



The Italian Academy of Endodontics and the Riitano Award: a commitment to excellence in dental education

The Italian Academy of Endodontics (Accademia Italiana di Endodonzia - AIE) was founded in 1992 by a group of practitioners of the endodontic discipline with the mission to share the science and practice of endodontics. The Academy serves as a platform for education, research and disseminating best practices among dental professionals. One of the Academy's significant contributions to the endodontic community is its commitment to fostering ongoing education and collaboration among specialties. Through various workshops, seminars and an annual congress, the Academy provides practitioners with the latest advancements in techniques, technologies and materials, ensuring they are well-equipped to deliver the highest standard of care to their patients. The congress not only serves as an educational

forum, but also as a vital networking hub where professionals can share experiences and strategies, further enhancing the collective expertise within the field. A hallmark event at the annual congress is the awarding of the Francesco Riitano Award. The award is reserved for graduates in Dentistry who have discussed their degree and master's thesis on topics relating to endodontics at Italian and foreign universities. The Academy has dedicated this award to Dr. Francesco Riitano, one of the fathers of modern endodontics. He had the intuition that endodontics needed to deepen the study of anatomy and the endodontic space to refine instrumentation techniques and disinfection of this space to guarantee a treatment as conservative as possible. In conclusion, the Italian Academy of Endodontics, through initiatives like the Riitano Award, highlights the importance of continuous advancement in dental care.

In this number AIE presents the abstracts of the Riitano Award of the International Congress of the Italian Academy of Endodontics held in Bologna on the 23rd-24th of February 2024.

Gianluca Plotino

Micro-CT Analysis: Comparison of Three Canal Sealing Techniques with Endosequence and a Reference Technique with Argoseal

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Aim

This experimental research involved evaluating the difference in the effectiveness of canal sealing using EndoSequence® BC Sealer™ (Brasseler USA, Savannah, GA, USA), employing three different canal filling techniques, compared to hot vertical condensation with ZOE cement Argoseal® (Ogna Lab S.r.l IT, Muggiò, MB, IT).

The Aim of the study was to compare the effectiveness of the different techniques in canal sealing, utilizing high-definition 3D technology of computed microtomography and dedicated software, by analyzing the quality of the obturation and the presence of voids within it.

Material and methods

The study included 40 canal units randomly selected. Through the first scan with SkyScan 1176 micro-CT (Bruker Corporation USA, Billerica, MA, USA) of the virgin teeth, it was possible to determine the root anatomy of the samples, which were then randomly divided into 4 groups, each with 10 canal units, according to the 4 canal sealing techniques used.

The crown-down technique with ZenFlex Ni-Ti rotary instruments (Kerr) was used for shaping. Based on the canal size, 30/0.4 instruments were used for small canals and 30/0.6 instruments for large canals. The irrigation protocol included canal washes with 5.25% sodium hypochlorite and 17% EDTA to remove the smear layer.

Canal obturation was performed using different methods for each group:

- G1: obturation with Endosequence bioceramic cement and single cone technique.
- G2: obturation with Endosequence bioceramic cement and single cone pumping technique.
- G3: obturation with Endosequence bioceramic cement and hot vertical technique.
- G4: obturation with Argoseal ZOE cement and hot vertical technique.

The samples were placed in a EuroClone S@feGrow 188 CO₂ (EuroClone IT, Pero, MI, IT) incubator for 10 days with 100% humidity and a temperature of 37°C. Subsequently, a second cycle of micro-CT scans was performed to evaluate the quality of the performed obturation.

Results

Thanks to the CTAn analysis program and the 3D Analysis function, it was possible to obtain the volume occupied by the obturation material and any voids, expressed in mm³. The average values, expressed as percentages, were then calculated, and it was found that higher percentages of voids were observed with cold obturation techniques compared to hot ones; in particular, the highest percentage of voids was found in group G1 (single cone pumping technique with EndoSequence), while the lowest was in group G4 (vertical hot condensation technique with Argoseal), which is the control group.

Starting from the formulation of a null hypothesis, which stated that there were no statistically significant differences, the Mann-Whitney statistical test was used to demonstrate this hypothesis (if the calculated P value is > 0.05) or to reject it (if the P value is < 0.05) and conclude that they have different medians. For all the values considered, the P values were greater than 0.05 except for the percentage of voids between G1 and G4 at the apical third level.

Conclusions

In general, a greater number of voids were detected with the use of single cone and single cone pumping techniques (G1 and G2) compared to the hot condensation techniques (G3 and G4). The technique with the lowest percentage of voids was the reference technique; however, the difference was not always statistically significant, suggesting that the technique, canal anatomy, and operator experience could influence the Results.

Therefore, Endosequence bioceramic cement showed a statistically significant inferiority in filling the apical third compared to ZOE Argoseal cement. However, given its bioactive, osteoconductive, and bactericidal properties, it was not possible to determine whether the presence of voids could clinically influence the quality of the canal seal.

For future research, studies with a larger number of samples are recommended to apply more significant parametric tests.

Experimental In Vitro Study on New Root Canal Irrigation Protocols

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Aim

The Aim of this study was to investigate, using scanning electron microscopy, single-rooted and single-canal teeth subjected to different irrigation protocols, which included the use of three different combinations of irrigants and activation with two different methods: passive ultrasonic irrigation (PUI) and intracanal heating combined with passive ultrasonic irrigation.

Materials and methods

Sequential chelation, performed with sodium hypochlorite 5,25% and EDTA 17%, was compared with two monophasic irrigants, Dual Rinse® HEDP and Triton®, to reduce clinical time and avoid loss of antibacterial efficacy of NaOCl due to its interaction with EDTA. Additionally, an attempt was made to overcome the limitations of EDTA in terms of excessive dentin demineralization, while Aiming for equal removal of the smear layer through, on one hand, etidronic acid (EA) with Dual Rinse® HEDP, and on the other hand, 2- phosphonobutane-1,2,4-tricarboxylic acid (PBTC) with Triton®.

Sixteen extracted single-rooted, single-canal human teeth were selected

Access cavities have been conventionally opened, the pulp extirpated, and the working length (WL) established by inserting a #10 K-file into the root canal until the file tip was visible through the apical foramen and then 1 mm was subtracted. The apical two thirds of the samples have been sealed with vinyl polysiloxane base, protecting the apical foramen with Teflon to prevent impression material infiltration, in order to simulate a closed system.

Root canals have been shaped using the NiTi Pro-Taper Next system (Dentsply Sirona, Ballaigues, Switzerland) to a tip size 40 .06 (X4), reaching 1 mm short of the anatomical apex.

Teeth have then been randomized into one of the irrigation protocols. During the final irrigation, each of the three different irrigation protocols was alternately subjected to one of the two different activation methods:

1. PUI (Passive ultrasonic irrigation), performed by an Irrisafe insert (IRR25, Acteon Satelec)
2. Intracanal heating + PUI, performed using the System B Heat Source (Analytic Endodontics, Orange, CA, USA) followed by the Irrisafe insert.

The sample groups (n=4) were named according to the different irrigation protocols received, as follows:

IA group	5,25% NaOCl + PUI + 17% EDTA
IB group	5,25% NaOCl + intracanal heating + PUI + 17% EDTA
DA group	NaOCl/Dual Rinse® HEDP + PUI
DB group	NaOCl/Dual Rinse® HEDP + intracanal heating + PUI
TA group	Triton® + PUI
TB group	Triton® + intracanal heating + PUI
C group	Control group – untreated sample
F group	Sterile saline solution

After removing the samples from the impression material, they were longitudinally fractured, examined using a stereomicroscope to verify the visibility of the canals, mounted on aluminium stubs and sputter-coated so that the prepared root canal surface could be observed in a scanning electron microscope (Supra 25; Zeiss, Germany) at 1000x magnification.

Coronal, middle, and apical thirds of the prepared root canal have been evaluated for the presence or the absence of smear layer and organic debris. Each section was assigned a score from 1 to 4 (a, b, c, d) according to Gutmann's classification. SEM evaluation was performed blindly by three different operators.

Results

The level of statistical significance was set at 5%. The Shapiro-Wilk test indicated that the values did not follow a normal distribution.

Kruskal-Wallis H test and Mann-Whitney U test with Bonferroni correction were used for intergroup comparisons, while Friedman test and Wilcoxon test with Bonferroni correction were used for intragroup comparisons.

The activation of sodium hypochlorite with both techniques, ultrasonic or ultrasonic with intracanal heating, in synergy with EDTA, ensured better smear layer removal and greater dentinal tubule patency at all root levels ($p > 0.05$), and it is statistically more effective than protocol DA (Dual Rinse® HEDP + PUI) ($p < 0.05$) and protocol F (sterile saline solution) ($p < 0.05$).

The activation of sodium hypochlorite with the combined technique of intracanal heating and ultrasound, with final rinsing with EDTA, was also statistically more effective compared to protocols TA (Triton® + PUI) and TB (Triton® + intracanal heating + PUI) ($p < 0.05$).

All protocols, at all root levels, were statistically more effective compared to protocol F (sterile saline solution) ($p < 0.05$).

Regarding surface debris, no statistically significant differences were found between the different irrigation protocols ($p > 0.05$), except when they were compared to protocol F (sterile saline solution) ($p < 0.05$).

With regard to the root thirds, all irrigation protocols showed a decreasing removal of smear layer from the coronal third to the apical third ($p < 0.05$), except for the groups irrigated with sodium hypochlorite and EDTA, which showed similar or even increased debridement, as in the case of the IB protocol from the apex to the coronal third ($p < 0.05$).

Conclusions

The present study found greater cleanliness and canal debridement when using a combination of sodium hypochlorite and EDTA, and even more so when NaOCl is activated not only with passive ultrasonic irrigation (PUI), but through intracanal heating followed by ultrasonics.

However, the levels of smear layer and debris removal capacity are similar among all different protocols. Therefore, Dual Rinse® HEDP and Triton® emerge as a valid alternative to the gold standard protocol of sequential chelation with NaOCl and EDTA, especially considering that both are single-phase irrigants. They are able to achieve excellent levels of smear layer removal while maintaining a lower concentration of sodium hypochlorite (specifically 4% in the case of Triton®) and using less aggressive chelators compared to EDTA.

Nevertheless, milder chelators (specifically, ethylenediaminetetraacetic acid (EDTA) and 2-phosphonobutane-1,2,4-tricarboxylic acid (PBTC) belonging respectively to Dual Rinse® HEDP and Triton®), have given, as a result, less visibility of dentinal tubules under SEM.

The study leaves open the question about the clinical significance of the visibility of dentinal tubules, namely whether this, as found in the study by Lottanti et al., corresponds to a real increase in dentin demineralization. It also remains to be understood whether such demineralization, in addition to compromising the possibility of sealing the canal optimally (Paulson et al.), reduces the mechanical resistance to stresses on the dental element.

Carrier-Based Obturation Retreatment Time: Two New Methods Compared

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Aim

The Aim of the study is to provide preclinical evidences regarding the retreatment of carrier-based obturation, both in natural teeth and 3D printed teeth, comparing two retreatment methods (the interweaving technique with Hedstroem files – the reciprocating technique with Reciproc R25). The variable analyzed was the retreatment time.

Materials and methods

the experiment was conducted by two operators with different backgrounds: the expert operator (E) and the beginner operator (B). Each operator was assigned two groups (n=30) based on the type of substrate used: natural tooth (N) and 3D printed tooth (S). Groups N and S were each divided into two subgroups (n=15), based on the retreatment technique used: interweaving technique (H) and reciprocating technique (R).

The specimens were obturated with Thermafil #30 and AH PLUS. After a period of 7 days, orthograde retreatment was performed.

Subgroup 1: Retreatment with Reciproc

In the first subgroup, the removal attempt was made using the reciprocating R25 instrument (Reciproc, VDW), which was used until the working length was restored and apical patency was verified with a k#10 file.

Subgroup 2: Retreatment with the interweaving technique

In the second subgroup, the procedure began by circumferentially using the rotating instrument #30.07 (Hyflex Remover, Coltene) around the carrier and subsequently, inserting two Hedstroem files into the canal. The files were intertwined and rotated around the carrier, in order to extract it by pulling in the coronal direction.

Results

Natural Tooth

The removal time of the carrier is significantly higher with both the Hedstroem and reciprocating technique for operator B compared to operator E ($p < 0.001$).

3D Printed Tooth

The carrier removal time is significantly lower with the Hedstroem technique for operator B compared to operator E ($p = 0.017$). This difference was not observed with the reciprocating technique ($p = 0.244$). A statistically significant time difference emerged between the two techniques for both operators

Discussions and Conclusions

Regarding the experienced operator, the time for carrier-based filling removal was not influenced by the adopted technique. For the beginner operator, reciprocating instrumentation allowed the retreatment of Thermafil in significantly shorter times compared to the weaving technique.

Endodontic Restorations After the Use of Intracanal Irrigants: Shear Bond Strength Test

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Aim

The Aim of the study is to evaluate whether combined irrigation protocols (IPO, EDTA, CHX) influence the shear bond strength of the adhesive bond in pre-endodontic restoration and to assess the possibility of maintaining the reconstruction as part of the final post-endodontic restoration.

Materials and methods

The composite resin reconstructions were made on human dentin blocks using a universal adhesive system in self-etch mode. The samples were then randomly assigned to one of the following irrigation protocols:

G1: no treatment (CTRL)

G2: application of 5.25% Sodium Hypochlorite (SH) for 10 minutes and final rinse with water G3: application of 5.25% SH for 10 minutes, rinse with water, and final rinse with 2% Chlorhexidine(CHX) for 2 minutes

G4: application of 5.25% SH for 10 minutes, rinse with water, and final rinse with 17% EDTA for 2 minutes

Groups 5-6-7-8 had the same sample numerosity and underwent the same irrigation procedures, with the addition of thermocycling before testing.

All samples were subjected to a shear bond strength (SBS) test. The shear bond strength was calculated as the ratio between the force needed to cause bond failure and the adhesion surface area ($R = F/A$).

Results

Data were analyzed using dedicated statistical software (STATA BE, version 17.1, StataCorp LP, TX,USA), setting the significance level at $\alpha = 0.05$.

The shear bond strength (SBS) was evaluated in eight distinct groups to verify if it is influenced by (A) different irrigation methods and (B) the addition of thermocycling.

It was noted that the shear bond strength values significantly decrease in groups where samples were subjected to thermocycling. The Kruskal-Wallis test showed a statistically significant difference between the groups ($p = 0.0001$). Dunn's post-hoc test was then performed to highlight specific differences between pairs. The post-hoc comparison revealed statistically significant differences between group 2 and group 4, as well as between group 3 and group 4 ($p < 0.05$).

Additionally, statistically significant differences were found between group 5 and group 6 ($p < 0.05$).

Conclusions and future research

The Results of this study indicate that treatment with NaOCl and EDTA seems to improve the adhesive bond's effectiveness compared to other combinations of irrigants. However, these Results should be confirmed by further studies.

All groups subjected to thermocycling showed lower SBS values, consistent with the literature. Among the thermocycled groups, the group treated with NaOCl showed significantly lower SBS values compared to the control group. This suggests that the adhesive bond, following contact with sodium hypochlorite and subsequent thermocycling, is sensitive to temperature variations.

It is currently not evident that the irrigant negatively impacts the adhesive bond at the dental interface. Therefore, the endodontic restoration performed prior to therapy can be maintained as part of the final post-endodontic restoration in clinical scenarios.

Following the Results obtained in the previous experiment, it was decided to continue the investigation, designing a second study, in which the behavior of the adhesive bond will be analyzed using micro-CT (μ CT).

The Washout of the Retrograde Root Filling Made by Three Different Materials in Microsurgical Endodontics: An in-vitro Study

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Aim

Nowaday, MTA and above all bioceramic sealers are considered the gold standard for retrograde root filling. As we know from previous studies, the success rate in the healing of periapical lesions mostly depends on the sealing ability of the material used for the retrograde obturation. The washout of the obturation can compromise the retrograde seal. As several studies have reported cases of washout of retrograde obturations made with MTA during the removal of the hemostatic material from the surgical crypt, the Aim of this study is to experimentally verify the susceptibility to washout and the consequent sealing ability of three different retrograde root filling materials: SuperEBA®, ProRoot MTA® and Well-Root PT®.

Materials and methods

Thirty-six single-rooted extracted teeth were selected for the study using the following inclusion criterias:

Only single canal samples were selected;

All the samples presented fully formed apices;

Sample roots showed no sign of caries, resorptions, cracks, fractures or shape anomalies (such as dilacerations).

Nine porcine mandibles were then scanned using CBCT, selecting the one that had the most suitable bone site for the surgical phase. After that any remaining porcine teeth were extracted to make space for the sample teeth.

Once the fitting of the samples in the alveolus was verified, microsurgical crypt (4mm x 4mm) was created using a Lindemann bur. Apicoectomies were then performed on all 36 samples, cutting the apical 3mm at a 90° angle, followed by 3mm deep retrograde cavity preparation using ProUltra® ultrasonic endo retrotips (Dentsply Sirona®, USA).

The samples were randomized into three groups of equal size (6 samples per group):

Group A: retrograde filling with SuperEBA® (Harry J. Bosworth® Company, IL, USA).

Group B: ProRoot MTA® (Dentsply Sirona®, USA).

Group C: Well-Root PT® (Vericom®, South Korea)

Ferric sulfate was so applied for hemostasis simulation. After retrograde filling, the surgical crypt was rinsed for 20 seconds per sample using high speed bur under constant irrigation to remove ferric sulfate. After one week in incubator All samples were 3Dscanned to analyze washout by measuring the linear distance from the deepest point of the remaining filling material to the apicoectomy resection surface.

Results

The mean washout values were 0.3584 mm in Group A (SuperEBA®), 0.7015 mm in Group B (ProRoot MTA®), and 0.5012 mm in Group C (Well-Root PT®). In order to determine if there was a statistically significant difference among the groups, a one-way ANOVA analysis was conducted. Since the p-value was <0.05, it indicated a statistically significant difference among the three groups.

Subsequently, Tukey's HSD post hoc test was performed to identify which groups exhibited this significant difference. The Results of this test indicated a statistically significant difference between Group A and B, Group A and C, as well as between Group B and C.

Conclusions

This study demonstrates that all retrograde filling materials are prone to washout, with MTA being the most susceptible. Well-Root PT® also showed higher susceptibility than SuperEBA, though lower than MTA. Despite their bioactive advantages in endodontic microsurgery, the main drawback of new retrograde filling materials is their tendency to be displaced during hemostatic agent removal. Thus, different hemostasis methods should be considered when using bioceramic materials. Future research by the authors will focus on protecting retrograde fillings during crypt rinsing to mitigate this issue.

Canal shaping of MTWO instruments with reciprocating movement

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Introduction

This study evaluates a new shaping technique with the Mtwo system, which involves mechanical scouting with austenitic instruments operated with reciprocating motion, without any preliminary preparation of the glide path with manual instruments.

Materials and methods

36 extracted teeth were selected for a total of 72 root canals. Preliminary radiographs were taken prior to accessing the pulp chamber and the canals were controlled for apical patency with a root canal instrument of size 08. The root canal instrumentation was performed using an endodontic motor set with angles of 110° clockwise and 30° counterclockwise at a speed of 250 rpm. The first instrument used was the 20/06, using a gentle in-and-out motion without pressure and carrying out a light brushing when necessary. In cases where some resistance was felt, which would have required greater apical pressure, the instrument was removed and used on 15/05. After reaching the working length with the 20/06, the basic preparation was completed with the 25/06. Each canal was assigned to one of two experimental groups. Group 1: root canals in which the hand file has reached the working length; Group 2: root canals where the hand file didn't reach the working length. After mechanical probing, the effective working length was measured in order to divide the canals of group 2 into medium and difficult.

Results

The working length in group 1 was reached in 25 out of 25 samples, without the use of 15/05. In group 2, 39 samples out of 47 were reached, of which 18 required 15/05. Using 20/06, Group 1 instrumentation time is significantly lower than Group 2. The total instrumentation time was lower in Group 1 than in Group 2, but not significantly.

Conclusions: The working length was reached in 100% of easy canals and 83% of medium and difficult canals. Shaping time with 20/06 is closely related to the anatomical difficulties of the canal. In the second group, three instruments 20/06 and four 15/05 showed a visible deformation of the blades, probably caused by an increase in torsional stress due to the need to cut more dentin.

Evaluation of physicochemical parameters in six endodontic sealers: an in vitro study

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Introduction

The present study Aims to evaluate the physicochemical properties of six endodontic sealers. The tested materials are: AH Plus® Bioceramic Sealer (Dentsply Sirona), AH Plus Jet® Root Canal Sealer (Dentsply Sirona), BioRoot™ Flow (Septodont), Endosequence® BC sealer™ (Brasseler), Endosequence® HiFlow™ (Brasseler), and an Experimental Resin Sealer (Dentsply Sirona).

Materials and methods

Setting time, radiopacity, solubility, flowability, and thickness of the sealers were evaluated following the ISO 6876 (2012) guidelines. Scanning Electron Microscopy (SEM) was used to examine the sealers' surface characterization. The analysis of data distribution was checked by using the Shapiro-Wilk test and after confirming it, the Kruskal-Wallis test was utilized to compare all study groups. Lastly, Dunn test was executed for the pairwise comparisons.

Results

For flowability, all the endodontic sealers exceeded the minimum value requested, corresponding to 17mm. The expected value for the thickness test was 50µm, and none of the tested sealers met this criterion. Only the Experimental Resin Sealer came closest to the aforementioned value showing an average thickness of 60µm. About the solubility and the setting time of the materials, only the Experimental Resin Sealer and the AH Plus Jet® Root Canal Sealer encountered the suggested values. In the radiopacity test, AH

Plus® Bioceramic Sealer, Experimental Resin Sealer, and AH Plus Jet® Root Canal Sealer yielded similar Results, as did BioRoot™ Flow and Endosequence® BC sealer™. Endosequence® HiFlow™ had radiopacity values in between. Through SEM examination, it was possible to observe the structures that the sealers' components could form after the final setting occurred.

Conclusions

The tested sealers all comply with the flowability requirements. AH Plus Jet® and the Experimental Resin Sealer also respected the recommended material hardening value. In contrast, all the other materials showed significantly longer setting times than those specified by the manufacturers. For the film thickness, all the material exceeded the value of 50µm; just the Experimental Resin Sealer showed a value close to 60µm. Regarding radiopacity assessment all tested materials did not meet the expected value, rather they have shown much higher rates. In solubility assessment, none of the materials satisfied the standard except for AH Plus Jet® and the Experimental Resin Sealer. Further studies are required to gain a more comprehensive understanding of these materials, particularly in their clinical application.

Review of the literature in relation to the different access flaps used in endodontic surgery

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Abstract

The incision planning and the choice of flap design are one of the central steps in endodontic surgery, as each type of incision is associated with possible complications.

The flaps described in the literature, which can be used for endodontic surgery, are the following: sulcular flap, triangular flap, trapezoidal (rectangular) flap, semilunar flap (according to Partch), scalloped submarginal flap (according to Oshenbein-Leubke), straight submarginal flap (according to Wadhvani), vertical flap (according to Eskici), flap with preservation of the papilla ("Papilla base" according to Velvard), flap of Lubow flap and flap of Vreeland.

The wide variety of flaps available in endodontic surgery reflects the number of variables to consider before choosing the appropriate flap.

The most useful access flaps are the triangular and rectangular sulcular flaps (full-thickness flaps), the Oshenbein-Leubke scalloped submarginal flap (incomplete full-thickness flap) and the Velvard "Papilla Base" flap (variable full-thickness flap).

These engraving techniques belong to three different groups and are to be used without distinction in all cases. From a clinical point of view, use is based on the evaluation of three fundamental requirements: the exposure of the buccal bone, the risk of aesthetic damage and the presence of attached gingiva.

Conclusions

When the case requires complete exposure of the buccal bone up to the coronal margin or when it is assumed to avoid the use of incomplete (paramarginal) flaps, the correct choice is between the "Papilla Base" flap and a complete full sulcular thickness (triangular or rectangular) depending on the aesthetic relevance of the area. If, however, a large exposure of the bone is not necessary, all the choices are still available and it is necessary to evaluate whether the case has aesthetic relevance, considering the degree of gingival exposure during the smile, regardless of the anterior or posterior position of the affected tooth.

If an apical-marginal defect is expected, the flap of choice is the "Papilla Base" flap when the site of surgery is an aesthetic area, while a full-thickness sulcular flap (triangular or rectangular) will be chosen if the area has no aesthetic importance.

However, when complete exposure of the vestibular portion is not necessary, regardless of whether or not it is in the aesthetic zone, to choose the appropriate flap it is necessary to evaluate the width of the attached gingiva.

If there is a large area of attached gingiva, in the absence of an apico-marginal defect, regardless of the presence or absence of an aesthetic zone, the correct choice is the Oshenbein-Leubke scalloped submarginal flap. Without a wide band of attached gingiva that allows a submarginal flap to be safely incised, the aesthetic importance of the area under consideration must be assessed. In the absence of an apical-marginal defect and without a large area of attached gingiva, in an area of aesthetic importance the correct choice is the "Papilla Base" flap.

In the absence of an apex-marginal defect and without a large area of attached gingiva, if the case does not require aesthetic value, the right choice is a complete full-thickness flap (sulcular, triangular or rectangular). In contemporary dentistry, the goal and success of endodontic surgery is not only the functional maintenance of the teeth, but also the achievement of optimal pink aesthetics. We achieve this result with a careful choice of the access flap.

Micro-CT study on shaping ability and accumulated debris by different kinematics

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Aim

The ideal kinematic should reduce the risk of file breakage and allow the canal treatment without compromising the root canal anatomy and causing damage to the root structure. Hybrid kinematics like Optimum Torque Reverse (OTR) and, more recently, Jeni mode (JENI) have been introduced. The OTR is a movement that combines continuous rotation with reciprocation, integrated in the TriAuto ZX2 (J. Morita Corporation) motor. This motor automatically measured the torque: if the torque is less than the set value, the file continues its clockwise rotation (CW); however, upon reaching the specified torque value, the file changes its continuous rotation with a reversed rotation in a counterclockwise direction by 90° and then continues in the cutting direction (CW) for 180° until the torque decreases below the set value. Jeni motion is a patented digital assistance system, incorporated in Canal Pro Jeni motor (Coltene/Whaledent). This motor constantly assesses several parameters such as pressure, torque, tension, and electrical intensity, adapting, through algorithms, the movement and speed to the degree of torsional stress, applied on the file, facilitating safe and predictable root canal preparation. According to the manufacturer's instructions, this motion does not require pecking, unlike all other kinematics. However, no study has examined the effect of pecking on shaping ability associated with this new kinematic. Moreover, no data are available on the shaping ability, the amount of AHTD and of untouched area with different kinematics using the same file system. In particular, no study has investigated these parameters for OTR and JENI mode by micro-CT.

The Aim of this study was to determine through micro-CT the shaping ability, the amount of accumulated hard tissue debris (AHTD) and untouched area generated by four different kinematics: Continuous Rotation (CR), Reciprocation (REC), Optimum Torque Reverse (OTR) motion, Jeni with pecking (JENI + PEC) and Jeni without pecking (JENI – PEC). The null hypotheses tested were:

- The four-different kinematics produced similar increases surface area, volume, and the amount of AHTD and untouched areas.
- The kinematics tested had similar shaping ability and shaping time.
- Jeni with pecking and Jeni without pecking produced similar Results for the all parameters analyzed.

Materials and methods

Forty mesial roots of mandibular molars with Vertucci type IV were pre-scanned in an X-ray micro-CT cone-beam system, TOMOLAB (www.elettra.trieste.it/Labs/TOMOLAB) and randomized to one of the five experimental groups (n=16), according to the kinematics used for canal preparation: CR, REC, OTR, JENI + PEC and JENI – PEC.

The specimens were decoronated to a standardized length of 16 mm, resulting in a working length (WL) of 15 mm and distal roots were resected. The selected teeth were cleaned by ultrasonic scaler and then stored in sequentially numbered, opaque sealed containers with 0.1% thymol at 5°C.

The root canal preparation was performed with HyFlex EDM (Coltene/Whaledent) up to ISO 0.25 mm and a taper of 0.08 mm/mm. All the preparation was conducted by a single expert operator according to the manufacturer's recommendations, as follows:

Group 1, CR: files were activated in continuous rotation at a constant speed of 400 rpm and 2.6 Ncm set in the Dr's Choice program of CanalPro™ Jeni micromotor (twist off mode).

Group 2, REC: the instruments were used with the reciprocating motion with CW advancement set in the Dr's Choice program of CanalPro™ Jeni micromotor. The reciprocating mode has a 300 rpm speed, 5.0 Ncm and the rotation angle was set at 83, 0, 17 as right, pause and left values, respectively. These parameters are similar to the 150°/30° CW/CCW.

Group 3, OTR: files were employed in the torque-controlled motor Tri Auto ZX2 with its specific 1:1 contra-angle handpiece. The speed was adjusted to 300 rpm, the 180° rotation angle was selected, and the trigger torque was set to 0.8 Ncm.

Group 4, JENI + PEC: the instruments were activated in Jeni automatic mode by CanalPro™ Jeni micromotor according to the manufacturer's instructions. The movement was performed with three peckings of an amplitude of under 3 mm until reaching the WL.

Group 5, JENI – PEC: the instruments were used with the Jeni automatic mode by CanalPro™ Jeni micromotor according to the manufacturer's instructions. The instrument insertion was executed with a continuous movement in apical sense.

The irrigation was conducted, during the instrumentation, with 3 mL 5.25% NaOCl using a disposable syringe on which an Endo Irrigation Needle single side vent was mounted. The final rinse was performed with 3 consecutive cycles of 1 ml of 5.25% NaOCl followed by a 1 ml of 17% EDTA and, finally, 1 ml of distilled water, up to a 1 mm short of the WL. The second micro-CT scan was performed and the matched images of the mesial canals, before and after preparation, were examined, using a commercial software AMIRA 2019.1 (Mercury Computer System Chelmsford), to determine the amount of AHTD and of untouched areas, the canal transportation and the centering ability.

Data were analyzed by using Kruskal-Wallis test and Dunn post hoc test for multiple comparisons with a significance level set at 5%.

Results

An initial examination of preoperative canal volume, and surface area confirmed that the groups were equivalent at the baseline ($p > .05$). During the root canal preparation, there were no occurrences of instrument breakage.

No significant differences were observed among the different kinematics analyzed, in terms of volume and area increase for the entire canal ($p > .05$). Similarly, no statistically significant differences were found for AHTD and the unprepared area between all groups ($p > .05$). However, a significantly larger amount of untouched area was found in the coronal third compared to the middle and apical thirds ($p < .05$) with no difference between these last thirds ($p > .05$) under continuous rotation.

The degree of transportation among the five groups was not significantly different in all the anatomical portion ($p > .05$). However, in the JENI – PEC group, there was more transportation in the coronal than in the apical third ($p < .05$). Centering ratio was significantly higher in the apical region of the JENI – PEC group compared to the same one of the JENI + PEC ($p < .05$). Additionally, in JENI – PEC group the shaping was less centered in the coronal third compared to the middle and apical thirds ($p < .05$) with no difference between these last portions ($p > .05$).

Meanwhile, in the JENI + PEC group, there was a significantly higher centering ratio in the middle third compared to apical third ($p < .05$).

Conclusions

No significant difference was found between the four different kinematics in terms of accumulated hard tissue debris, untouched areas, and root canal transportation; however, Jeni without pecking showed a better centering ratio in the apical portion than Jeni with pecking. The hybrid kinematics OTR and Jeni mode generated a suitable mechanical preparation and preserved the original anatomy of the root canals in a way similar to that of continuous rotation and reciprocation.

Comparison of Shaping Ability Between a Traditional Technique and an Innovative One in Shaping Oval Canals: “The Sliding Brushing Motion”

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Aim

To compare two different shaping techniques for the instrumentations of oval canals: “Sliding selective brushing motion” (SSBM) with small tapered files and traditional pecking motion with increasing taper files.

Materials and methods

The study was conducted on 20 extracted premolars selected according to specific criteria:

- Single-rooted premolars
- Type 1 of Vertucci’s Classification
- Single-canal with OVAL shape
- Teeth without any previous endodontic or conservative treatments
- Adequately preserved in saline solution after extraction

Each sample was firstly scanned at the Micro-CT in order to obtain a 3D calculation of the pretreatment volume to compare it with the post endodontic treatment volume. In order to have a repeatable repositioning, the teeth were englobed with resin in a brass cylinder that served as a model.

The samples were divided into two groups ($n=1$) according to the selected shaping technique:

Group A: The oval root canals were shaped with a traditional pecking technique without any lateral brushing movement using ProTaper Gold systematic up to F3 file (PTG; Dentsply, Tulsa Dental Specialties, Tulsa, OK, USA).

Group B: The oval root canals were shaped using the SSBM technique using VDW Rotate files (VDW, Munich, Germany) up to 30.04 file.

Irrigation, obturation and post-endodontic restoration procedures were performed according to the gold standard evidenced in the literature.

After endodontic and post-endodontic procedures, each sample was secondly scanned at the Micro-CT to obtain post treatment volume accordingly to each one third of the root (coronal, middle and apical).

Throughout the use of ImageJ the untouched areas of the root canal were identified and quantified, both in the total area and in each one third of the root (coronal, middle and apical).

The descriptive analysis was performed on the collected data which are:

1. Non instrumented canal surfaces (SSBM technique VS traditional technique)
2. Coronal third non instrumented canal surfaces (SSBM technique VS traditional technique)
3. Medium third non instrumented canal surfaces (SSBM technique VS traditional technique)
4. Apical third non instrumented canal surfaces (SSBM technique VS traditional technique)
5. Total presence of voids (SSBM technique VS traditional technique) Statistic test “U di Mann-Whitney ($\alpha=0.05$)” was used for this study to evaluate:
 1. Percentage difference in total root canal volumes before and after shaping (SSBM technique VS traditional technique)
 2. Percentage difference in coronal third root canal volumes before and after shaping (SSBM technique VS traditional technique)
 3. Percentage difference in medium third root canal volumes before and after shaping (SSBM technique VS traditional technique)
 4. Percentage difference in apical third root canal volumes before and after shaping (SSBM technique VS traditional technique)

Results

From quality evaluation of the ROI image, scanned with the Micro-CT, it has obtained:

1. Statistically significant difference ($p < .05$) in terms of total untouched root canal areas between the two groups.
2. Statistically significant difference ($p < .05$) in terms of total untouched root canal areas between the two subgroups in both the apical third, the middle third and the coronal third.
3. Non statistically significant difference ($p < .05$) for total gaps between two groups.
4. Non statistically significant difference ($p < .05$) in terms of Percentage difference in total root canal volumes before and after shaping between the two groups.
5. No statistically significant difference ($p < .05$) in terms of Percentage difference of the apical third, the middle third and the coronal third canal volumes before and after shaping between the two subgroups.

Conclusions

According to data, it has been possible to demonstrate that the taper of the instrument and the instrumentation technique can influence endodontic treatment, in terms of both preservations of the root canal anatomy and number of the root canal areas instrumented. So, it can be stated that the SSBM technique allows clinicians to obtain a batter shaping root canal.

Use of guided navigation systems for planning and carrying out interventions in surgical endodontics: a cadaver study

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Introduction

Guided navigation systems (3D-DNS) have been proposed in non-surgical endodontics for the execution of access cavities¹, in retreatments² and in microsurgical endodontics³, where the two most used systems are Navident⁴ and X-Guide⁵.

Currently, there are no comparative studies in the literature between the two most widespread guided navigation systems, compared to the free hand approach (FH).

Objectives of the study

The aim of this study on cadaveric anatomical preparations is to compare two 3D-DNS systems, Navident (ClaroNav, Toronto, Ontario, Canada) and X-Guide (Nobel Biocare, Zurich, Switzerland) and the traditional approach (FH) in the execution of surgical microendodontics interventions.

Materials and methods

Six cephalus anatomical preparations were used for a total of 119 dental sites. All anatomical preparations were subjected to multislice CT (axial acquisition, acquisition thickness 0.625 mm, interval between slices 0.625 mm, kVp 120, mA 200 and rotation time 1 s) to evaluate the localization of the root apices of all the dental elements and for the subsequent planning of the operative phases.

The dental sites considered were randomized and assigned to the three groups: group 1 (Navident), group 2 (Free hand) and group 3 (X-Guide).

The DICOM obtained were acquired in the Navident and X-guide software for planning the microsurgical endodontic interventions.

The 3D-DNS systems were used to perform the ostectomy and apicectomy in all the planned sites using 5.2 mm Trephine drills.

In group 2, ostectomy and apicectomy were performed with a free hand technique, with an operating microscope (Extaro 300 Zeiss).

In all sites, the retrograde cavity was prepared using ultrasonic tips.

The preparations were subjected to a postoperative multislice CT scan for matching with the preoperative images. Preoperative parameters were used (expert-inexperienced operator and difficulty level of the dental site), intraoperative parameters, divided into volumetric (3D removed volume, 2D volume surface and 2D entrance area), and linear (bevel angle °, root resection mm, retrograde preparation depth mm and retrograde preparation coherence) and target precision, intraoperative complications and iatrogenic damage to anatomical structures. Quantitative variables were analyzed with parametric methods, while qualitative variables were analyzed with non-parametric methods. The significance level was set at $p < 0.05$.

Results

Guided navigation systems offer better accuracy and precision than the (FH) method in complex sites, where there is a higher incidence of complications in inexperienced operators. The 3D-DNS technique showed greater precision for all linear and angular parameters of apicectomy ($p < 0.05$).

As regards the data relating to the depth of the retrograde preparation of the root canal system, there is no statistically significant difference ($p > 0.05$).

Discussion

3D-DNS techniques are a valid alternative to the FH technique, especially in the hands of an inexperienced operator, precision and accuracy are also better in 3D-DNS techniques compared to FH and the data we obtained are in line with those present in the literature. Aldahmash in 2022³ and Dianat in 2021⁵ applied this technology on anatomical preparations, reaching the conclusion that this method allows an accurate, rapid ostectomy with a smaller volume of bone removed, defining it as safe and very useful in the posterior mandibular sector.

Conclusion

3D-DNS techniques reduce osteotomy and apical resection times, offer greater precision and accuracy in complex sites, and a lower incidence of complications in the inexperienced operator compared to free hand techniques.

Bibliography

1. Dynamically Navigated versus Freehand Access Cavity Preparation: A Comparative Study on Substance Loss Using Simulated Calcified Canals
2. Sameer D. Jain, Madison W. Saunders, Caroline K. Carrico, Aniket Jadhav, Janina Golob Deeb, Garry L. Myers. JOE Volume 46 Number 11 November 2020
3. Endodontic Retreatment Using Dynamic Navigation: Case Report Jonathan Bardales-Alcocer, Marco Ramirez-Salomon, Elma Vega-Lizama, Maria Lopez Villanueva, Gabriel Alvarado-Cardenas, Kenneth S. Serota, Jorgeraul Ramirez-Wong. JOE Volume 47 Number 6 March 2021 3.Real-Time 3-dimensional Dynamic Navigation System in Endodontic Microsurgery: A Cadaver Study Sara A. Aldahmash, JeJery B. Price, Behzad Mostoufi, Ina L. Grijin, Omid Dianat, Patricia A. Tordik, frederico C. Martinho. JOE Volume 48 Number 7 July 2022
4. Endodontic Microsurgery Using Dynamic Navigation System: A Case Report Gianluca Gambarini, Massimo Galli, Luigi V. Stefanelli, Dario Di Nardo, Antonio Morese, Marco Seracchiani, Francesca De Angelis, Stefano Di Carlo. JOE Volume 45 Number 11 September 2019
5. Accuracy and efficiency of guided root-end resection using a dynamic navigation system: a human cadaver study O. Dianat, A. Nosrat, B. Mostoufi, J.B. Price, S. Gupta, F. C. Martinho. IEJ Volume 54 Number 5 May 2021

Antibacterial Activity in vitro of Bioactive Cements Against Enterococcus Faecalis Biofilm

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Aim

This study Aims to evaluate the antibacterial effect of two bioactive endodontic cements, NeoSealer Flo (Avalon Biomed, Houston, TX, USA) and AH Plus Bioceramic Sealer ([Dentsply Sirona USA](#)), against Enterococcus Faecalis biofilm, using a protocol that reflects clinical reality and is repeatable over time. The focus is on the antibacterial and antibiofilm capabilities of these materials to improve endodontic treatment efficacy and reduce persistent infections.

Material and Methods

- **Samples:** 40 single-rooted teeth, extracted for orthodontic or periodontal reasons.
- **Preparation:** Teeth treated with sodium hypochlorite, stored in physiological solution, decoronated, apical patency confirmed, and working length measured. Canals shaped with WaveOne Gold NiTi instruments, irrigated with sodium hypochlorite and EDTA, autoclaved, and inoculated with Enterococcus Faecalis.
- **Groups:** Divided into 4 groups:
 - Group A (negative control): 10 teeth with culture medium.
 - Group B: 10 teeth inoculated with Enterococcus Faecalis biofilm without cement.
 - Group C: 10 teeth inoculated with biofilm, sealed with NeoSealer Flo.
 - Group D: 10 teeth inoculated with biofilm, sealed with AH Plus Bioceramic Sealer.
- **Evaluation:** Bacteria grown, inoculated, and incubated in teeth. Cements applied using Flex Flo Tip. Teeth embedded in epoxy resin, sectioned, and stained with LIVE/DEAD kit. Images captured using a confocal microscope and analyzed.

Results

- No significant differences between NeoSealer Flo (Group C) and AH Plus Bioceramic Sealer (Group D) in coronal, middle, and apical thirds ($p > 0.05$).
- Significant differences between Groups C and D compared to control groups (A and B) in reducing bacterial count ($p < 0.05$).
- Significant difference in live bacteria percentage between coronal and apical thirds in both Groups C and D.

Conclusions

It can be concluded that bioactive cements exhibit an antibacterial effect, with no significant differences observed between the two products used in the study.

Influence of Root Canal Treatment on The Chemical and Mechanical Properties of Radicular Dentin

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Aim

The Aim of the present study is to evaluate, in patients of the same age group (45-55), the chemical and mechanical properties of the root dentin of elements with endodontic treatment at least 15 years old by comparing it with elements with recently treated dentin. These data were obtained using nanoindentation for the mechanical characteristics and Raman spectroscopy for the chemical ones.

Materials and methods

For the following study, 32 permanent single-rooted human teeth were collected from patients aged between 45 and 55 years, equally divided between vital elements (n=16) (RCT) and treated endodontically approximately 15 years previously (n=16) (RCR-T). These were then decrowned and respectively treated and re-treated endodontically; subsequently the post-space was prepared in each one and a fiber post was cemented. Finally, 3 cross slices 1mm thick were obtained from each sample, corresponding to the coronal, middle and apical third of the post-space and incorporated into the photo-polymerizable resin.

Results

Mechanical properties

The Results, obtained through nanoindentation, showed that teeth with old endodontic treatment (RCR-T) present worse mechanical characteristics, resulting more fragile and less elastic. On the other hand, the percentage of plasticization is increased showing that in RCR-T teeth there is a tendency to accumulate irreversible deformations.

Chemical properties

As regards the chemical properties, the Results were obtained using Raman spectroscopy.

Starting from the analysis of the inorganic component, a higher mineral-matrix ratio (understood as the ratio between phosphate and amide I) was found in samples with freshly treated dentin (RCT).

Moving on to the phosphate analysis: this was almost comparable between the two groups examined, but considering that the carbonate/phosphate ratio is significantly higher in the RCR-T group, it can be deduced that in the RCR-T samples there was a considerable substitution of carbonate in the structure of hydroxyapatite. This, consequently, would explain the worsening of the mechanical characteristics.

Taking into account the organic component of the root dentin tissue, the tissue with dated endodontic treatment (RCR-T) is characterized by a significantly lower Amide I/Amide III ratio. Similar Results are also found for the Amide I/CH₂ ratio.

These two parameters just described are an expression of the organization of the collagen structure that appears worsened in RCR-T samples.

Comparing the peak intensities corresponding to Amide III, CH₂ and Amide I, which are indicators of the amount of the organic component, an increase in RCR-T samples can be seen.

Conclusions

The loss of strength of the endodontically treated tooth certainly has multifactorial causes. One of the determining factors remains the loss of dental substance caused by previous pathologies (caries and traumas) and by root canal shaping procedures, and conservative-prosthetic ones. That said, taking into account the limitations of the present study, the Results just presented show that endodontic treatment produces, over the years, a chemical and structural decay of the root dentin. These important changes could play an important role in the survival of the endodontically treated tooth. The present work is among the first to deal with the chemical and structural properties of root dentin subjected to years of function after endodontic treatment. However, other studies are needed to better understand the correlation of chemical properties with mechanical properties and their role in the increased fragility of the endodontically treated tooth.