Results:
1. The Alamar Blue test shows that the gel is well tolerated by the cells, after 6 hours of application, the *vitro* cell viability is still 77%.
2. Bacterial growth is totally inhibited in liquid soil, in fact the addition of *E. faecalis* does not cause any increase in O.D. (which instead for *E. faecalis* alone are higher).
3. The plate activity shows a 1 cm halo of bacterial growth inhibition.
Conclusions: the gel has a thixotropic effect, chemical stability, cleaning and lubricating action, simplified penetration and biocompatibility. It can be used in combination with physiological solution, as an alternative to sodium hyplochlorite and EDTA.

A MECHANICAL COMPARISON OF TWO NICKEL-TITANIUM ENDODONTIC INSTRUMENTS

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Aim: the aim of this study was to explain the mechanical differences between Direct Gold (DG) and ProTaper Gold (PTG) determining the cyclic fatigue, torsional resistance and bending resistance.
Methods: 160 instruments were selected: 80 DG and 80 PTG (20 S1, 20 S2, 20 F1, 20 F2). Every type of instruments was submitted to each mechanical tests. The cyclic fatigue, torsional and bending tests were performed at a pre-set temperature of 25°C±1°C.
The cyclic fatigue test was performed in an artificial canal characterized by a curvature of 90°and 2-mm of radius of curvature. Time to fracture and the fragment length (FL) were recorded. During the static torsional performed by blocking the tip at 3 mm, Torque to Fracture (TtF) and FL were recorded. The fracture surface of 5 randomly selected fragments from each test was examined through a Scanning Electron Microscopy (SEM). 20 instruments for type were submitted to a bending test at 6 mm from the tip at 45° and the force generated (grams) to bend each was recorded. Recorded data of mechanical and metallurgical tests were statistically analyzed using a one-way analysis of variance (ANOVA) test with significance set to a 95% confidence level.
Results: all instruments of PTG systematics showed better results in terms of bending and cyclic fatigue resistance ($p < 0.05$), while in terms of torsional resistance DG systematics showed a higher torsional resistance than PTG systematics.
Conclusions: PTG systematics should be preferred in case of curved canals, whilst DG should be preferred in case of higher torsional load during instrumentation.

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PERICERVICAL DENTIN PRESERVATION: A MICRO-CT STUDY ON DIFFERENT ENDODONITC SYSTEMS

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Aim: the aim of the present work was to analyze the volume of the pericervical dentin after shaping using three different systems of mechanical instrumentation through the analysis of micro-computed tomography (µ-CT).

Methods: fifty mandibular molars were selected from a pool of teeth extracted for periodontal or orthodontic reasons and stored before and after preparation in a 0.5% w/w chloramine solution. Subsequently, samples were pre-treatment scanned using a pixel size of 9.5 µm, with angular steps of 0.4° on 180° of rotation of the sample, with an exposure time of 10s per projection, with a maximum time of 5h per scan. The 3D measurements were calculated based on a volumetric model of the root canal extending from the pulp chamber approximately 2 mm towards the apical region, for evaluation of the pericervical dentin region. Samples with similar volume value of the area of the region of interest (3.14x102 mm^3±0.5) were selected. The forty-five samples were selected and divided into three groups (n = 15) according to the shaping systems: Group I, Protaper Gold; Group II, Protaper Ultimate; Group III, BlueShaper. Then, the post-treatment scan was performed, using the same parameters used for the pre-treatment scans, and scans were compared to assess the remaining dentin thickness.

Results: all the systematics of the three groups were effective in shaping the specimens, with a similar amount of dentin volume removed and a low risk of errors in the used technique. Nonetheless, Group I showed a greater reduction in the thickness of the pericervical dentin than Groups II and III, which instead showed a minimal reduction, thus respecting the root anatomy.

Conclusions: despite the limitations of the study, the Protaper Ultimate and BlueShaper systematics would seem to be more conservative than that of the Protaper Gold.

EFFECTIVENESS OF CONTINUOUS CHELATION IRRIGATION PROTOCOL: A SCOPING REVIEW

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Aim: the current review aimed to answer the following research question: "Does continuous chelation irrigation protocol compared to sequential chelation, result in better smear layer and hard tissue debris removal, antimicrobial efficacy and dentine erosion during root canal treatment"?

Methods: this scoping review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Extension for Scoping Reviews. Literature search was conducted on PubMed and Scopus to identify all laboratory-based studies evaluating smear layer and hard tissue debris removal or, antimicrobial efficacy, or dentine erosion induced by continuous chelation compared to sequential chelation in extracted permanent teeth. Two independent reviewers performed the literature search, study selection, and data extraction. The irrigants used, outcomes reported, outcome measurement, and main findings were recorded using a standardized form.

Results: a total of 77 potentially relevant studies were identified. Finally, 23 *in vitro* studies met the eligibility criteria for qualitative synthesis. Seven studies focused on the smear layer/debris removal outcome, 10 on antimicrobial activity, and 10 on dentine erosion. In general, the continuous chelation protocol was equally or more effective in the cleanliness of root canals and antimicrobial activity compared with sequential. In addition, etidronate solutions seemed to be milder chelating agents compared to those with EDTA, thus resulting in reduced or no dentine erosion and roughness modification.
Yet, the methodological differences among the included studies limit the generalizability of the results.

Conclusions: the continuous chelation seems to be equally or more effective in smear layer/debris removal, antimicrobial activity and reducing dentine erosion when compared with the traditional sequential protocol. The laboratory studies cannot completely replicate the conditions of oral environment. Thus, when the outcome is appropriate, high-quality randomised clinical trials should be conducted to support the current findings.

REGENERATIVE ENDODONTIC PROCEDURES IN NECROTIC PERMANENT TEETH: CLINICAL STUDY

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Aim: necrotic permanent teeth with immature apex are traditionally treated with apexification, but this approach doesn't allow root maturation with an increased risk of root fracture over time. Regenerative endodontic procedures (REP) allow the regrowth of a vascularized tissue inside the canal with thickening of the dentin walls. This study aims to evaluate the clinical efficacy of REP.

Methods: a clinical observational study on 90 patients with necrotic permanent tooth with immature apex was performed following the REP clinical protocol published according to international guidelines. A follow-up was carried out to evaluate the prognosis at T1 (3 months), T2 (6 months), T3 (1 year) from the treatment. The clinical evaluations included: symptoms, periodontal probing, remission of the fistulous tract and a possible dyschromia of crown. The radiographic evaluations included: healing of periapical lesions, thickening of the root walls and lengthening of the root. The clinical results were collected in an anonymous database, which was analyzed with ANOVA test ($P < 0.05$).

Results: most patients who underwent REP showed the disappearance of symptoms and clinical signs of infection, with a high percentage of thickening of the root walls. The REP presented a good long-term prognosis with an increase in thickening of the root canal walls.

Conclusions: REP seem a valid alternative to apexification for the treatment of necrotic teeth with immature apex.

DIAGNOSIS, EVALUATION AND THERAPY OF ROOT RESORPTION: AN OBSERVATIONAL STUDY

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Aim: evaluation of root resorptions' characteristics through Cone Beam Computer Tomography (CBCT) at the diagnosis. The evaluated parameters were the most present type of resorption, the most involved teeth, the main risk factors, and the clinical and radiological characteristics of the defect.

Methods: the study proposed is a clinical observational study on 92 patients referred for the suspect of internal and external root resorption with CBCT. The radiographic analysis was carried out using two dedicated softwares Materialise Mimics 24.0 (Materialise NV, Leuvren) and Geomagic. The radiographic evaluation included the tooth involved, the type of resorption (internal, external or external cervical resorption), the location on the root, the maximum extension of the defect in in the three planes of space, the volume of the defect, the presence of osteosclerosis and the pulp involvement. The evaluation of patient data included age, gender, risk factors in accordance with the literature, clinical symptoms, signs of chronic apical periodontitisand the proposed clinical treatment.

Results: the most frequent resorption was the external and the most involved teeth were the upper incisors. In accordance with the literature, orthodontics and trauma were the most risk factors and most patients didn't present clinical symptoms despite a pulpal involvement.

Conclusions: the CBCT appeared fundamental for the correct diagnosis of the root resorptions and the careful evaluation of the risk factors appeared mandatory for the prevention of these pathologies that often lead to tooth extraction.

MECHANICAL PERFORMANCE OF 3 SINGLE-FILE RECIPROCATING INSTRUMENTS: A COMPARATIVE STUDY

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Aim: the aim of this study was to assess the mechanical properties of three different reciprocating instruments: Reciproc (VDW, Munich, Germany), Reciproc Blue (VDW, Munich, Germany) and Direct-R Gold (Direct Endodontics, Paris, France).
Methods: total of 60 nickel-titanium files from 3 different reciprocating systems were mechanical evaluated throughout cyclic fatigue, torsional and bending static tests. Mechanical performances of the selected file were examined by subjecting each specimen to Cyclic Fatigue test (90° 2 mm [seconds]) and Torsional test (3 mm from the tip [Ncm]) and Bending resistance tests (3 mm at 45°[g]). One-way analysis of variance and the post hoc Tukey test were performed with the significance level set to a 95% confidence level.
Results: direct-R Gold showed the best mechanical performances in terms of Cyclic Fatigue and Torsional Resistance ($P < .05$).
Direct-R Gold shows the same results as Reciproc Blue in terms of Flexibility ($P > .05$).
Reciproc has the worse Cyclic Fatigue performance ($P < .05$) and shows the same results as Reciproc Blue in term of Torsional Resistance ($P > .05$).
Conclusions: within the limitations of this study, Direct-R Gold file showed the best mechanical performances in terms of Cyclic Fatigue and Torsional Resistance; Reciproc file showed the worse mechanical performances in the three parameters.

ENDODONTICS' ROLE ON THE CHEMICAL, MECHANICAL, AND BONDING PROPERTIES OF RADICULAR DENTIN

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Aim: to assess the bond strength and the morphologic characteristics of the hybrid layer (HL) at the resin-dentin interface (R-Di) between root canal dentin and two resin cements in endodontically treated root canals and naturally aged re-treated teeth. The chemical and mechanical properties of the dentinal interface were also evaluated.
Methods: fiber posts were luted either with self-etch (SERc) (Universal Bond + DC Core Plus) or self-adhesive (SARc) (iCEM) in endodontically treated or re-treated teeth. Each radicular slice was submitted to push-out test. Each specimen was also tested with nanoindentation and raman spectroscopy to assess, respectively, the mechanical and chemical characteristics. RD-i morphology was evaluated through confocal laser scanning microscopy (CLSM).
Results: bond strength was jeopardized in RCR-T teeth, while the type of cement had no influence. HL thickness was also hindered in RCR-T teeth and SARc produced a thinner HL compared to SERc. The aged re-treated samples showed also increased micro-hardness, behaving as a more brittle material, increased mineral to collagen ratio and collagen cross-linking ratio.
Conclusions: as SARc showed similar bond strength values compared to SERc, it can be suggested that simplified single-step luting systems may be a reasonable option for the fiber post luting in RCT aged teeth with a heavily modified substrate.

SMEAR LAYER AND DEBRIS REMOVAL COMPARING TRADITIONAL SYRINGE IRRIGATION AND 3D CLEANING

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Aim: this study assesses the difference in smear layer removal using the 3D cleaning technique and traditional syringe needle irrigation.
The 3D cleaning technique includes the ultrasonic activation of intracanal-heated NaOCl.
Methods: our current study used single-rooted human mandibular premolar teeth to test the earlier-mentioned technique (n = 30). Initially, an endodontic access cavity was performed. Consequently, specimens were randomly distributed into three study groups according to irrigation protocol. The groups were Group 1, where the traditional syringe needle irrigation system was applied; Group 2, where the 3D cleaning technique was performed; and Group 3, in which teeth remained uncleaned as it was regarded as the control group.
Once the experiment was completed, the teeth were decoronated at the cementoenamel junction (CEJ) and examined using scanning electron microscopy (SEM). Debris and smear layers were viewed in 1000× magnification and scored.
Results: statistical analysis was performed with a standard statistical software package (SPSS, version 28.0; SPSS IBM, Armonk, NY, USA). Data were analyzed with a nonparametric analysis of variance (Kruskal–Wallis ANOVA) among the groups tested and among the thirds of the canals. The level of significance was set at $p < 0.05$. A statistically significant ($p < 0.05$) lower mean smear layer and debris score was observed in both study groups compared to the control group. Group 2 showed better results compared to Group 1.
Conclusions: the present study concluded that the 3D cleaning technique is an effective irrigation method for removing debris and smear layers. Future research, such as CLSM (Confocal Laser Scanning Microscopy) and Histological study, should be employed to confirm this study's conclusion.

SMEAR LAYER AND DEBRIS REMOVAL FROM POST SPACE COMPARING DIFFERENT IRRIGATION TECHNIQUES

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Aim: post space objectives include eliminating or decreasing smear layer and debris along the Root canal. This study evaluates the dissimilarity in smear layer and debris removal utilising the 3D cleaning procedure and traditional irrigating technique. Moreover, defining the 3D cleaning technique comprises the ultrasonic activation of EDTA solution heated directly inside the post-space preparation.
Methods: 30 lower premolars were used. Initially, an endodontic access cavity was performed. Then, specimens were randomly distributed into three study groups according to irrigation protocol. The groups were Group 1, where the 3D cleaning technique was performed; Group 2, where the traditional irrigation with EDTA was applied; and Group 3, where teeth remained uncleaned, using only saline as an irrigant. The latest group was considered the control group. After concluding the tests, the teeth underwent a decoronation at the CEJ level and were analysed via SEM. In detail, the magnification was used to evaluate and score the smear layer and debris.
Results: statistical analysis was completed using the classic statistical software pack. Then, data were interpreted with a non-parametric analysis of variance (Kruskal–Wallis ANOVA) among the groups experimented. The significance level was decided at $p < 0.05$.
Furthermore, a statistical significant ($p < 0.05$) lower mean smear layer and debris score was found in both examination groups compared to the control group. Group 1 demonstrated greater results compared to Group 2.
Conclusions: the current research concluded that the EDTA 3D cleaning technique is an effective irrigation technique for clearing debris and smear layers in the post space. Future research, such as push-out bond strength, should be used to verify this research's conclusions.

HUMAN MILK OLIGOSACCHARIDES (HMOS) IN ENDODONTICS: *IN-VITRO* STUDY ON *E. FAECALIS*

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Aim: endodontic root treatments aim at the resolution of the infectious process. Despite the best efforts in order to reduce the bacterial load in the endocanalar system, the complete sterilization of the root canals is not yet achievable. Pre-clinical and clinical studies evaluated various disinfection techniques such as laser and natural products. Human Milk Oligosaccharides (HMOs) are prebiotics found in breast milk with antibacterial properties against Gram+ bacteria, such as Streptococci. In this experiment we investigate the antimicrobial effect of two HMOs (2'-fucosyllactose and Lacto-N-neotetraose) on *Enterococcus faecalis.*

Methods: the coronal portion of the extracted teeth was removed and the roots were embedded in silicone.

The samples were sterilized using an autoclave. Glide path was created and a kfile 25 was inserted at working length. The infection of the canals was performed via an *E. faecalis* suspension, injected using a tubercolin syringe.

Canals were treated using sodium hypochlorite, EDTA and the X1, X2 and X3 instruments.

The case canals were rinsed with a solution of 2'-fucosyllactose and Lacto-N-neotetraose for 60 seconds. Harvesting consisted of sampling with sterile paper cones. Microbiological analysis was conducted.

Results: a significant reduction of *E. faecalis* was shown in the case group, suggesting the antimicrobial effects of the oligosaccharides.

Conclusions: the experiment suggested the efficacy of these two HMOs on *E. faecalis*. Given the wide range of compounds that are part of HMOs, further studies with different compounds and different bacterial biofilms are required.

ENDODONTIC MICROSURGERY'S UNDERGRADUATE TRAINING WITH VIRTUAL REALITY SIMULATION

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Aim: the latest progress in virtual reality and haptic technology are transforming the world of dental education. Pre-clinical dental training is important to gain familiarity with difficult surgical techniques, to implement personal skills and to acquire knowledge of the oral anatomy. This study aims to evaluate skill acquisition in endodontic microsurgery through haptic VR training for undergraduate students.

Methods: an exercise that focused on the essential feature of endodontic microsurgical preparation was conceptualized and developed. Ten undergraduate students were selected to perform the exercises both on virtual typodont and virtual patient. Each exercise has been performed 4 times during a 4 week program.

At the end of the 4 week each student had to perform the exercise without the target suggestion from the simulator. Feedbacks from the simulator were recorded for each attempt and the performance were compared.

Results: a t test was performed which showed a significant difference ($p < 0.05$) between the first and the last simulation both in accuracy and target progress for the osteotomy exercise while there was no difference in the apicoectomy exercise, although a better trend is evidenced.

Conclusions: this study gives a proof that it is possible to provide reliable and clinically relevant qualitative feedback with VR simulator. This illustrates the importance of implementing digital teaching in the dental curriculum.

TWO-YEAR HEALING SUCCESS RATES AFTER 3D CLEANING TECHNIQUE: A MULTICENTER CLINICAL STUDY

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Aim: this prospective multicenter clinical study aims to evaluate healing rates for teeth after root canal treatment utilizing the 3D cleaning technique and to report predictive values for success.
Methods: ninety patients were included. All patients were treated with the 3D cleaning protocol. Four endodontists performed the clinical procedures and follow-up evaluations. Each patient was assessed for any clinical signs or symptoms. Afterwards, two trained, blinded, and independent evaluators scored the subject's periapical radiographs. This score was made by checking for the presence or absence of apical periodontitis using the periapical index (PAI). Then, the teeth were classified as healing or healed and were considered a success based on a cumulative success rate of healing.
Results: 90 patients were evaluated at two years with a follow-up rate of 97.7%. The cumulative success rate of healing was 95.4%. Eight predicting aspects were identified by employing bivariate analyses. Then, using logistic analyses, the two prognostic significant variables directly correlated to healing were the preoperative presence of periapical index.
Conclusions: in this two-year clinical study, the cumulative success rate of healing was 95.4% when patients were treated with the 3D cleaning protocol.

IN VITRO EVALUATION OF THE EFFECT OF DIFFERENT KINEMATICS ON APICAL DEBRIS EXTRUSION

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Aim: to compare the amount of extruded debris associated with different motions using a single file system.
Methods: Fifty mandibular first molar teeth with moderate to severe curvature in the mesial root were randomly divided into 5 groups (n = 10) according to the motion tested: Optimize Torque Reverse (OTR), TF Adaptive Motion (TFA), continuous rotation (CR), reciprocation motion (+150°, -30°) (REC), Jeni motion (Jeni). One Curve single file 25/06 (Micro-Mega, Besançon, France) was used in all experimental groups. The root canals were irrigated with 2.5% NaOCl, and the extruded debris were collected at pre-weighted glass vials. The glass vials were kept inside an incubator for one week at 70°C to dry out the irrigating solution. The extruded debris was quantified by subtracting the pre-instrumentation from the post-instrumentation weight of the glass vials. The time required for each instrumentation procedure was digitally recorded. All data were analyzed statistically with one way ANOVA and post-hoc Tukey test ($P < 0.05$)
Results: a motions extruded apically debris with Jeni mode caused significantly less debris extrusion than TFA, REC and CR ($P < 0.05$) while no significant difference emerged compared with OTR. No significant difference was detected between TFA, REC and CR. Preparation time was not significantly different among the tested kinematics.
Conclusions: within the limits of the present study, all the kinematics produced apically debris extrusion, with Jeni reporting a similar amount of debris compared with OTR and significantly less than TFA, REC and CR. Preparation time was similar for the all the tested kinematics.

EFFECTS OF BRUSHING MOTION ON THE CUTTING EFFICIENCY OF TWO NITI FILES: A MICRO-CT STUDY

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Aim: to assess the cutting efficiency of two heat-treated endodontic files with a brushing motion in oval-shaped canals.
Methods: ten intact lower molars with a single oval distal canal were selected and randomly divided into two groups according to the system used for shaping: 2Shape (Micro Mega, Besançon, France) and Hyflex CM (Coltene, Cuyahoga Falls, OH, USA). The shaping procedure was performed in two parts: a first shaping according to the manufacturer's instructions and final shaping using 5 brushing motions on the distal, lingual, and buccal walls, avoiding the danger zones. Micro computed tomography (micro-CT) scans before and after the brushing motion were superimposed at all three levels: coronal, middle, and apical.
Canal changes in buccolingual (ΔBL) and mesiodistal (ΔMD) dimensions were measured. Data were statistically analyzed by repeated-measures analyses of variance and the student t-test with $P < 0.05$.
Results: as concerns for ΔMD, there was no significant difference between the 2Shape and Hyflex CM in the apical and coronal thirds. However, the cutting efficiency was significantly greater with the 2Shape in the middle third ($P < 0.05$). As for ΔBL, no statistically significant difference emerged between 2Shape and Hyflex CM comparing the anatomical thirds, while 2Shape had a significant higher cutting efficiency considering the total BL diameter ($P < 0.05$).
Conclusions: under the limits of this study, the shaping procedure with 2Shape and brushing motion resulted more efficient than the Hyflex CM in the midroot levels in terms of ΔMD, and in total canal space for ΔBL. Both files ensured an effective mechanical preparation.

CYCLIC FATIGUE RESISTANCE OF NITI INSTRUMENTS IN DIFFERENT CURVATURES AND TEMPERATURES

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Aim: to compare cyclic fatigue resistance of different nickel-titanium instruments inside single and double-curved canals at different temperatures in a dynamic model.
Methods: a total of 160 HyFlex EDM #20.05 (HEDM, Coltene/Whaledent, Altstätten, Switzerland), VDW.ROTATE #20.05 and #25.06 (VDW, Munich, Germany), Mtwo 25.06 (VDW) were divided in 4 groups ($n = 10$) for the dynamic cyclic fatigue resistance tests according to curvature (single and double) at room (20°±1°C) and body temperature (35°±1°C). Single curved canal with 60° of angle of curvature and 5 mm of radius was used. The coronal curve of the double curved canal had 60° of angle of curvature with 5 mm of radius, the apical curve 70° with 2 mm radius. A continuous back and forth axial oscillation motion was performed with an amplitude of 3 mm/s for the dynamic test. The number of cycles to fracture (NCF) was calculated and the length the fragments was measured. The surfaces of the broken files were observed under a scanning electron microscopy (SEM). Data were analyzed statistically using two-way analysis of variance and the Bonferroni multiple comparison post hoc test with the significance level at 0.05.
Results: fatigue resistance of all instruments decreased at body temperature in single and double curvatures ($P < 0.05$). HEDM showed higher resistance compared with other files in all testing conditions ($P < 0.05$), while no differences emerged between Mtwo and VDW.ROTATE #25.06.
Conclusions: with the limitations of a *vitro* study, temperature impaired cyclic fatigue resistance of all NiTi files except for HEDM for which no difference emerged between room and body temperature in double curvature. Double curvature negatively affected cyclic fatigue resistance of all files except for VDW.ROTATE #20.05 at body temperature for which no significant difference emerged between the two tested curvatures. HEDM instruments exhibited the highest cyclic fatigue resistance in all testing conditions.

MICRO-CT STUDY ON SHAPING ABILITY AND ACCUMULATED DEBRIS BY DIFFERENT KINEMATICS

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Aim: the aim of this study was to determine through micro-CT the shaping ability and accumulated hard tissue debris generated by different kinematics.

Methods: thirty mesial roots of mandibular molars were pre-scanned through micro-CT evaluation and randomized to one of the five experimental groups (n = 12), according to the kinematics used for canal preparation: Continuous Rotation (CR), Reciprocation (REC), Optimum Torque Reverse (OTR) motion, Jeni and Jeni with no pecking. After root canal preparation with HyFlex EDM (Coltene/Whaledent, Allstätten, Switzerland) up to ISO size 25 and .08 taper achieved, the samples were then scanned and the matched images of the mesial canals, before and after preparation, were examined to determine the untouched surface canal areas, the amount of hard accumulated debris and to assess the canal transportation and the centering ability. Data were analysed by using Kruskal-Wallis test and Dunn post hoc test for multiple comparisons with a significance level set at 5%.

Results: no significant differences emerged between the tested kinematics regarding the untouched canal surface areas, hard-tissue debris accumulation, canal transportation and centering ability. Jeni with pecking resulted in significantly less centered root canal preparation than Jeni without ($p < 0.05$).

Conclusions: wroot canals prepared were found to present similar untouched canal surface areas, hard-tissue debris accumulation and shaping ability independently from kinematics. All motions generated an acceptable mechanical preparation of the mesial canals of mandibular molars and none of them was able to keep the root canals completely free from packed hard tissue debris.

EVALUATION OF APICALLY EXTRUDED IRRIGANT WITH TWO SONIC ACTIVATION SYSTEMS: *IN VITRO* STUDY

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Aim: literature has demonstrated in detail how much activation procedures, which take place inside endodontic spaces, can increase irrigants efficacy. Furthermore, the issue linked with apical extrusion of sodium hypochlorite during endodontic procedures is equally well documented. Despite this, the safety of sonic activation systems during irrigation in apexes with different dimensions has never been analyzed. The aim of this study is to evaluate the quantity of irrigant extrusion during sonic activation, compared with conventional irrigation methods.

Methods: a model has been created in order to analyze the quantity of irrigant extruded from apexes with dimensions ranging in between 30 and 130 hundredths of millimeter. Two different sonic activation systems (EDDY® and EndoActivator®) have been investigated. Positive pressure irrigation and passive irrigation with EndoVac® have been used as a control.

Results: in all diameters EDDY® and EndoActivator® have caused less sodium hypochlorite extrusion, if compared with traditional positive pression irrigation. However, the aforementioned sonic irrigation systems, had more extrusion than passive irrigation.

Conclusions: this study reveals that, even in apexes with large diameters, sonic activation systems have less risk of causing sodium hypochlorite accidents if compared with positive pressure irrigation.

ACCESS CAVITY TRAINING USING IN-HOUSE 3D PRINTED TEETH AND DIGITAL SCANNING

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Aim: student learning during pre-clinical training is a critical component of dental education. New technologies, such as 3D printers, intraoral scanners and mesh processing software, can be used to implement endodontic training in a simple and economical way. The aim of the study was to investigate students' satisfaction with a new learning method adopted in access cavity exercises based on 3D technologies.

Methods: replicas of teeth 11 and 36 were printed with 3D printer FORM2 (Formlabs), using Model V2 resin, from .stl files found on the web. The artificial teeth were used for access cavity exercises by students attending 2022-2023 Endodontic course at Parma University. The prepared teeth were scanned with Omnicam (Dentsply Sirona) and visualized in Meshlab software to align the student's and the teacher's prepared tooth for self-assessment purposes. Students were asked to answer an anonymous questionnaire about their experience with this new teaching method.

Results: student feedback was positive: 73% found access cavity assessment by scanning more useful compared to traditional visual inspection and 57% reported that they had better understanding of errors and mishaps. Most of the students (84%) found that the 3D printed teeth had a pulp morphology easy to understand and only 3 students (16%) found difficult to locate anatomical references for a correct access cavity opening. Students also stated that the 3D printed teeth were too soft and did not provide a realistic tactile sensation.

Conclusions: in-house 3D printed teeth in pre-clinical training can help to overcome some of the drawbacks associated with extracted teeth, such as limited availability and cross-infection. However, the material used in the printing process needs to be improved to ensure a better tactile sensation and a better understanding of the endodontic morphology. The use of intraoral scanners and mesh processing software could improve student self-assessment.

INTENTIONAL REPLANTATION: SURVIVAL OF SINGLE-ROOTED *VS* MULTI-ROOTED TEETH

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Aim: the technique of intentional replantation can provide a second chance to save teeth that would be destined for extraction. Therefore, the present systematic review aimed primarily to estimate tooth survival after intentional replantation and secondarily to compare treatment outcomes in single-rooted and multi-rooted teeth.

Methods: the study protocol was developed before the analysis according to the Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines. Articles were electronically searched in PubMed/MEDLINE, the COCHRANE library and Google Scholar by two independent reviewers, and those that met the eligibility criteria were included. A statistical analysis using the chi-square test with a p-value of <0.05 was performed on the reported outcomes of intentional replantation.

Results: a total of 44 single-rooted replanted teeth with five failures (11.36%) and 42 multi-rooted replanted teeth with six failures (14.28%) were reported in the literature, corresponding to a survival rate of 88.64% and 85.57%, respectively. The overall survival rate for the replantation procedure was 86.7%.

Conclusions: intentional replantation can be considered a safe therapeutic choice for both single-rooted and multi-rooted teeth, with a high survival rate and predictability, provided it is performed correctly and in accordance with basic biological principles, especially with regard to extra-oral environmental time.

ODONTOGENIC-RELATED GENE EXPRESSION: A STEP FORWARD TO DENTIN-PULP COMPLEX REPAIR

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Aim: human stem cells within dental pulp might be a potential source of odontoblasts in response to injury and might be applied in the repair of dental structures. The aim of the present study was to assess the expression of odontogenic-related genes and differentiation markers of human Dental Pulp Stem Cells (hDPSCs) cultured in presence or not of calcium-based materials.

Methods: hDPSCs obtained from a third molar of a young patient were cultured to evaluate their differentiations toward odontoblastic pattern. Odontogenic-related gene expression [i.e. OCN, MEPE, DSPP, DMP-1, GAPDH] and alkaline phosphatase activity (ALP) were evaluated in presence of growth medium (GM), odontoblastic-induction medium (OIM), and different concentrations (1 or 10µg/ml) of calcium carbonate (CaCO3), calcium hydroxide ($Ca(OH)_2$), and mineral trioxide aggregate (MTA). In addition, Alizarin red assay was performed to evaluate the ability to form mineralized matrix.

Results: hDPSCs expressed during their differentiation an upregulation of odontoblastic cell-related genes and an enhancement of ALP activity as well as presence of calcium deposits. This trend was greater in presence of calcium-based materials, mainly with MTA, supporting the hypothesis that these materials are effective for dentinogenesis.

Conclusions: odontoblast-like cells were able to preserve most of the physiological, biochemical, and genetic features of odontoblasts, representing a potential source for dentin-pulp complex repair.

APPLICATION OF A 3D NAVIGATION SYSTEM IN MICROSURGICAL ENDODONTICS: CASE REPORT

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Aim: the objective of this case report is to validate the application of dynamic navigation systems in microsurgical endodontics.

Methods: after previous renewal of the existing restoration and non-surgical retreatment, microsurgery was carried out using the Navident system. CBCT dicom data and stl files obtained from intraoral scans were uploaded into the software. The digital planning defined the direction and depth of the ostectomy with 5.2 mm cilindrical bone mill drill. On the day of surgery an optic support was placed adhesively at the mandibular level, detected by the Navident camera.

The handpiece was calibrated through 6 landmarks indicated on the screen. Subsequently, the core drill was also calibrated. A mucoperiosteal flap was made from the element 3.7 to element 3.4 with medial release incision. The 5.2 bone mill drill used with dedicated surgical motor Kavo conducted an osteotomy which allowed a selective access to the mesial root. The root end was resected around the broken instrument and removed with low power ultrasonic tip. The retrocavity was prepared and filled with BC RRM fast set putty. A collagen sponge was placed into the cavity to support the cortical block. The flap was repositioned and sutured with 6.0 PTFE suture.

Results: the 1 year follow up images demonstrate the occurred healing process.

Conclusions: 3D navigation allowed to create a precise and targeted osteotomy. Correctly sized bone and optimal repositioning of the cortical block allowed to enhance the repair process. The use of 3D navigation seems to be a valuable aid in complex cases.

CLINICAL MANAGEMENT WITH DIFFERENT STRATEGIES OF TWO ROOT RESORPTIONS ON ADJACENT TEETH

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Aim: this case report illustrates the clinical management of multiple invasive cervical and root resorptions. Root resorptions represent an insidious clinical status, and the clinician should plan a therapeutic process constantly accompanied by periodic follow-ups.

Methods: the case refers to a young healthy patient diagnosed with an external invasive cervical resorption of tooth 2.2 and multiple root resorptions, both at the middle and apical third, referred to 2.1. The history revealed that the 2.1 had been treated two years earlier elsewhere for a previous EICR with a composite resin restoration and a removable orthodontic treatment to correct the inclination of the tooth. The complexity of the issue and the proximity between the involved elements required a deferred treatment approach between the two elements. 2.1 was treated with intentional reimplantation. In a later stage, 2.2 was treated by a surgical approach and the restoration of the defect with a Silicate Root Repair Material.

Results: the two-year follow-up shows good stability of soft and hard tissues, as well as the absence of symptoms on both teeth. The RRM appears radiographically well-integrated. The resolution of the case with a conservative approach made it possible to procrastinate the more invasive implant-prosthetic therapies on a young patient preserving the periodontal tissues.

Conclusions: thanks to the new biomaterials, it is possible to manage cases of advanced resorptions. Due to the complexity of the pathology, these cases need to be followed by periodic clinical and radiographic follow-ups.

THE CHALLENGE OF ENDO-PERIO LESIONS: A CASE REPORT

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Aim: it might be difficult to distinguish between periodontal and endodontic issues, so treating endo-perio lesions is a very tough assignment for dentists.

In this study, we analyze the case report of a patient for which endodontic treatment was scheduled before periodontal therapy.

Methods: a 40-year-old male patient, who is a current smoker and who complained of discomfort and pus discharge from the third quadrant is the subject of this case report.

He has M1 mobility, purulent exudate, and spontaneous gingival bleeding on the 3.7 tooth; he has positive familiar anamnesis for periodontal disease. On the distal root, a deep periodontal pocket measuring 10 mm was found, and the furcation was also involved.

An endo-perio lesion may be seen on the radiograph, with an enlarging periodontal pocket and a significant amount of radiolucency in the periapical region of the distal root that extends to the furcation.

The damaged element's pulpal necrosis was verified by the cavitary and cold tests. It was immediately treated with NiTi rotary instruments and warm vertically compacted gutta-percha obturation technique.

Afterward, two sessions of scaling and root planing are completed, followed by the topical application of antibiotics to the periodontal pocket.

Results: a periapical radiograph, taken after a year, reveals that the lesion has healed, the bone defect has mineralized, the periodontal probing depth has improved, and the furcation is no longer involved.

Conclusions: the correct diagnosis and therapy of the endo-perio lesion led to the successful resolution of a complex dental problem.

ENDODONTIC THERAPY *VS* SURGICAL THERAPY IN THE TREATMENT OF LARGE MAXILLARY CYSTS

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Aim: inflammatory periradicular cysts origin from Malassez's residual cells developing under the influence of periapical inflammation. These cysts are most frequently found in anterior maxillary region and they can be distinguished in true cysts (entirely coated by epithelial tissue) and Pocket Cysts (coated by epithelial tissue in continuous with the roots). In the last case the lesion could heal after an endodontic treatment.
Methods: 67-year old woman without any symptoms but with a vestibular fistula in the 23/24 region. From the orthopantomography it is possible to deduct a bone rarefaction apical to the aforementioned elements and not underlined in the report. The CBCT exam shows an erosion of both the entire palatal wall and the nasal one. The proposed treatment (before a prospective surgical treatment) consists of an endodontic treatment of elements 23 and 24.
Results: after the endodontic treatment, healing of the fistula and normalization of the palatal mucosa have occurred. Another CBCT after 1 year from the treatment illustrates a complete healing of the palatal and nasal walls.
Conclusions: some periapical lesions, in particular Pocket Cysts, can respond positively to endodontic treatment. This therapy is particularly effective on patients with demanding surgery approaches. However, due to the fact that no histopathological exam is available, the patient should be followed up constantly.

MANAGEMENT OF SEVERE CURVATURES WITH THE HYBRID CRYSTALLOGRAPHIC PHASES APPROACH

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Aim: to discuss the clinical shaping approach for root canal treatment (RCT) of teeth with severe curvatures using the hybrid crystallographic phases approach.
Methods: 6 teeth with severe curvatures requiring RCT were selected and treated by adopting an innovative instrumentation technique based on the alternating use of austenitic and martensitic instruments. Three different instruments have been selected, increasing their amount of martensite contemporaneously with the increase of their metal mass: Mtwo 10.04 (conventional NiTi), X1 17.04 (slightly martensitic) and EOF Primary (martensitic).
Results: the presented clinical approach highlights the advantages of metallurgical and mechanical properties of NiTi alloy, both for martensitic and austenitic phases, adapting the heat treatments to the clinical case. Increasing the diameter and taper, the instruments are more susceptible to flexural stress, while the smallest ones have a lower torsional resistance. For this reason, it is reasonable to exploit the stiffness of austenite in the first phases of RCT when smaller instruments are used, to prevent torsional failure. Progressively increasing the instruments' size, the increased quantity of martensite ensures higher cyclic fatigue resistance and flexibility, despite the increased mass.
Conclusions: the proposed protocol seems to enhance the properties of the NiTi alloy, overcoming the main limitation of endodontic instruments in the management of severe curvatures.

RADIOLUCENT AREAS MIMICKING ENDODONTIC LESIONS: A CASE OF SECONDARY HYPERPARATHYROIDISM

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Aim: to report mandibular radiolucent areas mimicking endodontic lesions in a patient affected by secondary hyperparathyroidism.

Methods and results: a 36-year-old Asian woman was referred to Clinica Odontoiatrica of Brescia for a dental visit because of a kidney transplant. The patient's medical history included chronic renal failure, hypocalcemia and secondary hyperparathyroidism. Panoramic and periapical radiograph showed periapical radiolucencies associated with mandibular teeth 36, 45 and 46. Elements 45 and 46 were affected from deep carious lesions but both were vital and normal responders to electrical test. Medical history and clinical/radiological examination leaded to suppose secondary hyperparathyroidism was the aetiology of periapical radiolucencies mimicking endodontic lesions. During carious tissue removal, pulp horn of 46 was exposed; root canal treatment for tooth 46 and direct restoration for tooth 45 were performed.

After 18 months, teeth 36, 45 and 46 were asymptomatic; a periapical radiograph showed periapical lucencies of 45 and 46 teeth were diminished.

No change in the status of the patient's systemic disease was assessed.

Conclusions: secondary hyperparathyroidism can present with periapical radiolucencies mimicking endodontic lesions. Medical history and clinical examination are decisive to establish a correct diagnosis and a conservative treatment plan.

RETRIEVABILITY OF TWO BIOCERAMIC SEALERS: AN *IN VITRO* STUDY

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Aim: to evaluate the retrievability of two different bioceramic sealer with and with not solution.

Methods: a total of 40 teeth with straight canal were decoronated to a standardized root length. Canals were instrumented to 50.06 and randomly divided into two experimental groups (BC: EndoSequence BC Sealer; NEO: NeoSEALERFlo). The apical 3 mm was obtured only by sealer. After storage for 2 weeks at 37°C and 100% humidity, the teeth were retreated using a rotary instrument (Hyflex Remover, Coltene, CH) in association with or without NaCl, to evaluate the best approach. Time to reach WL and Patency was measured with a chronometer (s). Data were analyzed using Kruskal-Wallis' and Mann-Whitney's tests.

Results: success rates for apical patency in BC and NEO were 100%. Removal time of bc sealers was better with no solution ($p = 0.009$). Time to reach WL was longer for BC Group (180.5±248.6 s) than NEO Group (61.2±25.1 s).

Discussion: the difficulty during non-surgical endodontic retreatment is to restablish the patency and to reach the WL. In this study, apical patency was obtained in all the samples and removal of bioceramic sealer was well performed, especially if no solution was used.

According to literature, bioceramic sealers are difficult to retreat. In the light of our results, it is not excluded that bioceramic sealer could have different setting time and physical properties when used *ex vivo*.

Conclusions: Hyflex remover is efficient in retreat BC and NEO sealers. Their retreatment is more effective when no solution is used.

INFLUENCE OF THERMOMECHANICAL COMPACTION ON THE MARGINAL ADAPTATION OF 4 HYDRAULIC SEALERS

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Aim: to evaluate the behavior of four different endodontic sealers using a single-cone technique or through thermomechanical compaction, by evaluating the marginal gap existing between the obturation materials and the dentinal walls.

Methods: a total of 104 single-rooted, straight canal teeth were selected and divided into four groups according to the selected endodontic sealer ((AH) Plus Bioceramic Sealer (AHP), EndoSequence BC Sealer HiFlow (ES), C-Root SP (CR), and GuttaFlow Bioseal (GF)). Each tooth was decoronated and instrumented with the HyFlex EDM/CM systematics up to 30.04. After irrigation procedures, the teeth of each group were divided into two subgroups and obturated according to the two above-mentioned obturation techniques. After the required sealer setting time, each tooth was sectioned in three parts at 3, 6, and 9 mm from the apex, and each section was observed with a scanning electron microscope. The marginal gap of each sample was measured using G* Power Software v 3.1, and the statistical analysis was performed using the Kruskal-Wallis test, followed by a post hoc Dunn's test.

Results: there were not any statistically significant differences in terms of the marginal gap between the two different obturation techniques for each sealer, except for the middle third of root canals, where a statistically significant difference was found for AHP, ES, and GF sealers.

Conclusions: the thermomechanical compaction of hydraulic sealers and gutta-percha guarantees better sealing than the single-cone technique when the root canal shape is not rounded.

ANALYSIS OF GAPS AFTER APICOECTOMY IN SINGLE POINT AND BIOCERAMIC SEALER TREATED TEETH

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Aim: to evaluate in an *ex vivo* study by scanning electron microscopy (SEM) the presence of gaps between the obturation materials and the dentinal walls on the cutting surface after apicoectomy.

Methods: twenty human mono-rooted teeth were instrumented (Rotate, VDW) and filled with gutta-percha single cone technique (SCT) using and a bioceramic sealer (BCS) (AH Plus, Dentsply Sirona). Teeth were divided into two experimental groups (n = 10): G1- root end cutting surface uncoated; G2- root end cutting surface coated with the same bioceramic material. Samples were wet stored at 37°C. After 12 hours apicectomy was performed 3 mm from the apex with a high-speed bur under cooling water and the roots were processed to the SEM observation. Samples were mounted on aluminum stub coated with double-side carbon tape and analyzed with a Scanning Electron Microscope (FEI Quanta 250) in low vacuum conditions (130 Pa) using secondary electrons and an acceleration voltage of 30 kV, at a working distance of 10 mm.

Results: a low mean percentage of micro-gaps was found in G1, but there was no statistical difference in comparison with G2. Voids were localized between the sealer and the dentin walls. The contour of gutta-percha cone was unaltered.

Conclusions: in case of gaps, BCS used to cover the cutting surface could be used to fill them.

A NEW CLEANING PROTOCOL IN ENDODONTIC SURGERY: AN *EX VIVO* STUDY

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Aim: to enhance cleaning during retro-preparation in endodontic microsurgery.
Methods: fourty mandibular premolars were instrumented, filled with a single cone technique, then retro-preparation was performed and assigned to experiment A. In group A1, after retro-preparation, the retro cavity was cleansed with 2 ml of sterile saline via a 30-gauge endodontic needle. In group A2, the retro cavity was cleaned with 2 ml of sterile saline using a 30-gauge endodontic needle after the retro preparation. Subsequently, in group A2, 17% EDTA gel and 5.25% gel was introduced into the cavity and then activated ultrasonically. After the irrigation protocols, the specimens were decalcified for histological evaluation.
Results: in the experiment, the amount of hard tissue debris was significantly greater in group A1 compared to group A2 ($P < 0.05$).
Conclusions: the samples in group A2 where the new protocol was performed, showed statistically significant results.

TORSIONAL EVALUATION ON DIFFERENT BENDING CONDITIONS OF TWO NI-TI ROTARY GLIDE PATH

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Aim: comparing the torsional resistance of two different glide path files, the Mtwo (10.04) and the Hyflex EDM Glide Path files (10.05), under different bending conditions.
Methods: thirty Mtwo 10.04 files and thirty Hyflex EDM glide path files 10.05 were used in the present study (N = 60) and divided into 3 test groups of 10 files. A customized device made of a mobile structure with a connection that holds the handpiece, and the artificial canal was used for the experiment to make the measurements repeatable. These canals were created with a 90° curvature, a 60° curvature, and lastly a straight canal. Each instrument was rotated at 300 rpm with a maximum torque value of 5.5 Ncm with the apical 3 mm firmly secured in a vise. The torque to fracture and the time to fracture were recorded by the software integrated in the handpiece and evaluated through statistical analysis.
Results: statistical analysis did not find significant differences in the values of torque to fracture (TIF) between these 3 groups.
Conclusions: the results of the present study should be explained by the flexural rigidity, for Hyflex EDM Glide Path 10.05 is influenced by the combination of rectangular cross-sectional shape and CM Wire and S Shaped cross-sectional design and Austenitic NiTi for the Mtwo 10.04. These combinations of characteristics could justify the results of the present study, the absence of difference between an austenitic and a martensitic file on the torsional resistance under different bending conditions.

ASSESSMENT OF ROOT CANAL DISINFECTION WITH A NOVEL AUTOMATED DEVICE: A PRECLINICAL STUDY

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Aim: the cleanliness of the root canal is a key factor for the success of the endodontic treatment. Therefore, the aim of this study was to evaluate the cleanliness and disinfection potential using a novel automated device compared to standard irrigation techniques.

Methods: twenty-one extracted single-rooted teeth were shaped to a 30 size and 0.6 taper. Then, teeth were randomly allocated into three groups: group I, Manual irrigation (MI); group II, Automated irrigation (AI); group III, Passive ultrasonic irrigation (PUI).

The specimens were examined under scanning electron microscopy (SEM) and separate evaluations were undertaken to assess debris and smear layer.

Results: the study results showed a significant difference ($p < 0.05$) in the scores among the groups and at various assessed levels (apical, middle, coronal). The recorded debris scores were higher at apical levels which were around 3.48±0.36, 2.64±0.32, and 1.22±0.24 in MI, AI, and PUI groups, respectively. The recorded smear scores were also higher at the apical level, specifically 3.02±0.25, 2.70±0.21, 1.15±0.19 for each group respectively. There wasn't a significant difference ($p = 0.15$) in the scores among the various levels within PUI group.

Conclusions: within the limitation of the present study, it could be concluded that PUI activation has shown to be more effective than MI and AI, although the latter has proven to be better than MI.

THE VAPOR LOCK EFFECT ON ENDODONTIC DISINFECTION: AN *IN VITRO* STUDY

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Aim: the physicochemical phenomenon of apical vapor lock can affect endodontic space disinfection efficacy preventing to the irrigant solutions reach the working length. This *in vitro* study is aimed at evaluating the formation and the extention of vapor lock during routine procedures of endodontic therapy.

Methods: 8 single-rooted teeth, extracted for periodontal reasons, were decrowned at 17 mm from the anatomical apex and placed in a closed system which allowed to confirm apical patency and to prevent irrigants extrusion. After cleaning and shaping procedures, a contrast medium mixed with 5% sodium hypochlorite was delivered 1 mm from the working length by using a 30 G needle. The statistical, quantitative and quality analysis were subsequently, for each canalar third, performed on the basis of data obtained by 3D scans.

Results: in the apical third of the samples was detected a total of 17 bubbles (mean 2.125 and SD 0.99 values). The cross-comparison relating to the canalar volume occupied by the vapor lock in the apical third (84.084%) showed a significant (P-value 0.0001) difference with the coronal third (7.773%) and a highly (P-value <0.0001) difference with the middle third (3.768%).

Conclusions: the obtained data, referred to the use of NaOCl delivered inside the canal by passive irrigation with manual devices, confirmed the presence of bubbles located especially in the apical area linked to the vapor look phenomenon. Could be interesting to test different solutions and activation techniques in order to avoid vapor lock or effectively remove the air bubbles.

SHOULD THE PRE-ENDO PROXIMAL WALL RECONSTRUCTION BE REPLACED AFTER ENDODONTIC PROCEDURES?

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Aim: this laboratory study aims to evaluate if irrigating protocols during endodontic treatment can influence the retention of pre-endo resin composite reconstructions.

Methods: human molars were embedded in acrylic resin and the deep dentin surfaces exposed. Adhesive procedures were performed at the periphery to simulate proximal pre-endo reconstructions with a universal adhesive (iBond universal, Kulzer) and composite (Venus Pearl, Kulzer). The specimens were randomly assigned to one of the following irrigating protocols (n = 20): C: No treatment; SH: 5.25% sodium hypochlorite for 10 min + final water rinse; CHX: The same as SH + final 2% chlorhexidine rinse for 2 min; EDTA: The same as SH + final EDTA rinse for 2 min. The shear bond strength test (SBS) was performed after 24 h or 10.000 thermocycles (TC; 5-55 °C, 30s dwell time). Data were statistically analyzed ($p < 0.05$).

Results: the irrigating solution, ageing and their interactions statistically influenced the results ($p < 0.001$). At baseline, EDTA recorded the highest SBS values, with no differences between CTRL, SH and CHX ($p < 0.05$). TC statistically decreased the bonding values in all groups and no differences were observed irrespective of the irrigating protocol ($p > 0.05$).

Conclusions: the irrigating solutions did not influence the bonding performances of resin composite restorations. Clinically, this would translate in the possibility to maintain the pre-endo proximal wall for the final coronal restoration. However, further studies are warranted.

3D EVALUATION OF THE ROOT APEX OF PERMANENT MAXILLARY PREMOLARS: A MULTICENTRIC STUDY

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Aim: modern endodontics has advanced radically in the recent years, and recently, it has been focused on the concept of mini-invasive treatments. This study aimed to evaluate the sections of the root apices at 1 mm from the radiographic apex using a high-resolution CBCT.

Methods: the current study was performed in three different dental centers. One hundred maxillary permanent premolars (50 first and 50 s premolars) were analyzed using measurement software of the CBCT radiographic pictures. The mesio-distal (M-D) and bucco-palatal (B-P) sections were measured at 1 mm from the radiographic apex of each root. The section of 0.3 mm or less, 1 mm from the anatomical apex of the upper premolars, was decided as the limit value. All values were statistically analyzed.

Results: the mean value in the 304 sections analyzed was 1.03 (±0.37). Only 19 sections (6.3%) had measurements less than or equal to 0.3 mm. All these 19 sections were from first premolars ($p = 0.002$).

Conclusions: based on the data obtained, the authors recommend performing conservative shaping when endodontically treating first maxillary premolars, especially when a pre-operative CBCT to evaluate the actual apical dimensions cannot be acquired.

VITAL PULP THERAPY ON PERMANENT MATURE TEETH: A PRELIMINARY OBSERVATIONAL STUDY

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Aim: vital pulp therapy (VPT) has been recently suggested as an alternative clinical procedure to treat symptomatic mature permanent teeth presenting deep caries lesions, in order to maintain the pulp vitality over time and to avoid or post-pone root canal therapy (RCT). Therefore, the aim of the present clinical observational study was to assess the success rate of mature permanent teeth underwent full pulpotomy.

Methods: systemically-healthy subjects presenting deep caries lesions approximating/involving the pulp of mature permanent teeth and with signs and symptoms of reversible pulpitis, underwent full pulpotomy using hydraulic calcium-silicate based cements. After final restorations, dental elements were clinically and radiographically followed-up to assess the success rates over time. All treatments were performed at the Dental Clinic of University of Naples Federico II.

Results: five clinical cases were followed for different time intervals (3 to 12 months) and a 100% of clinical and radiographical success rate was reported.

Conclusions: within the limitation of the present study, it could be concluded that VPT, especially full pulpotomy, should be considered as a valid non-invasive treatment in mature permanent teeth with signs and symptoms of reversible pulpitis. However, a larger sample size and a longer follow-up period are needed to confirm the preliminary obtained results.

ROOT CANAL ROTARY INSTRUMENTATION BY TWO NI-TI ENDODONTIC INSTRUMENTS. A 3D-FEA STUDY

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Aim: the aim of this investigation was to calculate the stress distribution in the root dentine canal during mechanical rotation of different NiTi endodontic instruments by means of 3D FEA.

Methods: one conventional NiTi instrument F6 Skytaper 25/06 in comparison to a heat treated NiTI, Protaper Next 25/06 were considered and analyzed. The instruments' flexibility (reaction force) and geometrical features (cross section, conicity) were previously investigated. For each instrument, dentine root canals with two different elastic moduli (18 GPa and 42 GPa) were simulated with defined apical ratios. Four different CAD instrument models were created, and their mechanical behaviors were analyzed by a 3D-FEA. Static structural analyses were performed with a non-failure condition in a linear elastic behavior.

Results: all the instruments generated a stress area concentration at approx. 7 mm from the apex. The maximum values were found when instruments were analyzed in the highest elastic modulus dentine canal. Strain and von Mises stress patterns showed a higher concentration in the first part of curved radius of all the instruments. Conventional Ni-Ti endodontic instrument demonstrated higher stress magnitudes and it showed the highest von Mises stress values in 18 and 42 GPa dentine canals. Heat-treated endodontic instrument with higher flexibility values showed a reduced stress concentration map.

Conclusions: Protaper Next 25/06 displayed the lowest von Mises stress values of respectively 35.73 and 44.30 GPa for sound (18 GPa) and mineralized dentine (42 GPa).

BOND STRENGTH AND MMPS ACTIVITY OF RADICULAR DENTIN OBTURED WITH BIOCERAMIC SEALERS

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Aims: evaluation of radicular bond strength and dentinal MMPs activity with different endodontic sealers, filling techniques and adhesive protocols.

Methods: 48 extracted, caries-free, single-rooted teeth were selected and shaped with Proglider, ProTaper Next X1-X2. Samples were randomly divided in four groups: warm filling with ZoE sealer; cold filling with resin based sealer; cold filling with bioceramic sealer; warm filling with bioceramic sealer. After 7 days, an 8 mm post space was prepared, and each group was divided into 2 subgroups according to the adhesive procedure (SE *vs* ER) employed for cementation with dual resin cement. Samples were analyzed with micro push-out test at T0.

Eight additional non-carious multi-rooted teeth were prepared in accordance with the described groups for in situ zymography analysis at T0. A 3-way ANOVA, post-hoc Tukey were used to test the three factors and one-way ANOVA to evaluate the differences within each variable ($\alpha = 0.05$).

Results: radicular bond strength was significantly influenced by adhesive protocol and ageing ($p < 0.05$) in accordance with MMPs activity analysis. In addition, obturation technique demonstrated a significant impact on enzymatic activity, while no differences were found for endodontic sealers.

Conclusions: the results showed that bioceramic sealers should not alter the radicular dentin bond strength and endogenous enzymatic activity. The heat produced during the root canal obturation might modify the internal enzymatic activity. ER technique increase the enzymatic activity and reduce the radicular bond strength.

SURGICAL GLUE ON HEMORRHAGE CONTROL IN ENDODONTIC MICROSURGERY: RANDOMIZED CLINICAL STUDY

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Aim: one of the major concerns during periapical microsurgery is the attainment of adequate hemostasis. The use of a medical glue for the bleeding control has been proposed for several surgical procedures. However, no data are available about the use of a specific surgical hemostatic glue for the management of the endodontic microsurgical field. Moreover, a reduced operative time and bleeding may affect the postoperative patients' quality of life. The aim of this randomized controlled study is to evaluate the influence of a surgical hemostatic glue on the bleeding and postoperative patients' quality of life (QoL) compared to traditional hemostatic solutions.

Methods: the eligibility criteria included patients who were medically fit for oral surgical procedures with the diagnosis of symptomatic/asymptomatic apical periodontitis in endodontically treated teeth. Recruited patients were randomized equally to both the surgical glue and the control groups. Hemorrhage control during surgery was assessed by the surgeon and two evaluators. The quality of life of patients was analyzed for limitations of oral and general functions and other symptoms, while for pain assessment a VAS scale was used.

Results: it was observed that with the use of surgical glue, hemorrhage control can be achieved in patients with large periapical lesions, positively influencing operative time and postoperative patients related quality of life.

Conclusions: the results give positive outcomes regarding hemorrhagic control with surgical glue, especially in case of large periapical lesions. However, more patients will be required to confirm the preliminary results obtained.