MANAGEMENT OF WIDE APICES: THE MTWO® APPROACH AND THE "GC HOMEMADE" TECHNIQUE IN A CLINICAL CASE OF ENDODONTIC RETREATMENT

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Aim: this study aims to illustrate an innovative method for the preparation and filling of root canals with apex sizes larger than 0.6 mm, using Mtwo® instruments.

Methods: the study focuses on the use of Nickel-Titanium (Ni-Ti) rotary instruments for the preparation and filling of root canals with considerable apex sizes (over 0.6 mm). A sequence of Mtwo® instruments with varying sizes and tapers was used. To manage large apices, an innovative technique called "GC homemade" was developed, which involves the progressive cutting of the tip of an Mtwo® instrument. After preparation, filling was performed using the Microseal technique with gutta-percha and Ni-Ti cones. This approach was applied to a clinical case of endodontic retreatment of a lower molar, demonstrating the effectiveness of the "GC homemade" technique in treating root canals with large apices.

Results: the procedure was successfully performed using Ni-Ti instruments and the Microseal technique. Anesthesia was administered using mepivacaine with adrenaline 1:100,000, and the operating field was isolated with a rubber dam. Access to the pulp chamber was obtained with high-speed diamond burs, followed by entry into the root canals. During instrumentation, sodium hypochlorite and EDTA were alternated for irrigation. The Microseal technique allowed effective sealing of the canal apex.

Conclusions: the described technique proved effective in treating root canals with large apices, allowing proper preparation and filling.

This approach may improve clinical success in cases with complex root canal anatomy.

CLINICAL AND HAEMATOCHEMICAL SEQUELAE OF A HYPOCHLORITE ACCIDENT: A CASE REPORT

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Aim: reporting the clinical sequelae and haematochemical examinations of a patient affected by a hypochlorite accident.

Methods: the patient was monitored clinically and haematochemically for the duration of 30 days.

Results: a 48-year-old woman in good health presented to our attention after starting a root canal treatment of tooth #27. Objective examination showed oedema and haematoma of left-hand side of the face with involvement of the labial and genial mucosa. Anti-inflammatory (NSAIDs, cortisone) and antibiotic therapy were prescribed. The haematochemical examinations, 6 hours after the episode, showed a neutrophilic shift [neutrophils: 89.7% (40-74); lymphocytes 8.0% (20-45); monocytes 2% (3.4-9)] which resolved after 24 hours. PCR was altered after 1 day (10.9 mg/L [<5.0]). 7 days after the episode, both oedema and haematoma were improving, while trismus and dysesthesia of the lip occurred. One month later, haematochemical examinations revealed no significant changes. Clinically, there was improvement of the lockjaw (without complete resolution) and persistence of hypoesthesia of the upper left lip, with pain localised to the oral mucosa at site #23, evoked by palpation.

Conclusions: short-lasting systemic inflammation may develop during a hypochlorite accident. Clinical sequelae may also develop at a distance from the site of origin, suggesting an indirect mechanism, mediated by the inflammatory process.

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MTA *VS* BIODENTINE IN PULPOTOMY, SAME PATIENT, TWO DIFFERENT TEETH: CONSIDERATION ABOUT HANDLING AND 6-MONTH FOLLOW-UP

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Aim: calcium hydroxide and hydraulic calcium silicate-based cements can both be used for direct pulp capping and partial and full pulpotomy for favorable outcomes in terms of decrease of post-operative pain and the manteinance of the vitality pulp. The main qualities of bioceramic materials are biocompatibility, bioactivity, non-toxicity, antibacterial properties, chemical and dimensional stability, sealing ability, osteoinduction, the capacity to stimulate and modulate biomineralization processes.

The aim of this study is to evaluate the handling of bioactive cements (MTA and Biodentine) and to conduct a 6-month follow-up.

Methods: a 13-year-old patient came to our attention with pain referred to teeth 3.6 and 1.5. The percussion and palpation were negative; the vitality cold test was positive. An intraoral periapical radiograph showed two deep carious lesions in proximity to the pulp chamber without any periapical lesions.

Two complete pulpotomies were carried out with the placement of Biodentine on tooth 3.6 and MTA on tooth 1.5, followed by temporary filling.

Results: after one week the patient returned for a follow-up visit without any symptoms. Future prosthetic rehabilitations were therefore scheduled. Between the two materials, Biodentine was easier to handle.

Conclusions: at the 6-month follow-up both dental elements are asymptomatic, and the intraoral radiograph shows no signs of periapical lesions.

The successful outcome achieved through vital pulp therapy using CEM biomaterials in the reported case suggests that this method may produce favorable outcome for vital permanent teeth and that both MTA and Biodentine are easy to handle.

VITAL PULP THERAPY FOR MATURE PERMANENT TEETH: A CONSERVATIVE APPROACH TO PULP PRESERVATION

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Aim: Vital Pulp Therapy (VPT) aims to preserve pulp vitality in cases of deep caries or trauma using techniques like pulp capping and pulpotomy. VPT is increasingly applied to mature permanent teeth with deep carious lesions as an alternative to Non-Surgical Root Canal Therapy (NSRCT). It leverages the pulp's healing ability, but success depends on inflammation and histopathological damage. Diagnosing pulp conditions remains difficult due to the lack of precise tools.

Methods: eight systemically healthy patients (aged 9-32) with deep carious lesions near or involving the pulp were treated at the University of Naples with full pulpotomy using Biodentine. Diagnosis was based on clinical symptoms and radiographs, confirming reversible pulpitis. Procedures followed PROBE and Helsinki guidelines. Follow-ups up to 12 months showed 100% clinical and radiographic success. Mild sensitivity lasted 1-2 days post-op.

Results: VPT showed a 100% success rate for mature permanent teeth with reversible pulpitis. Biodentine demonstrated good biocompatibility and sealing properties, with all patients showing clinical and radiographic success. The pulpotomy resulted in less post-operative pain and fewer analgesic requirements compared to traditional root canal therapy. However, accurate diagnosis remains challenging due to the lack of reliable histological tools.

Conclusions: this minimally invasive approach offers a viable alternative to traditional endodontic treatments, though further studies with larger sample sizes are needed to confirm its long-term effectiveness.

EVALUATION OF MARKERS OF ALTERED ENDOTHELIAL PERMEABILITY IN SUBJECTS WITH CHRONIC APICAL PERIODONTITIS BEFORE AND AFTER ENDODONTIC TREATMENT

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Aim: to demonstrate the role of chronic Apical Periodontitis (AP) in the etiopathogenesis of altered endothelial permeability, that contributes to different inflammatory-based pathological conditions.
Methods: 27 patients with clinically and radiographically diagnosed AP were enrolled. All individuals with obesity, systemic, oncological or immune system diseases, as well as those with other oral diseases or who had received dental treatment in the previous 6 months were excluded. Control subjects are free of systemic and oral diseases. Following diagnosis, patients undergo primary root canal treatment. All patients and control subjects take a blood sample at enrolment and at 6- and 12-month follow-up. Serum levels of pro-inflammatory cytokines, IL-1, IL-6, IL-8 and TNF-α, and endothelial barrier proteins, such as VE-cadherin, Occluding Zone-1 (ZO-1) and claudin-5, are assayed by ELISA assays. Subsequently, the expression of occluding zone proteins will be assessed by cell imaging.
Results: in addition to the increased levels of inflammatory cytokines assayed, ZO-1 levels at the time of enrolment were significantly higher in the AP group (116,5 ± 1,4 pg/ml) than in the control group (90,48 ± 0,2 pg/ml, p <0,0001), and decreased in the patients at 6 months of treatment (106,5 ± 1,3 p <0,001), accompanied by inflammatory, clinical and radiographic improvement or complete healing from the AP.
Conclusions: AP is involved in the etiopathogenesis of altered endothelial permeability and root canal treatment reduces the risk of this manifestation.

ROOT CANAL SHAPING EFFECT OF A NEW ENDODONTIC INSTRUMENT SEQUENCE: A MICROCT ANALYSIS

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Aim: this study aims to evaluate the changes in root canal volume following preparation with a new endodontic instrument sequence, MEA Adrenaline (Brief SRLS, Ghedi (BS), Italy).
Methods: two extracted molars were used for this analysis. Each root canal was prepared using all six instruments in the MEA Adrenaline sequence. Four MicroCT scans were performed for each tooth: one before instrumentation, one after the fourth instrument ("Shape", 15.05), one after the fifth instrument ("Inverse1", 20.04), and a final scan after the sixth instrument ("Inverse2", 25.04). Volumetric comparisons were conducted using the 3D analysis software *3D Slicer*.
Results: the results indicated that the root canal volume in the apical zone did not significantly increase, and the overall morphology of the root canal was preserved throughout the shaping process.
Conclusions: study concluded that the newly developed MEA Adrenaline endodontic sequence is highly conservative in the apical zone. Moreover, the use of advanced MicroCT analysis enabled a detailed evaluation of canal anatomy preservation, providing superior insight compared to conventional radiographic techniques.

COMPARATIVE ANALYSIS OF SMEAR LAYER REMOVAL USING THE ULTRA-X DEVICE AND XP-ENDO FINISHER FILE SYSTEM: AN *EX VIVO* STUDY

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Aim: chemomechanical debridement is a critical step in root canal therapy. Irrigant activation, as the final step before obturation, plays a key role in effectively cleaning and disinfecting the complex root canal system. This study aimed to compare the effectiveness of smear layer removal after activation using Ultra-X and XP-Endo Finisher (XPEF).

Methods: sixty single-rooted extracted second premolars were collected. The specimens were decoronated to a standardized length of 13 mm and shaped using Protaper Gold rotary files to size 40, following a standard irrigation protocol. After shaping, the specimens were randomly assigned to one of three groups based on the final activation method: Group 1: Conventional Needle Irrigation (CNI) (n = 20) (control group); Group 2: Activation using the Ultra-X ultrasonic device (PUI) (n = 20); Group 3: Activation using XPEF (n = 20). The specimens were then examined for smear layer and debris removal using Scanning Electron Microscopy (SEM).

Results: the experimental groups showed significant differences ($p < 0.05$) in debris and smear layer removal compared to the control group. However, no significant differences ($p > 0.05$) were observed between Groups 2 and 3.

Conclusions: both Ultra-X and XPEF devices demonstrated comparable effectiveness in removing debris and smear layer.

COMPARISON OF DIFFERENT IRRIGANT ACTIVATION AND AGITATION TECHNIQUES ON DEBRIS AND SMEAR LAYER REMOVAL: AN *EX VIVO* STUDY

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Aim: the current study evaluated the cleaning efficacy of different irrigation activation techniques in removing debris and smear layers from straight root canals.

Methods: ninety lower premolars with straight root canals were assigned to six experimental groups: control group, conventional irrigation, Passive Ultrasonic Activation (PUI), distilled water Laser-Activated Irrigation (LAI), PulpSucker irrigation, and iVac irrigation. Each canal was shaped to size 30/04 and irrigated with 5% NaOCl.

After shaping and irrigation procedures, the teeth were split longitudinally and subjected to Scanning Electron Microscopic (SEM) analysis for each root canal third.

Results: activated irrigation techniques significantly outperformed conventional irrigation, with the iVac technique demonstrating the best results in smear layer and debris removal in the apical third.

The increased cleaning efficiency of iVac is probably due to a system that merges three different agitation techniques: piezoelectric ultrasonic activation, the negative pressure and the concomitant irrigation, by which a continuous renew of the volume of irrigants is supplied, ensuring their sustained efficacy.

Conclusions: the activation of irrigants proved to be an efficient method for removing debris and smear layers from root canal systems and should be preferred over conventional irrigation systems during disinfection procedures. The combination of ultrasonic agitation and negative pressure irrigation shows the best results in terms of cleaning efficacy.

A NOVEL TECHNIQUE FOR IN-HOUSE 3D PRINTING OF TOOTH MODELS

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Aim: since 2023, students attending the undergraduate endodontic course at Parma University have practiced access cavity preparation on in-house 3D-printed tooth models. The aim of this study was to describe a new in-house 3D printing technique for creating improved tooth models for student learning and research purposes.

Methods: STL files of the external anatomy of teeth were freely obtained from the web and imported into Meshmixer to separate the roots from the crowns and to design the endodontic spaces. Then, the modified files were imported into PreForm, where they were oriented before being printed using a VAT Formlabs Form 2 printer with LT Clear V1 resin for the roots and Resin V3 for the crowns. After curing the tooth parts in Form Cure, ketchup sauce was inserted into the endodontic spaces to simulate the pulp tissue, and the parts were assembled using cyanoacrylate glue.

Results: the 3D-printed teeth proved suitable for both training and research purposes, featuring a patent pulp chamber and negotiable root canals. Student feedback showed improvement compared to the previous models used during pre-clinical training. However, the Vickers Hardness (HV) of the printed tooth models was found to be lower than that of natural teeth.

Conclusions: in-house 3D-printed teeth for pre-clinical training can help overcome some of the drawbacks associated with extracted teeth, such as limited availability and the risk of cross-infection. However, the material used in the printing process needs to be improved to ensure a better tactile sensation.

COMPARATIVE ANALYSIS OF CYCLIC FATIGUE RESISTANCE OF DIFFERENT HEAT-TREATED NICKEL-TITANIUM RECIPROCATING FILES IN A SINGLE-CURVATURE ARTIFICIAL CANAL

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Aim: the purpose of this study was to compare the static cyclic fatigue resistance of two newly developed Ni-Ti reciprocating files, TF4 GOLD and RC BLUE (Perfect Medical Instruments, Shenzhen, China), with two already established instruments, respectively Wave One GOLD (Dentsply Maillefer, Ballaigues, Switzerland) and Reciproc Blue (VDW, Munich, Germany).

Methods: for each experimental group, ten instruments were tested in a stainless-steel artificial canal with a 5-mm radius of curvature and a 60° angle of curvature. All instruments were operated until fracture occurred and the Time to Fracture (TF) was recorded in seconds. The mean and the standard deviation of TF were calculated for each system. Statistical analyses of the data were performed using F-test, Independent T-test and Welch's T-test.

Results: TF4 GOLD's cyclic fatigue resistance was statistically higher than Wave One GOLD's (164,59s vs 123,49s). No statistical difference was noted between the standard deviations of the two instruments. Compared to Reciproc Blue, RC BLUE showed statistically higher cyclic fatigue resistance (638,56s *vs* 140,63s) and standard deviation (125,93s *vs* 18,02s).

Conclusions: within the limitations of the study, it was found that TF4 GOLD performed overall better than Wave One GOLD, suggesting that execution quality of the gold thermal process might vary significantly between manufacturers. RC BLUE appeared more resistant than Reciproc Blue, but the large variability in its results might suggest that Perfect's blue treatment process is less consistent or controlled than its competitor.

RETRIEVABILITY OF NEOPUTTY: AN *IN VITRO* STUDY

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Aim: to evaluate the retrievability of NeoPUTTY® (Avalon, USA), a BioCeramic Root Repair Material (BC RRM), and comparing it with MTA (Dentsply USA).

Methods: a total of 30 extracted single-rooted teeth with straight canal were decoronated to a standardized root length. Canals were instrumented to 50.06 and randomly divided into two experimental groups (Group A: NeoPutty; Group B: MTA). The apical 5 mm was obtured. After storage for 2 weeks at 37°C and 100% humidity, teeth were retreated using a rotary instrument (MicroMega Remover, Coltene, CH) and apical patency was evaluated. Data were analyzed using the Chi-squared test.

Results: success rate for apical patency in Group A (MTA) was 0% (0/15) while in Group B it was 7% (1/15). There was no significant difference between the two groups ($\chi 2 = 1.034$). NeoPUTTY® and MTA showed similar hardness, making them difficult to retreat mechanically. NeoPUTTY® exhibited a low retreatability index (1/15), similar to MTA. There is no explanation available for the failed test. Further *in vitro* and clinical studies with larger sample sizes are needed to confirm its reliability and effectiveness compared to other BC RRM.

Conclusions: due to proper hardening, retrievability of NeoPutty® with rotary instrumentation is very difficult. A correct setting of cement is relevant for clinical use.

IMPACT OF FERRULE, POST MATERIAL, AND SHAPE ON THE MECHANICAL BEHAVIOR OF ENDODONTICALLY TREATED CANINE TEETH

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Aim: the aim of the current research was to assess the effect of ferrule and of specific material-shape combinations for the post on the mechanical behavior of post-endodontically restored canine teeth.

Methods: micro-CT scan images of an intact canine were used to create a 3D tessellated CAD design and geometric models of post-endodontically restored teeth were created. Two types of 15 mm post were evaluated: a quartz fiber post with conical-tapered shape, and a Carbon (C) fiber post with conical-cylindrical shape. The abutment was created around the coronal portion of the posts and 0.1 mm cement was added between prepared crown and abutment. Four models were analyzed by Finite Element (FE) Analysis: with/without a ferrule for both types of post material and shape. A load of 50 N was applied at 45◦ to the longitudinal axis of the tooth, acting on the palatal surface of the crown.

Results: models without a ferrule showed greater stress (16.3 MPa) than those for models with a ferrule (9.2 MPa). With a ferrule, stress was uniformly distributed along the abutment and the root. In all models, the highest stresses were in the palatal wall of the root. Models with the C-fiber post had higher stress than models with the quartz fiber posts. The most uniform stress distribution was with the combination of ferrule and quartz fiber post.

Conclusions: the FE analysis confirmed a beneficial ferrule effect with the combination of ferrule and quartz fiber post, with tapered shape, affording no critical stress concentrations within the restored system.

MICROSCOPICAL EVALUATION OF THE DISINFECTION POTENTIAL OF A NEW ENDODONTIC IRRIGATING SYSTEM: AN *IN VITRO* STUDY

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Aim: to evaluate the *in vitro* disinfection potential of the iVac Irrigating System, compared to the traditional syringe irrigation protocol, from a microscopical point of view.

Methods: twelve (N = 12) extracted monoradicular teeth were shaped until ProTaper Next X3. The specimens were sterilized by autoclave and infected with E. Faecalis. Afterwards, irrigation protocols were compared by assigning each sample either to Group 1 (n = 5), in which iVac was tested as irrigant device, or Group 2 (n = 5), who employed a 30G needle and syringe. The samples were stained with Baclite Dead-Live (PI - SYTO9) and prepared for CLSM analysis. The Mean Ratio (MR) of red fluorescence (dead cells) over the whole red/ green fluorescence (%) and the Mean Penetration Depth (MPD) of red fluorescence were calculated for coronal, middle and apical sections. MPD was evaluated at inner and outer level. The analysis of variance was performed by Kruskal-Wallis and Chi-Square Test.

Results: the MR was not different between groups (Group 1: Mean 52,36, range 46,56-67,79; Group 2: Mean 53,54, range 45,87-59,38, p >0,001). A positive correlation existed between the apical sections and the MR (p = 0,003). MPD was comparable between the two groups in superficial sections, while in outer sections the MPD was increased in Group 1 rather than Group 2. These results were statistically significant only in the coronal and middle sections. Variance analysis showed no difference between groups.

Conclusions: iVac can be considered a reliable device to implement endodontic treatments in monoradicular teeth.

CORRELATION BETWEEN ROOT CANAL TAPER AND FRACTURE RESISTANCE OF MAXILLARY PREMOLARS WITH FULL-CROWN PREPARATION

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Aim: to investigate the effect of root canal taper on the fracture resistance of endodontically treated maxillary premolars and the effect of fiber post placement and full crown preparation on the residual dentin thickness after shaping with different tapers.

Methods: forty extracted, caries-free, maxillary premolars are selected. A traditional access cavity is created, and the specimens are Micro-CT scanned to confirm inclusion criteria. All the collected teeth are divided into 4 groups: Trunatomy taper .04, B4U taper .05, Protaper Next taper .06 and Protaper Gold taper .08. After instrumentation a MOD cavity is prepared, and a second Micro-CT scan is performed. Afterwards each group is divided into two subgroups:

- subgroup A: no post space;
- subgroup B: post space and fiber post placement.

In the subgroup B 6 mm post space is created in the palatine canal using fiber post drills. Then all the specimens are prepared for a full-crown iuxta-gingival chamfer preparation at CEJ level, and a third Micro-CT scan is performed. Each root canal is filled with a single cone and bioceramic sealer. In subgroup A a composite restoration is achieved while in Subgroup B a fiber post is luted in the prepared root followed by a composite restoration. The specimens are submitted to static fracture resistance test.

Results: the dentin removal at the CEJ level after full crown preparation is higher than the amount spared with different shaping tapers. The insertion of a fiber post and the root canal taper didn't affect significantly the residual dentin thickness after full crown preparation. The fracture resistance and failure modes didn’t show differences between groups.

Conclusions: the root canal preparation taper seemed not to affect significantly the residual coronal dentin thickness and fracture resistance after full crown preparation in maxillary premolars.

ULTRASTRUCTURAL AND COMPOSITIONAL ANALYSIS OF ROTARY ENDODONTIC INSTRUMENTS: A SCANNING ELECTRON MICROSCOPY INVESTIGATION

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Aim: this study aims to analyze the surface of rotary endodontic instruments using a Scanning Electron Microscope (SEM) to evaluate their surface quality and chemical composition.
Methods: ultrastructural analysis was performed on 3-4 distinct portions of the instrument surfaces. Samples were provided in their proximal part for correct positioning in the SEM chamber. Instruments were analyzed without further treatments, in a sterile environment, using a Hitachi TM4000 Plus Tabletop SEM (Hitachi Ltd, Tokyo, Japan) at 15 kV acceleration voltage, with an Oxford EDS microanalysis probe, controlled by AZtecOne software (Oxford Instruments Ltd, Bristol, UK).
Results: the analyzed instruments, particularly the Perfect TG6 T1, Perfect TF4 gold T25, and Perfect RC blue R25, exhibited surfaces with abrasions and irregularities at the edges of the spirals and tips. The tip was incomplete in the Perfect TG6 T1 and especially in the Perfect RC blue 40. Foreign elements were present, some in trace amounts and others in significant percentages. The identified foreign elements included: Mg, Ba, Si, W, Yb, K, Na, Cl, Fe, S, B, C, Sr, Al, and Au.
Conclusions: the results suggest that the production quality of instruments should always be carefully analyzed, although the same results should always be correlated with clinical performance tests.

DO DUAL THERMALLY TREATED NITI INSTRUMENTS CAUSE MORE CANAL TRANSPORTATION? AN *IN VITRO* STUDY

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Aim: endodontic shaping is a crucial step in root canal treatment to remove infectious reservoirs and optimize root canal sealing.
Recently, dual thermally-treated endodontic instruments, characterized by a highly flexible body and a stiffer tip, have been introduced to enhance cutting efficiency. However, this configuration could influence apical transportation compared to martensitic instruments composed entirely of a flexible alloy.
This study aims to evaluate the differences in apical transportation between dual thermally-treated instruments and instruments with the same design, but with a single thermal treatment.
Specifically, this research assesses the apical transportation caused by two instrument sequences, SlimShaper (single thermal treatment) and SlimShaperPRO (dual thermal treatment), in resin blocks with simulated curved canals.
Methods: forty-four specimens were divided into two groups (n = 22): Group A (shaped with SlimShaper up to size 25/0.04) and Group B (shaped with SlimShaper PRO up to size 25/0.04). Pre- and post-shaping images were super-imposed using specialized software and apical transportation was measured.
Results: the results were analyzed using the Student's T-test and showed no statistically significant difference in mean apical transportation between the two groups ($p = 0.57$).
Conclusions: within the limitations of this *in vitro* study, dual thermally treated NiTi instruments did not result in a statistically significant increase in apical transportation. Therefore, the use of the new SlimShaperPRO instrument sequence is recommended.

THE ROLE OF DIFFERENT COMPOSITE ON THE STRENGTH OF ENDODONTICALLY TREATED PREMOLARS

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Aim: the long-term success of endodontically treated teeth relies on preserving structure, function, and aesthetics. This *in vitro* study evaluated the mechanical behavior and fracture patterns of premolars restored with different combinations of fiber posts and composite resins, after thermomechanical aging and simulated chewing.

Methods: fifty extracted maxillary premolars were divided into five groups: a control of intact teeth and four experimental groups with hollow or compact fiber posts and traditional or bulk-fill composites. After cyclic fatigue, fracture strength and failure modes were analyzed.

Results: the control group showed significantly higher fracture resistance (1909 ± 177 N) than the experimental groups ($p > 0.05$).

Bulk-fill composites showed slightly higher strength and more favorable fractures. The combination of hollow posts and bulk-fill composite yielded the best outcomes (n = 8 favorable fractures).

Conclusions: bulk-fill composites may offer a practical and effective option for restoring endodontically treated teeth. Further studies are needed to confirm these results.

MICRO-CT ANALYSIS OF THE SEALING ABILITY OF ENDODONTIC MATERIALS AFTER APICAL RESECTION, APICAL SEALING, AND MTA RETROGRADE FILLING

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Aim: a micro-CT study evaluates, before and after apicoectomy and sealing of the resected dentinal surface, the % Volume of Voids (VoV) and silver nitrate penetration (VoN) into endodontic materials and canals. Results are compared with those of an apicoectomy with MTA retrograde filling. The null hypothesis assumes no significant differences among the groups.

Methods: thirty monorooted teeth underwere orthograde endodontic treatment (single point technique with bioceramic sealer). Apicoectomy was performed and the resected teeth were assigned to 4 groups: G1 (untreated surface, n = 5), G2 (retrograde MTA filling, n = 10), G3 (Geristore apical seal, n = 10), and G4 (Adhese Universal apical seal, n = 10). Micro-CT analysis assessed voids at t0 (after orthograde obturation) and t1 (after apical resection and apical sealing); then the teeth were stained ($AgNO_3$) and dye penetration was measured (t2). Amira software quantified VoV (t0, t1), in the whole endodontium (tot) and at 1 and 3 mm from the apex; VoN and Silver Nitrate depth (SNd) (t2). Data were analyzed using non-parametric statistical tests.

Results: at t0, no statistical difference in VoV was observed among groups in all the canal portions. G2 showed the higher values of voids (t1) (tot VoV 2.81 ± 0.21%, 1 mm VoV 0.73 ± 0.08%, 3 mm VoV 2.31 ± 0.16%) and stain (t2) (VoN 3 mm 1.97 ± 1.40% $p < 0{,}001$, SHd 3.39 mm $p = .007$).

Conclusions: G2 showed the highest VoV, VoN, and SNd, G4 the lowest, rejecting the null hypothesis. Surface sealants like Adhese Universal may enhance apical sealing by reducing microleakage.

COMPARATIVE EVALUATION OF DIFFERENT ENDODONTIC SYSTEMS ON PERICERVICAL DENTIN PRESERVATION: A MICRO-CT STUDY

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

Methods: 75 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 (3.14 x 102 mm 3±0.5) were selected and divided into five groups (n = 15) according to the shaping systems: Group I, Protaper Gold; Group II, Protaper Ultimate; Group III, BlueShaper PRO; Group IV, SlimShaper PRO; Group V, WaveOne Gold. 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 five groups were effective in shaping the specimens, with a similar amount of dentin volume removed and a low risk of errors in the technique used. Nonetheless, Group I showed a greater reduction in the thickness of the pericervical dentin than Groups II and IV, which instead showed a minimal reduction, thus respecting the root anatomy.

Conclusions: despite the limitations of the study, the Protaper Ultimate and SlimShaper PRO systematics would seem to be more conservative than others.

ITALIAN SCIENTIFIC PRODUCTION IN ENDODONTICS: A BIBLIOMETRIC ANALYSIS FROM 1995 TO 2024

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Aim: in the last decades, Italian scientific production has grown in different areas of dentistry. This study aimed to perform a bibliometric analysis of scientific production in Endodontics by authors with Italian affiliation from 1995 to 2024.

Methods: the Scopus database was searched for articles concerning Endodontics with at least one author affiliated to any Italian institution and relevant bibliometric data were extracted and summarized. A comparison of scientific production in the decades 1995-2004, 2005-2014, and 2015-2024 was carried out.

Results: 2150 records published in 287 different sources were found, with an average annual growth rate of 13.1%. The year with the most articles published was 2021 (177). The highest number of citations (32207) was collected in the decade 2005-2014. The average number of authors per article has increased from 3.8 to 6.3, and the percentage of international co-authorship was 41.8%. The Sapienza University of Rome was the most productive affiliation, and the most productive source was the *Journal of Endodontics*. Co-occurrence analysis of author keywords revealed a change in topic interest during the 3 decades.

Conclusions: this bibliometric study highlights the growth of Italian scientific production in Endodontics over time, likely driven by the increasing number of researchers in Italian universities and their rising productivity.

NANOPARTICLES IN ENDODONTICS: ANTIBACTERIAL PROPERTIES AND THERAPEUTIC POTENTIAL

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Aim: the treatment of root canals remains a challenge due to the persistence of bacterial biofilms within complex anatomical structures that cannot be eliminated by conventional cleaning and disinfection methods. This review examines the potential of nanoparticles in endodontic therapy, highlighting their antimicrobial properties and clinical applications.

Methods: a literature review was conducted to assess the antimicrobial efficacy, mechanisms of action, and clinical applications of various nanoparticles, including chitosan, silver, graphene, poly(lactic-co-glycolic acid), bioactive glass, mesoporous calcium silicate, hydroxyapatite, zirconia, glucose oxidase magnetic, copper, and zinc oxide.

Results: nanoparticles exhibit several antimicrobial mechanisms, including disruption of the bacterial wall, increased membrane permeability, generation of reactive oxygen species, and inhibition of DNA replication by controlled ion release. These properties enhance biofilm eradication and can improve endodontic outcomes.

Conclusions: nanotechnology offers a promising alternative to conventional antimicrobial strategies that may overcome biofilm persistence and antibiotic resistance. The high biocompatibility and broad-spectrum efficacy of nanoparticles support their integration into endodontic treatment protocols and warrant further clinical validation.

THE USE OF GEL FORMULATIONS DURING ROOT CANAL SHAPING: HOW FAR IS IT BENEFICIAL FOR SHAPING?

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Aim: root canal shaping is a key phase of endodontic therapy, with irrigants playing a crucial role in cleaning, bacterial reduction, and preserving instrument integrity. While liquid-based solutions are well-documented, gel-based formulations have been proposed for improved lubrication and reduced apical extrusion. However, their clinical efficacy remains controversial. This systematic review assesses the effects of gel- *versus* solution-based irrigants on smear and debris removal, file separation, instrument fatigue, bacterial reduction, debris extrusion, and postoperative pain.

Methods: a systematic search following PRISMA 2020 guidelines identified 37 eligible studies, including *ex vivo*, *in vitro*, and clinical trials.

Results: gel-based irrigants showed advantages in glide path creation and limiting apical extrusion but were associated with increased dentinal debris accumulation, greater instrument fatigue, and a higher risk of file separation. Moreover, their antibacterial activity and tissue dissolution capacity were inferior to those conventional solutions.

Conclusions: the inconsistent findings and absence of standardized clinical protocols limit the broad adoption of gels in root canal shaping. Further clinical studies are needed to optimize gel formulations and define effective irrigation protocols. While gels may serve niche purposes, current evidence supports the superior efficacy of liquid-based solutions in canal shaping and disinfection.

ASSESSMENT OF IRRIGATION DYNAMICS COMPARING SYRINGE NEEDLE IRRIGATION WITH VARIOUS OTHER METHODS OF IRRIGATION USING COMPUTATIONAL FLUID DYNAMICS: A SYSTEMATIC REVIEW

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Aim: this systematic review evaluated the irrigation dynamics of conventional needle irrigation versus alternative irrigation techniques using Computational Fluid Dynamics (CFD).

Methods: a comprehensive search of PubMed, Scopus, and Cochrane databases was conducted up to June 2022, following predefined inclusion and exclusion criteria. Studies comparing conventional needle irrigation with other techniques were selected. Two reviewers independently screened and assessed the studies.

Results: from 329 articles initially identified, 23 were selected for full-text review. After excluding 18, five *in vitro* studies met the eligibility criteria and were included. Risk of bias was assessed using modified JBI criteria and CRISS guidelines. Key parameters analyzed included shear stress, irrigant replenishment, velocity, turbulence, and apical pressure.

Conclusions: negative pressure irrigation demonstrated superior performance compared to conventional positive pressure needle irrigation, although the latter generated higher apical pressures.

IMPACT OF SODIUM HYPOCHLORITE CONCENTRANSIONS ON ENDODONTIC FLARE-UP: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Aim: this systematic review and meta-analysis aimed to evaluate the effect of different NaOCl concentrations on post-operative pain following root canal treatment.

Methods: this systematic review was conducted according to PRISMA guidelines and registered in PROSPERO (CRD42023451576). The research question was formulated based on the PICO strategy. A comprehensive literature search was performed in multiple electronic databases, using predefined keywords and MeSH terms. Randomized Controlled Trials (RCTs) comparing different NaOCl concentrations (<5% *vs* ≥5%) and reporting post-operative pain in adult patients undergoing primary root canal treatment were included. The risk of bias was assessed using the Cochrane RoB 2 tool. Meta-analyses were conducted for pain levels at 24-, 48-, and 72-hours post-treatment.

Results: seven RCTs met the inclusion criteria, and four were included in the meta-analysis. The results showed no statistically significant difference in post-operative pain between low (<5%) and high (≥5%) NaOCl concentrations at any time point. However, two studies reported lower pain levels with lower NaOCl concentrations, while one study found the opposite trend.

Conclusions: within the limitations of this review, no significant differences in post-endodontic pain were found between high and low NaOCl concentrations. However, concentrations below 5% may be associated with lower pain levels. Further well-designed clinical trials with standardized methodologies are needed to provide more conclusive evidence.

BIOCERAMIC CEMENTS: A REVIEW OF CLINICAL APPLICATIONS

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Aim: this study explored the use of bioceramic cements in modern endodontics, focusing on their clinical applications, benefits, and limitations. Bioceramics, known for their bioactivity, have recently been introduced as endodontic sealers and are also used for retrograde fillings, perforation repair, and pulp vitality preservation.

Methods: a comprehensive literature review was conducted using PubMed to identify relevant scientific articles that provide insights into the clinical application of bioceramics as endodontic cements. Clinical success was evaluated through various case studies, accompanied by radiographic analysis.

Results: bioceramic sealers show high biocompatibility and promote bone healing, although cytotoxicity may vary. Setting time depends on humidity, composition, and clinical conditions. These materials are harder to remove during retreatment, posing risks such as apical foramen blockage. Some formulations show excessive solubility, potentially affecting long-term sealing. However, they offer minimal tooth discoloration, high pH, calcium ion release, and strong initial antimicrobial effects, which decrease over time. Their hydrophilicity and bonding strength enhance sealing ability and fracture resistance.

Conclusions: despite certain challenges like retreatability and solubility, bioceramic cements are a promising alternative to traditional materials due to their biocompatibility, sealing ability, aesthetics, and antimicrobial properties.

POSTOPERATIVE PAIN OUTCOMES OF BIOCERAMIC SEALER IN THREE DIFFERENT OBTURATION TECHNIQUES: A RANDOMIZED CONTROLLED STUDY

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Aim: pain control after root canal therapy is essential. Postoperative pain is a common but undesired outcome of endodontic procedures. Interest in the clinical use of bioceramics is increasing, yet their scientific validation remains necessary. This randomized controlled trial evaluated the effectiveness of three obturation techniques using CeraFill RCS bioceramic sealer in reducing postoperative pain in patients with asymptomatic irreversible pulpitis.

Methods: ninety-three patients were randomized to receive one of three techniques: Cold Lateral Compaction, Sealer-based Obturation, or Hot Modified Technique. Pain levels were measured using the Visual Analog Scale (VAS) at 6-, 12-, 24-, and 48-hours post-treatment. Pain scores were analyzed with Kruskal-Wallis and Mann-Whitney U tests, and linear regression identified predictors of pain outcomes.

Results: sealer-based and Hot Modified techniques significantly reduced postoperative pain compared to Cold Lateral Compaction at all time points ($p < 0.05$). Regression analysis confirmed obturation technique as a significant predictor of pain reduction. The Hot Modified Technique provided the most consistent relief, highlighting the potential of advanced obturation methods in improving recovery.

Conclusions: sealer-based and Hot Modified techniques improved postoperative pain outcomes compared to traditional methods. These results support the use of innovative bioceramic sealers to enhance pain management and patient comfort in endodontic practice.

A 6-MONTH FOLLOW-UP OF ROOT CANAL OBTURATION USING A CALCIUM SILICATE-BASED SEALER AND AN EPOXY RESIN-BASED SEALER WITH WARM CARRIER-BASED TECHNIQUE: A RANDOMIZED CLINICAL TRIAL

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Aim: this randomized clinical trial was designed to evaluate the clinical outcome of non-surgical root-canal treatment comparing a bioceramic-based sealer (AH Plus Bioceramic) versus an epoxy-resin-based sealer (AH Plus) used with Thermafil warm carrier-based technique over 6 months follow-up.

Methods: 105 teeth were divided into two groups and randomly treated either with AH Plus Bioceramic (Group A) or AH Plus (Group B) and Thermafil warm carrier-based technique. Clinical and radiographic evaluations were conducted after 1, 3 and 6 months. Healing rate, extrusion rate, PAI score were assessed. Post-operative pain was also recorded before treatment and after 24-48-72 hours, one week and one month.

Results: a total of 83.0% and 84.6% teeth were classified healed (PAI 1-2) respectively in Group A and Group B. No statistically significant differences were found between groups in terms of radiographic healing ($p > 0.05$). Apical extrusion of the sealers occurred in both groups: 55.8% in Group A and 47.2% in Group B but only Group A showed a resorption/modification of the sealer during the follow-up. No significant differences were observed between the two groups in terms of post-operative pain.

Conclusions: the use of bioceramic-based sealer showed clinical results comparable with epoxy-resin-based-sealer used with carrier-based technique.

COMPARISON OF FOUR NI-TI ROTARY SYSTEMS: DENTAL STUDENTS' PERCEPTIONS IN A MULTI-CENTER SIMULATED STUDY

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Aim: Nickel-Titanium (Ni-Ti) rotary instruments have greatly improved the efficiency and safety of root canal shaping. However, the various Ni-Ti systems, which differ in alloy composition, taper design, and heat treatment, may affect their usability, especially for novice operators. This study aimed to assess the perceptions of dental students using four Ni-Ti rotary systems (MTwo, SlimShaper Pro, ProTaper Gold, and HyFlex EDM) in a simulated environment.

Methods: forty dental students from two universities took part in the study and completed a standardized preoperative training session. Root canal shaping was performed on resin tooth models, and an 11-item questionnaire was used to evaluate various parameters, including flexibility, ease of use, and the ability to maintain working length.

Results: the results revealed significant differences in student feedback. SlimShaper Pro and HyFlex EDM were favored for their flexibility, reduced resistance, and smooth instrument transitions, likely due to their smaller tapers and martensitic alloys. MTwo was rated the least flexible and more difficult to use.

Conclusions: these findings highlight the importance of user-friendly Ni-Ti systems in novice to minimize procedural challenges and operator stress. Further research is needed to validate these results in clinical settings and enhance the training of inesxperts operators.