

ESE
2019



Vienna calling

experience **the** sound **of** Endodontology

General Endodontic Abstracts

19th Biennial ESE Congress

11-14 September 2019
Austria Center Vienna

Contents

Thursday 12th September	3
Treatment planning	3
Local anaesthesia and pain control.....	6
Access cavity preparation	7
Tooth and canal anatomy	8
Canal preparation - cleaning ability	13
Canal preparation - shaping ability	15
Irrigants/medicaments - antimicrobial activity.....	25
Irrigants/medicaments - canal cleaning.....	43
Irrigants/medicaments - dentine disinfection	48
Irrigants/medicaments - other.....	50
Friday 13th September	59
Instruments – cyclic fatigue and fracture	59
Canal filling – general.....	67
Canal filling - leakage	73
Canal filling – MTA/calcium silicate cements.....	75
Canal filling - sealers	81
Restoration of root filled teeth	87
Education	88
Imaging.....	93
Pulp and periapical tissue biology and pathology	95
Microbiology	103
Biocompatibility and bioactivity	104
Endo-perio-ortho-implant relation	106
Epidemiology.....	107
Saturday 14th September	114
Evaluation of a technique/materials.....	114
New clinical techniques and materials	125
Endodontic revitalization/regeneration	128
Endodontic surgery	132
Root canal retreatment	136
Clinical outcome studies – endodontic surgery.....	142
Clinical outcome studies – root canal treatment and retreatment.....	143
Case report or case series	150
Trauma and root fractures.....	165
Other	167

Thursday 12th September

Treatment planning

GE1

The dental and general health of patients requiring root canal treatment in New Zealand: a pilot study

*Gilroy FG¹, Chandler NP¹, Daniel B², Friedlander LT¹

¹Department of Oral Rehabilitation, ²Higher Education Development Centre, University of Otago, Dunedin, New Zealand

Aim To pilot a questionnaire exploring the dental history and general health of patients receiving root canal treatment (RCT) in New Zealand.

Methodology Ethical approval was obtained and a mixed-methods questionnaire collecting information about dental and general health was developed and piloted for use in a larger study. Questionnaire data was collected from 39 participants receiving RCT in postgraduate and undergraduate clinics at the University of Otago, Faculty of Dentistry, and with a private specialist. Data was evaluated using descriptive statistics and thematic analysis.

Results The questionnaire was effective in providing quantitative and qualitative data. The mean age of patients was 50 years (range 24 – 76 years) and 94% were of European descent. Half the patients regularly attended the dentist for routine examinations and radiographs, and 75% of patients had previously had RCT. Most reported a positive experience of RCT which was influenced by the dentist's skills, and communication. The main reason patients opted for RCT rather than extraction was to retain the dentition followed by function and aesthetics. Most patients' rated their general health as 'fair to good' and this was often better than how they perceived their dental health. Healthy diet and exercise were considered important, with almost all respondents engaging in physical activity three times per week. Patients had a range of medical conditions and 75% were

taking regular medications. Existing conditions that were well controlled did not negatively influence perception of health.

Conclusions The questionnaire is suitable for use in a national study of patients requiring RCT and is effective in providing information related to the general health of patients presenting for care.

Patients' have differing perceptions of their general and dental health, and experience of RCT is mostly influenced by a professional, well-communicated approach by the clinician.

Acknowledgements This study was supported by a Fuller Scholarship, University of Otago.



SAPIENZA
UNIVERSITÀ DI ROMA



UNIVERSITETI I MJEKESISE, TIRANE
FAKULTETI I MJEKESISE DENTARE



DIAGNOSIS AND TREATMENT PLANNING WITH 3D ENDO SOFTWARE

Isufi A^{*1,2}, Xhajanka E², Plotino G³

¹ Department of Endodontics, "Sapienza" - University of Rome, Italy

² Faculty of Medical Dentistry, Tirana, Albania

³ Private Practice, Rome, Italy

Aim: To discuss the use of 3D Endo software for the visualization, diagnosis and treatment planning in a second upper premolar with chronic periapical periodontitis.

Introduction: CBCT-based software enable preplanning and optimization of endodontic treatments on the basis of imaging. The use of 3D data and its specific visualization allow analyzation of the natural shape of the root canal, measurements and virtual simulation of endodontic treatment.

Case Presentation: The patient, male 35 years old was diagnosed with chronic apical periodontitis and it was necessary to perform endodontic treatment.

CBCT data were exported as DICOM files and imported into 3D Endo Software to evaluate 3D tooth anatomy, isolate second upper right premolar and diagnose the pathology of chronic apical periodontitis. The software enabled identifying root canal, mark canal orifice and apical foramen to evaluate 3D canal anatomy and measure the curvature of 139.7°.

After case study and treatment planning, a conservative access cavity was performed. The root canal was shaped with reciprocating instruments to 0.40 diameter at the apex. Irrigation with sodium hypochlorite and EDTA, activated with sonic system EDDY during the hole preparation. Each activation with EDDY was for 20 second and 1 minute at the end of preparation (3 time for 20 seconds). The endodontic treatment was performed in one session because the canal could be dried. Resin- based cement and vertical condensation of gutta-percha technique were used to fill the root canal.

The tooth was then restored with resin composite.



Discussion: CBCT is used in endodontic therapy for the study of root canal anatomy, evaluation of endodontic treatment, in retreatments, allowing better understanding of three dimensional anatomy and its variability. The use of in vivo CBCT and 3D reconstruction software provide a significantly faster image acquisition and reconstruction scheme, with relatively high resolution images for effective evaluation of root canal morphology, accurate identification of apical periodontitis and presurgical planning in root-end surgeries.

Conclusion & Clinical Relevance: Virtual evaluation and 3D reconstruction software provide the ability to visualize and manipulate, measure and simulate the root canal treatment itself. These preoperative procedures will increase predictability of the chosen technique, improve applicability of the treatment plan, shorten operative time and improve communication with patients.

References

- Gambarini G *et al.*, A preliminary assessment of a new dedicated endodontic software for use with CBCT images to evaluate the canal complexity of mandibular molars. *Int Endod J.* 2018 Mar;51(3):259-268.
W.J. van der Meer, *et al.*, 3D Computer aided treatment planning in endodontics, *Journal of Dentistry* (2016), <http://dx.doi.org/10.1016/j.jdent.2015.11.007>
<http://www.sirona.com/en/news-events/news-press/corporate-news-detail/34009/>

Local anaesthesia and pain control

GE3

Anaesthetic efficacy of a volume of 3.6 mL versus 1.8 mL for inferior alveolar nerve block in mandibular molars: a systematic review and meta-analysis

Saatchi M, *Khazaei S, Khademi A

Department of Endodontics, Isfahan University of Medical Sciences, Isfahan, Islamic Republic of Iran

Aim To compare the success rate of 3.6 mL versus 1.8 mL anesthetic solution for achieving pulpal anesthesia in mandibular molars using inferior alveolar nerve block (IANB).

Methodology The present systematic review and meta-analysis protocol was registered in the PROSPERO database (CRD42017057654). Comprehensive searches were carried out in PubMed, Scopus, the Cochrane Central Register of Controlled Trials, the U.S. National Institutes of Health and Iranian Registry of Clinical Trials. Randomized, controlled trials that evaluated the pulpal anesthetic efficacy of 3.6 mL and 1.8 mL volumes of any anesthetic solution via any delivery technique with or without vasoconstrictor were considered. Assessment of the risk of bias was evaluated based on The Cochrane Collaboration “Risk of Bias” tool. All data were treated as dichotomous and results were report as risk ratio (RR) with 95% confidence intervals (CI) in which were pooled using the random-effects model and the Mantel-Haenszel statistical method by Review Manager Software (RevMan Version 5.3).

Results In both normal healthy teeth and irreversible pulpitis teeth, using 3.6 mL volume of anesthetic solution was more likely than 1.8 mL volume to achieve successful anesthesia (7 trials; risk ratio [RR], 1.56; 95% confidence interval [CI], 1.41–2.13; $P = 0.0006$; $I^2 = 57\%$). Subgroup analysis showed that in participants with normal healthy teeth, there was no significant difference between using 3.6 mL and 1.8 mL volume of anesthetic solution (3 trials; RR, 1.28; 95%CI, 0.95–1.75; $P = 0.11$; $I^2 = 48\%$). Beside, in participants with irreversible pulpitis teeth using 3.6 mL volume of anesthetic

solution was more likely than 1.8 mL volume to achieve successful anesthesia (4 trials; RR, 2.17; 95%CI, 1.37–3.43; P = 0.0009; I2 = 25%).

Conclusions Using volume of 3.6 mL of anesthetic solution for achieving pulpal anesthesia in symptomatic mandibular molars is recommended.

Access cavity preparation

GE4

Effect of conservative endodontic buccal access cavity preparation on the fracture strength of maxillary and mandibular premolar teeth

*Gündoğar M¹, Plotino G², Isufi A³, Grande NM⁴, Uslu G⁵, Özyürek T⁶

¹*Department of Endodontics, İstanbul Medipol University, İstanbul, Turkey,* ²*Department of Endodontics, Grande Plotino & Torsello – Studio di Odontoiatria, Rome, Italy,* ³*Department of Oral and Maxillo- Facial Sciences, Sapienza University of Rome, Rome, Italy,* ⁴*Department of Endodontics, Catholic University of Sacred Heart, Rome, Italy,* ⁵*Department of Endodontics, Çanakkale Onsekiz Mart University, Çanakkale, Turkey,* ⁶*Department of Endodontics, İstanbul Medeniyet University, İstanbul, Turkey*

Aim To compare the fracture strengths of maxillary and mandibular premolar teeth with buccal penetrating caries prepared with a buccal endodontic cavity (BEC) and a buccal-occlusal cavity (BOEC).

Methodology Forty-eight maxillary and mandibular premolar teeth were randomly divided into 2 groups and 3 subgroups. In group 1 maxillary premolar teeth, in group 2 mandibular premolar teeth. In subgroups 1 teeth were kept intact. In subgroup 2 BECs, and in subgroup 3 BOECs were prepared. Then, the teeth were restored using composite resin. All specimens in each group were exposed to 1.2 million cycles of thermomechanical fatigue loading in a computer-controlled dual-axis chewing simulator. All specimens that did not fracture during the dynamic loading were loaded until fracture

in a universal testing machine. Data were analyzed using two-way analysis of variance and Tukey tests at 5% significance level.

Results The intact teeth groups and the BECs groups showed the highest fracture strength values in both maxillary and mandibular premolar teeth ($P < 0.05$). There was no significant difference between intact teeth group and BECs groups in terms of fracture strength values ($P > 0.05$). The BOECs groups showed the lowest fracture strength values in both maxillary and mandibular premolar teeth ($P < 0.05$).

Conclusions Within the limitation of the present study, conservative access cavity preparation (BOEC) in maxillary and mandibular premolar teeth improved their fracture strength values compared to traditional cavity preparation (BEC).

Tooth and canal anatomy

GE5

A cone-beam computed tomographic study of root and canal morphology of maxillary and mandibular premolars in a Moroccan population

*Drouri S, Dhoum S, Benkiran I, Dhaimy S

Department of Restorative Dentistry and Endodontics, Hassan II University, Casablanca, Morocco

Aim Evaluation of the number of roots and their length of maxillary and mandibular premolars in a Moroccan population using CBCT.

Methodology 919 premolars were evaluated, 180 were first maxillary premolars, 178 were secondary maxillary premolars, 304 were first mandibular premolars and 257 were secondary mandibular premolars, The CBCT images were obtained using a CBCT scanner then the number of roots as well as their length were evaluated using “Planmeca viewer” software (version 3.2.7). The statistical analysis was then carried out using the Epi info 6 software.

Results Maxillary first premolars: 38.3% were single rooted with an average length of 21.74mm +/- 2.002mm, and 61.7% presented two roots with an average length of 21.92mm +/-1.860mm for the buccal roots, and 20.67mm +/-1.951mm for the lingual roots.

Conclusions the results showed a high prevalence of two rooted maxillary first premolars, as for the maxillary second premolars and mandibular first and second premolars, the number of single rooted teeth was the most frequent. Regarding the mean length, the maxillary first premolars' was of 21.74mm for the single rooted teeth, 21.92mm for the buccal roots and of 20.67mm for the lingual roots of the bi-rooted ones. The maxillary second premolars' was of 21.4mm and the mandibular premolars exhibited the same mean length which was of 21.5mm.

GE6

Bilateral symmetry of the roots and root canal system of permanent mandibular first molars in Saudi population: *in vivo* cone-beam computed tomography study

Gambarini G¹, Shibani M¹, Almasrahi M², *Almalwi A³, Mashyakhy M¹

¹*Odontostomatological Sciences and Maxillo Facciali, University of Rome "La Sapienza", Rome, Italy,*

²*Ministry of Health, Jazan, Saudi Arabia,* ³*Restorative Department, School of Dentistry, The University of Sheffield, Sheffield, United Kingdom*

Aim To identify the presence of bilateral symmetry of the first molars in the same patient in regard to the number of roots, canals and canal's configuration according to Vertucci classification.

Methodology A total of 174 mandibular first molars CBCT scans of (61 males and 37 females) with an age range between 18–50 years were collected, using (3D Accuitomo 170 machine (MORITA, Japan). The CBCT images were accessed and evaluated by two endodontists and any disagreement in the assessment was resolved by consensus.

Results Out of 98 patients, 77 had both right and left first mandibular molars. With regard to the number of roots; the right and left sides showed 100% symmetry. Three canals were the most

prevalent in both right and left quadrant 51/58 (87.9%). The most common bilateral canal system configuration in mesial root was type IV representing 40/48 of cases (83.3%), and type I in distal root representing 55/61 of cases (90.2 %).

Conclusions There is a high possibility of having the same external anatomy and internal morphology in right and left mandibular first molars in the same patient, so the clinician should be aware of the present anatomy. However, variations might happen so a CBCT small field of view scan is recommended when complicated anatomy is suspected in periapical x-ray.



Endodontic treatment of mandibular premolar teeth with atypical root canal morphology: 2 case report

Birgul Eren, Barış Kandemir

Baskent University, Department of Endodontology, Ankara, TURKEY



Aim

To report the treatment of mandibular premolar teeth with atypical root canal morphology

Introduction

The major causes of endodontic failures depend on inadequate obturation all of the root canals. To achieve endodontic success the entire root canal system must be debrided, disinfected and obturated. Anatomically lower premolars are described as teeth with single root and single root canal. However they could be the most challenging to treat due to the failure to identify the complex variations in their root canal morphology.

Case Presentation

Case 1: A 36-year-old man presented to our clinic with pain in left second mandibular premolar. On intraoral clinical examination considerable destruction by caries was visible in distal surface of the tooth. Radiographic examination showed that the teeth #35 with atypical root canal morphology. Following anesthesia, the tooth was isolated with rubber-dam. The endodontic access cavity was opened by cleaning the caries and working length was established. During the management, the teeth was debrided, irrigated and calcium hydroxide paste was placed in to the root canals for one week. In the second session, the root canals were filled with X2 gutta-percha points and AH 26 (Dentsply De Trey, Konstanz, Germany) sealer.



Case 2: A 41-year-old male come to our clinic with severe pain in left mandibular region. On intraoral clinical examination deep caries was visible in distal surface of the teeth #35. Radiographic examination showed that teeth #35 with unusual root canal morphology. The access cavity was opened under local anesthesia. The tooth was isolated with rubber-dam and chemomechanical preparation of the root canals were performed. The canals were obturated with lateral condensation of gutta-percha with AH Plus sealer.



Discussion

Good quality periapical radiographs and the careful evaluation of additional root canals are important. As a general principle, if the diameter of the middle third of the root canal is equal to or greater than the coronal diameter, it is possible to find variations in the root canal configuration. In these cases, an additional radiograph should be taken from the mesial or distal. If a radiolucent line is observed at the mesial or distal of the main canal at the radiograph, an additional canal should be suspected. In addition, if there is a wide canal in the cervical third of the root, it should be considered that there can be more than one canal in the middle or apical third, if it suddenly becomes narrow or disappear.

Conclusion

In conclusion, although the incidence of multi-canal mandibular second premolar teeth is inconsiderable, but the presence of second or third canals should be carefully and clinically investigated in each case in which an additional canal is suspected during the root-canal treatment.

References

1. Vertucci FJ. Root canal morphology and its relationship to endodontic procedures. *Endodontic Topics*. 2005; 10: 3-29.
2. England M, Hartwell GR, Lance JR. Detection and treatment of multiple canals in mandibular premolars. *J Endod*. 1991; 17: 174-8.
3. Rödiger T, Hülsmann M. Diagnosis and root canal treatment of a mandibular second premolar with three root canals. *Int Endod J*. 2003; 36: 912-9.

Endodontic Management of Maxillary Premolars: Three roots & Vertucci Type II configurations

S. Al Akhond, A. Dutta*

*MClinDent Endod. postgraduate Dentist
*Consultant in Restorative Dentistry



Aim

Discuss the diagnosis and successful non-surgical retreatment of a case presentation of a three-rooted maxillary first premolar (U14) and a Vertucci type II canal anatomy in a maxillary second premolar (U15).

Introduction

The objective of root canal treatment is to perform complete debridement of the root canal and subsequent obturation to facilitate healing of periapical lesions. Inadequate shaping and cleaning of the root canal space may lead to persistence of post-treatment apical pathology. This becomes more likely with the presence of additional root canal systems that are difficult to locate.

Pre-operative clinical photos



Pre-Operative radiograph



Restorability assessment of U14



Case Presentation

- A healthy 36-year-old male patient was referred to the Cardiff Dental School with pain associated with both upper left first and second premolars.
- The patient had previously undergone endodontic treatment for the teeth more than 2 years ago with the general dental practitioner.
- Clinical examination revealed a sinus tract located midway between the apices of upper first and second premolars. Both teeth were non-responsive to cold and electronic pulp tests. Tenderness to palpation and percussion was positive for both. (Fig. 1 & 2)
- A preoperative periapical radiograph confirmed previous endodontic treatment and well-defined periapical radiolucencies were associated with both teeth. (Fig. 3)

Radiographs of U14



Radiographs of U15



Restorability assessment of upper left 5



Preparation of both upper left 4 and 5



Temporary crowns



Treatment

- U14 & 5 were treated over multiple visits with calcium hydroxide interappointment dressing.
- Gutta percha was removed using Healonix files and Eucalyptol oil.
- Working length was determined by a periapical radiograph and Root ZX periapical (Moriita).
- Buccal canal of U14 bifurcated into two canals which were positioned mesially and distally. A separate palatal canal was seen in the palatal root. This configuration was observed under the microscope. A straight-line access was achieved for the common portion of the root trunk reflected in the long pulp chamber using piezosonic ultrasonic tips. Both buccal canals were negotiated and instrumented with ProTaper Gold.
- Canals were irrigated with 1% NaOCl between instrumentation and this was activated with ultrasonics.
- Canals were obturated with continuous wave technique.
- The master apical files for the U15 did not reach full working length when placed together. This was also observed with the placement of the master cones. This was an indication that both canals joined apically and shared a single foramen (Vertucci type II).
- The U15 canals were obturated with both master cones placed together, down packed and then backfilled with injectable thermoplasticized gutta percha (ITCP).

Discussion

Identifying and accessing root canals can be challenging especially with atypical canal configuration. The maxillary first premolar has a highly variable canal and root morphology, commonly with two separate canals and two foramina. In most cases, they feature two coronal roots, buccal and palatal, with one canal in each root (1). Studies have revealed that up to 5-6% of maxillary first premolars have three canals (1, 2). Although a preoperative radiograph is a two-dimensional view of a three-dimensional object, there are some features that suggest the presence of a third canal root. A sudden loss of radiolucency in the pulp chamber and a greater mesiodistal diameter in the middle third is an indication of the presence of an additional root in maxillary first premolars (3). If the pulp chamber appears to deviate from a normal configuration and seems to be either triangular in shape or large on mesiodistal plane, more than one root canal may be suspected (4). Endodontic treatment of such morphology has to be adjusted by modifying the outline of the access cavity from elliptical to triangular, with the base toward the buccal aspect and the apex toward the lingual aspect. Such premolars with three canal morphology have been previously reported (5). The use of ultrasonics in the long pulp chamber helped gain good straight line access to all three canal orifices. This aided canal orifice visualization & therefore was paramount. Even though shaping & cleaning was relatively simple for the U14, obturation was challenging owing to very limited coronal space. We used Buchanan's technique, but placed all three cones at the same time and used a System B tip to sever these at the canal orifices, almost halfway down the root, which was technically demanding. This was followed by a downpack for each root canal & and backfill to their respective orifices before using ITCP to fill the remainder coronal segment.

Conclusion

In the case presented, the critical step for locating the second buccal canal using tactile examination with the aid of magnification & ultrasonics was pivotal in successfully completing the endodontic treatment. Recognition and knowledge of anatomical variations based on radiographic presentation and clinical intra-operative findings are crucial for providing expert endodontic care at the specialist level.

References

- Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surgery, Oral Medicine, Oral Pathology. 1984;58(5):589-98.
- Vertucci FJ, Goggin RA. Root canal morphology of the maxillary first premolar. J Am Dent Assoc. 1976;99(2):194-6.
- Arora MB, Bissani T. Diagnosis and Treatment of Three-Rooted Maxillary Premolars. European Journal of Dentistry. 2005;3(7): 63-6.
- Salazar AO, Sroufe SD, Amadio M. Maxillary first premolar with three root canals: a case report. Annals of Indian postgraduate medicine. 2013;17(1):181-186.
- Nelson R, Raftery G. Evaluating the maxillary premolar with three canals for endodontic therapy. J Endod. 1991;17(11):521-7.

GE9

Modified root canal treatment for a 37-mm length maxillary canine:

*Hussain SE, Awooda EM

Department of Endodontics, University of Medical Science and Technology, Khartoum, Sudan

A 75-year old man came for filling of decayed upper front teeth. Radiographically tooth No. #13 showed abnormally of length, clinically it was caries and not tender to percussion. Diagnosis made was asymptomatic irreversible pulpitis with normal apical tissues of a rare case canine of 37-mm length. Root canal treatment in such cases is challenging, that necessitated modification of the instruments and techniques to negotiate root canal and to obturate to the full working length. This case illustrated the use of hand H-files (ISO) with removal of the plastic head that grasped by dental tweezer and the canal prepared in push –pull movement and obturated conventionally through lateral condensation technique.

Key words: alternative treatment, hand H-file, Lengthy Root Canals, maxillary cuspid.

Canal preparation - cleaning ability

GE10

***In vitro* comparison of XP-Endo shaper VS Ultrasonic Irrigation for the removal of intracanal dressing**

Hofmann-Saucedo ME, Garcia-Briones JC, Lopez-Hernandez LC, Carrillo-Varguez LH, Estrada-Cardenas CE

Department of Endodontics, Universidad Autonoma de Baja California, Tijuana, Mexico

Aim To assess and compare the capacity of intracanal dressing removal between XP-Endo shaper and Ultrasonic irrigation on apical third.

Methodology The crown of 34 freshly extracted tooth was removed to get 15 mm of length for each root sample. All samples were instrumented to 40/04 (EdgeFile X7) and irrigated with 5 mL of 5.25% NaOCl, then dried with paper points. 2 samples were taken for negative control group. Remaining samples were obturated with calcium hydroxide paste at 0.6% (w/v). Samples were incubated at

room temperature for 7 days. 2 samples were taken for positive control group. Remaining samples were randomly divided into 2 groups. Group A (n=15): Samples were irrigated with 2 mL of NaOCl (5.25%) and ultrasonic was activated 3 times for 20 seconds each. Group B (n=15): Samples were irrigated with 2 mL of NaOCl (5.25%) and XP-Endo Shaper was activated for 60 seconds. All samples were fixed in formol. Samples were longitudinally divided with a diamond disc and the surface of the apical third were analyzed with Scanning Electron Microscopy at 2000x.

Results Three unrelated evaluators analyzed the micrograph of all 34 samples and gave scores of 0 to 4 depending of the remaining Calcium hydroxide on the surfaces. Group B showed better removal of Calcium Hydroxide with statistically difference ($p < 0.05$).

Conclusions The current assay showed that XP-Endo Shaper is better than ultrasonic for the removal of intracanal dressing in apical third

GE11

Endodontic retreatment of calcium silicate-based sealers: a scanning electron microscope analysis

Cameli V¹, Lavigna P², Grande NM¹, *Castagnola R¹, Rengo C², Fortunato L², Marigo L¹

¹*Department of Operative Dentistry and Endodontics, Catholic University of the Sacred Heart, Rome,*

²*Department of Cariology, Magna Graecia University, Catanzaro, Italy*

Aim To evaluate in vitro the quality of endodontic non-surgical retreatment of single-rooted teeth, filled with gutta-percha and three different sealers (EndoSequence BC SealerTM [Brasseler, Savannah, Georgia, USA], BioRootTM RCS [Septodont, France] and Pulp Canal SealerTM [Kerr, Italy]), using reciprocating instruments (Reciproc® [VDW, Munich, Germany]).

Methodology Fifty single-rooted teeth were selected and randomly divided into 5 groups (n = 10) with regards to the sealer used and the tug-back of the gutta-percha master cone (up to the working length or 2 mm shorter than the apical foramen). For all the samples, the following data were recorded: possibility and time of retreatment and residual root canal debris at scanning electron

microscope. Data were analysed using the one-way ANOVA test and HSD Tukey for multiple comparisons regarding the time variable, and Kruskal Wallis test for the residual debris. The level of significance was set at $P < 0.05$.

Results The retreatment in the control group has been faster than in experimental groups ($P < 0.05$). Patency was achieved in 49 out of 50 samples. Differences in the amount of post-retreatment debris were found between the control group and the experimental groups ($P < 0.05$), but not within the experimental groups ($P > 0.05$). The coronal and middle thirds were the areas with the greatest percentage of residual debris. In the apical third there were no differences in terms of debris removal among the groups ($P > 0.05$).

Conclusions The complete removal of filling material from the endodontic system was not obtained in any sample. Calcium silicate-based sealers can be retreated, even when a 2 mm apical stop of bioceramic material was present, although the increased time of instrumentation demonstrated a more difficult retreatment possibility if compared with traditional sealer and gutta-percha. Reciprocating instruments showed effectiveness in terms of safety and speed during endodontic retreatment.

Canal preparation - shaping ability

GE12

Micro-CT assessment of dentineal microcracks during root canal preparation with three novel instruments in young premolars

Katanec T¹, Miletic I², Barsic G³, *Jukic Krmek S²

¹Department of Oral Surgery, School of Dental Medicine, ²Department of Endodontics and Restorative Dentistry, School of Dental Medicine, ³Department of Quality, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Zagreb, Croatia

Aim To explore microcracks formation after root canal preparation with Self Adjusting File (SAF), Reciproc Blue and ProTaper Next on young, freshly extracted premolars by means of micro CT images.

Methodology Thirty upper premolars with two canals extracted due to orthodontic reasons from the patients age from 16 to 20, stored up to 2 months in saline solution were selected. Specimens were decoronated and imbedded in polysiloxane impression material and acrylic mould. Teeth were scanned at structural resolution of 20.2 µm and randomly divided in three groups: SAF, Reciproc Blue and ProTaper Next. Specimens were instrumented according manufacturer instructions with matching glide path instrument. Irrigation was performed with 12 ml of 2.5% NaOCl and 4 ml of 17% EDTA per root canal. Then, the specimens were scanned in the same conditions as before. In order to analyse the presence of microcracks in dentineal walls, image-processing software Volume Graphics VGStudio Max 3 was used.

Results In all evaluated samples no any dentineal defect was found, in pre- and neither in post-operative scans.

Conclusions Under the circumstances of this study it can be concluded that instruments with improved design and metallurgy do not cause dentineal defects in young premolar teeth.

Acknowledgements This study is funded by Croatian science foundation, project “Investigation and Development of New Micro and Nanostructural Bioactive Materials in Dental Medicine” , BIODENTMED No. IP-2018-01-1719.

GE13

Evaluation of root canal treatment efficacy and root dentine changes after instrumentation with Protaper Univ and SAF Systems.

*Galieva D, Sobkina N, Ostanina D, Mitronin A

Department of Endodontics, Moscow Medical Dental University, Moscow, Russian Federation

Aim To study root canal dentine morphology after instrumentation with Protaper Univ and SAF.

Methodology After instrumentation with NiTi systems (Protaper Univ and SAF) morphology of root canal dentine was studied using optical microscope (MC-M1232, DF Vasconcellos) - subgroup I and scanning electron microscope LEO-1430VP - subgroup II. 80 untreated teeth extracted for different indications were divided into 2 groups (group 1 - instrumentation with Protaper Univ, group 2 - SAF). Treatment of root canals was performed according to protocols of instrumentation (group I - ISO #20, SX, S1, S2, F1, F2; group II - ISO #20, NiTi #20. 4%, SAF 1.5 mm) and chemical cleaning (3.5 %NaOCL and 17% EDTA). The teeth were divided into subgroups. 50 teeth were in subgroup I (n =25 SAF, n=25 Protaper Univ). In subgroup I roots were cut longitudinally and canals were examined for surface defects and debris using a microscope (x3, x5). In subgroup II 30 teeth (n =15 SAF, n=15 Protaper Univ) were split with forceps after instrumentation, treated canals were exposed, coated, fixed and examined with SEM. Statistical analysis was performed using variation statistics techniques with MicrosoftOfficeExcell 2007 and StatisticaStatsoft 8.0 software.

Results Dentine debris was present on all canal surface in 68% of samples (17 out of 25) in group I subgroup I (n =25 Protaper Univ). Dentine debris was present in SAF subgroup in 60% of samples (15 out of 25) but mainly in the apical third ($p=0.77$). Surface defects were in 48 samples in Protaper Univ group (1.92 ± 0.22) and 22 samples in SAF group (0.88 ± 0.18) ($p < 0.01$). In group I subgroup II dentine morphology corresponded to combination of applied compressive and cutting forces. The surface was smooth in Group II (n =15, SAF).

Conclusions Difference between SAF and Protaper Univ in extent of root canal cleaning was not statistically significant. However surface defects and root dentine morphology prove that SAF system removes dentine gently and minimally invasively.

GE14

Shaping ability of ProTaper Universal, ProTaper NEXT and WaveOne Primary in severely curved resin blocks

*Saleh A¹, Tavanafar S², Gilani P³, Schäfer E⁴

¹*Restorative Dentistry, Ajman University, Ajman, United Arab Emirate,* ²*Department of Oral and Maxillofacial Surgery, School of Dentistry,, Shiraz University of Medical Sciences, Shiraz, Islamic Republic of Iran,* ³*Private Practice, Tehran, Islamic Republic of Iran,* ⁴*Central Interdisciplinary Ambulance in the School of Dentistry,, University of Münster, Münster, German, Germany*

Aim: The purpose of this study was to compare the shaping ability of three engine-driven nickel-titanium instruments in severely curved simulated canals.

Materials and Methods: Forty-eight severely curved simulated canals in resin blocks were prepared to an apical size of 25 using the following systems (n=16 per group): ProTaper Universal (PTU), ProTaper NEXT (PTN), and WaveOne Primary (WO) (all Dentsply Maillefer, Ballaigues, Switzerland). Composite images were made from the superimposition of pre- and post-instrumentation images. The amount of resin removed by each system was measured by using a digital template and image analysis software. Shaping ability of each system was compared using different parameters: total resin removal, centering ability, canal transportation in the apical, middle and coronal third of canal. Preparation times were also recorded. The data were statistically analyzed by using analysis of variance, paired t-test, and Tukey's post hoc test.

Results: Canals prepared with PTN were better centered in the apical part than those prepared with WO and PTU ($p<0.05$). WO removed significantly more resin at the outer aspect of the maximum point of curvature. WO and PTU caused similar canal transportations at 7 points out of 11 measuring points. At measuring points 3, 4, and 5 WO caused more canal straightening than PTU. Instrumentation with PTU required more time than with the two other instruments ($p<0.05$). No preparation error or instrument separation.

Conclusion: In the apical part of the canals PTN obtained the best results with regard to canal transportation.

Keywords: Nickel-titanium, ProTaper NEXT, resin blocks, shaping ability, WaveOne.

Comparative study of the apical deformation produced by five mechanical instrumentation systems

Navarro Lucena B, *Raldúa Hernanz M, Gonzalez DM, Perez Higuera J, Tabares Martinez P

Master Endodoncia, UCM, Madrid, Spain

Aim To compare the degree of apical deformation and widening, after using 5 mechanical instrumentation systems: Protaper Next® (PTN), Wave One Gold® (WOG), Twisted Files Adaptive® (TFA), Reciproc Blue® (RB) and Komet F360® (K); between each other, and within the same system using the file that fits with a 0.25 diameter and the next of the larger tip of each of them.

Methodology 50 double-curved methacrylate blocs were used. Each block was photographed frontally before and after the instrumentation. First with the file corresponding to the 0.25 tip and then, with the next largest file of each system. These were divided into 5 groups (n=10), and were randomly distributed to 2 operators, postgraduates and in endodontic training, to proceed to their instrumentation, until arriving at the file corresponding to an apical tip of 0.25mm for each one of the systems. And then, with the following file that corresponded in each one of the systems. We measured in an image analyzer (ImageJ® 1.50i) the distance between the initial reference point, the inner edge of the canal curvature and the outer edge of the canal, before and after instrumentation. The statistic was done with IBM SPSS Statistics® 22.0 performing the analysis of the variance (ANOVA).

Results Statistically significant differences were found between the 5 groups in terms of deformation after the first instrumentation. TFA, WOG and PTN deform more than RB and K.

After the second instrumentation, was observed that TFA deforms more than the rest of the systems. TFA widens more than WOG, RB and K. However, with the next file used in each system, there has been a greater widening in TFA and RB. RB widens more, but deforms as the other.

Conclusions With a .25 tip, TFA, WOG and PTN were the systems that deform the canal significantly more. And TFA widens the most. Using the larger tip of each system, we found that TFA and RB were the ones that widen the most. Komet is the file that less deforms and widens.

GE16

Cutting efficiency of two different types of rotary nickel-titanium instruments in simulated double (s-shaped) and single curvature canals : a pilot study

*Shahmari M¹, Güngör F², Türkaydın D¹, Baştürk FB¹, Sazak Öveçoğlu H5¹

¹Department of Endodontics, ²Marmara University, İstanbul, Turkey

Aim To compare the cutting efficiency of Hyflex CM and Silk Mani rotary files in simulated canals with double and single curvature.

Methodology A total of 24 resin blocks (12 J-shaped and 12 S-shaped) were divided into 4 groups according to the preparation system and resin block curvature shape (n=6) : Group A: J-shaped resin blocks prepared with Silk Mani, Group B: J-shaped resin blocks prepared with Hyflex CM, Group C: S-shaped resin blocks prepared with Silk Mani Group D: S-shaped resin blocks prepared with Hyflex CM. After checking the canal openings of the simulated canals using a #10 K-file, blocks were prepared to the size of #20 using k-file. In group A and C, the canal preparation was completed with Silk Mani complex pack (08/25, 04/20 and 04/25). In group B and D, the canal preparation was completed with Hyflex CM (08/25, 04/20 and 04/25). One set of rotary file was used in each group and all instruments were used in accordance with the manufacturer's instructions. Resin blocks were measured before and after instrumentation using a digital balance (0.001 g Readability). Cutting efficiency was determined by calculating the amount of resin removed by each system.

Results In both single and double curvature canals, Silk Mani displayed greater cutting efficiency than Hyflex CM. It was also observed that both rotary files displayed greater cutting efficiency in double curvature canals rather than single curvature canals.

Conclusions Silk Mani rotary files demonstrated higher cutting efficiency than Hyflex CM rotary files.

GE17

Evaluation of pressures distribution against root canal walls of NiTi rotary instruments by finite element analysis

*Gibello U¹, Scattina A², Paolino DS², Chiandussi G², Marchetti A¹, Pasqualini D¹, Berutti E¹

¹Department of Surgical Sciences, Dental School, Endodontics, University of Turin, ²Department of Mechanical and Aerospace Engineering, Turin., Politecnico di Torino, Turin, Italy

Aim To evaluate the contact pressure distribution of two different nickel-titanium (NiTi) endodontic rotary instruments against the root canal walls and to virtually predict their centering ability during shaping with finite element analysis (FEA).

Methodology Two resin blocks simulating root canals were used. The first was shaped with ProGlider and ProTaper Next (PTN) X1 - X2 and the second with ScoutRace and BioRace (BR) 1, 2 and 3. Afterwards, both resin blocks were virtually replicated with a computer-aided design (CAD) software. The endodontic instruments ProTaper Next (PTN) X2 and one BioRace (BR) 3 were also replicated with CAD. The NiTi instruments and the shaped blocks geometries were discretized and exported for a dynamic FEA. The typical material models of the BR and PTN NiTi alloys were applied. The instruments rotation in the root canals was virtually replicated. The finite element simulation was performed applying an insertion and extraction force of 2.5 N with a constant rotational speed. To highlight possible differences between instruments' pressures distributions against the root canal portions outside and inside the canal curvature, parameter Var was originally defined.

Results The Var values were systematically lower for PTN revealing a better centering ability.

Conclusions Dynamic FEA proved effective for the virtual prediction of the centering ability of NiTi instruments during an early design phase without the use of prototypes.

GE18

Respect of the canal path: Comparative study between WaveOne and ProTaper Universal.

Dhoum S, Jabrane K, *Skalli R, Benkiran I, Laslami K

Department of Conservative Dentistry and Endodontics, Hassan II University, Faculty of Dentistry of Casablanca, Casablanca, Morocco

Aim This study compared two major parameters of the respect of the canal path during the shaping: the canal deviation and the centering ability between two different systems on human canal teeth by using cone beam computed tomography (CBCT): Waveone; the new single-file systems in reciprocating motion and Protaper Universal; representing the conventional systems in continuous rotation.

Methodology Fifty mesio-vestibular canals of permanent maxillary first molars, freshly extracted and preserved in physiological serum, were distributed according to the instrument used to shape the canal into two groups of 25 canals each: ProTaper Universal and WaveOne. The canals were scanned by CBCT before and after the canal shaping. The canal deviation as well as the centering ability were evaluated at two levels: 3 mm and 6 mm from the apex.

Results Our study revealed that there is no significant difference between the two compared systems.

Conclusions According to our study, the two systems are similar regarding the respect of the canal path.

GE19

Comparison of canal transportation and centering ability of One Curve, Wave One Gold & ProTaper Next using CBCT: An *in vitro* study

*Mahmoud O, Mathew A, Al-Shadidi R, Afana H, Ghanem R

Restorative Department, Ajman University, Ajman, United Arab Emirates

Aim To compare the centering ability, canal transportation, and preparation time of Wave One Gold (WOG), One Curve (OC), and ProTaper Next (PTN) rotary systems in curved root canals to find better instrumentation technique for maintaining root canal geometry.

Methodology Forty-five simulated L-shaped root canals resin blocks (n=15) were randomly divided into 3 groups. The canals were prepared to the working length using WOG primary file, OC primary file, and PTN X2 file along with their designated path files. Pre- and post-instrumentation images were obtained using Cone Beam Computed Tomography (CBCT) at three levels, 3mm apical, 5mm middle, and 7mm coronal above the apical foramen. Amount of transportation and centering ability were assessed. The three groups were statistically compared with analysis of variance and Tukey honestly significant test.

Results Canal transportation for WOG in cross-sections 3mm, 5mm and 7mm is -0.17, -0.16 and -0.10 respectively. Canal transportation of OC in cross-sections 3mm, 5mm and 7mm is -0.04, -0.32 and -0.25 respectively. Canal transportation of PTN in cross-sections 3mm, 5mm and 7mm is -0.16, -0.28 and -0.16 respectively. The mean centering ability of WOG in cross-sections 3mm, 5mm and 7mm is 0.25, 0.18 and 0.85 respectively. The mean centering ability of OC in cross-sections 3mm, 5mm and 7mm is 0.43, 0.21 and 0.42 respectively. The mean centering ability of PTN in cross-sections 3mm, 5mm and 7mm is 0.93, 0.42 and 0.68 respectively. The average preparation time of WOG is 53.6 sec, OC is 35.4 sec, and PTN is 66.6 sec.

Conclusions OC has showed significantly the least amount of canal transportation in the apical third, followed by both PTN and WOG respectively. The WOG has the best centering ability followed by the OC and PTN respectively. OC was significantly faster than both WOG and PTN.

GE20

Evaluation of preparation of curved root canals using rotary and reciprocating systems with different surface treatments

*Kabil E¹, Katic M², Anić I¹, Pavelic B¹, Bago I¹

¹*Department of Endodontics and Restorative Dentistry, School of Dental Medicine,* ²*Department of Materials, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Zagreb, Croatia*

Aim To evaluate, using micro-computed (micro-CT) tomography, the preparation (transportation and centering ability) of curved root canals using a rotary and two reciprocating systems with different surface treatments.

Methodology Thirty-six curved mesial separated root canals of human extracted lower molars and upper first molars were used in this study. The prepared samples were randomly allocated into three groups (n=12) according to the instrumentation technique used: Group 1. Rotary ProTaper Next (Dentsply Sirona, Ballaigues, Switzerland) system (up to X2 instrument); Group 2. Reciprocating Reciproc R25 instrument (VDW, Munich, Germany); Group 3. Reciprocating Reciproc Blue R25 (VDW) instrument. The instruments were advanced apically using an in-and-out pecking motion according to the manufacturer's instructions. Root canal patency was checked after each instrument. A total of 15 mL of 2.5% NaOCl was used during instrumentation and smear layer was removed with 15% ethylenediaminetetraacetic acid (EDTA) (1 min) and NaOCl. The samples were scanned in a micro-CT scanner (Nikon XT H 225, USA) before and after instrumentation to analyse canal transportation and centering ability.

Results Post-hoc analysis revealed that ProTaper Next compared to Reciproc and Reciproc Blue had significantly less transportation ability ($p = 0.020$). Also, the Reciproc in relation to Reciproc Blue had significantly less value for transportation ($p = 0.049$). At 5 mm, the Reciproc showed higher transportation than Reciproc Blue and ProTaper Next ($p=0.044$). There are no statistically significant differences in centering ability when all three techniques are considered together ($p = 0.090$).

Conclusions Although the difference between the techniques is very small, ProTaper Next showed the smallest root canal transportation ability. All three systems showed no difference in centering ability.

Irrigants/medicaments - antimicrobial activity

GE21

The effect of a novel antibiotic-steroid paste over conventional antimicrobials in regenerative endodontics.

* Tilakchand M, Hegde S

¹*Department of Conservative Dentistry and Endodontics, SDM CDS, Dharwad, India*

Aim To evaluate the antimicrobial efficacy of a Novel Antibiotic-Steroid paste over the regularly used Calcium hydroxide, Double antibiotic paste and Modified Triple antibiotic paste and to check the antimicrobial efficacy of irrigating solutions, Chlorhexidine Digluconate(CHX) and Sodium Hypochlorite (NaOCl) against a 3 week old *Enterococcus faecalis* biofilm.

Methodology A total of 112 human extracted teeth were contaminated with *E.faecalis* for a period of 21 days. The teeth were assigned to 8 groups with n = 14 in each group. The novel Antibiotic-Steroid Paste, Calcium hydroxide, Double antibiotic paste, Modified Triple antibiotic paste and a placebo were placed inside the canal, sealed and incubated in an aerobic environment at 37°C. For irrigating solutions, each prepared sample was immersed in 1 mL of sterile saline for 1 min followed by irrigating and immersion with 1.5% NaOCl and 2% CHX for 5 minutes. An antimicrobial assessment was performed at the end of 2 days and 7 days, with seven teeth from each group, for each time interval. Dentine debris collected was transferred to the respective medium for culture. After 24h, colonies were counted using classical bacterial counting technique as colony formed units (CFU).

Results Statistical analysis revealed that Novel Antibiotic-steroid paste showed statistically insignificant difference when compared to DAP which had the highest antimicrobial properties .

1.5% NaOCl provided complete eradication of *E. Faecalis* biofilms. 5-minute biofilm exposure to 2% CHX provided an antibiofilm effect against 3 week old *E.Faecalis*, but not as effective as 1.5% NaOCl.

Conclusions 1.5 % sodium hypochlorite and double antibiotic paste had the highest antimicrobial properties in their respective groups and the novel Antibiotic steroid paste had antimicrobial efficacy similar to that of double antibiotic paste. Before this study opens new opportunities for the use of this novel antibiotic steroid paste, its cytotoxicity to the underlying mesenchymal stem cells at varying concentrations needs to be studied in detail.

GE22

Evaluation of irrigation penetration following three irrigation techniques

Drouri S, Benkiran I, Dhaimy S

Department of Conservative Dentistry and Endodontics, Hassan II University, Faculty of Dentistry of Casablanca, Casablanca, Morocco

Aim To compare radiographs based on the penetration depth of the irrigant following three final irrigation techniques.

Methodology A sample of sixty teeth with single roots were prepared with stainless steel K files followed by mechanized Ni-Ti files iRace under irrigation with 2.5% sodium hypochlorite.

Radiopaque solution was utilized to measure the penetration depth of the irrigant. Three irrigation techniques were performed during this study: (i) passive irrigation, (ii) manually activated irrigation, and (iii) passive irrigation with an endodontic needle CANAL CLEAN. Radiographs were performed to measure the length of irrigant penetration in each technique.

Results In comparison, passive irrigation with a conventional syringe showed infiltration of the irrigant by an average of 0.682 ± 0.105 , whereas the manually activated irrigation technique

indicated an average of 0.876 ± 0.066 infiltration. Irrigation with an endodontic syringe showed an average infiltration of 0.910 ± 0.043 . The results revealed highly significant difference between the three irrigation techniques ($P < 0.05$).

Conclusions Adding manual activation to the irrigant improved the result by 20%. This study indicates that passive irrigation with an endodontic needle has proved to be the most effective irrigation technique of the canal system.

GE23

A comparison of the antibacterial efficacy of photoactivated disinfection and traditional irrigation against polymicrobial root canal biofilm: an *in vitro* study

*Mitronin AV¹, Podporin MS¹, Tsarev VN², Ostanina DA¹


¹*Department of Cariology and Endodontics, ²Department of Microbiology and Immunology, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russian Federation*

Aim To compare the antibacterial effect of photo-activated disinfection (PAD) with passive ultrasonic irrigation (PIU) and 5% sodium hypochlorite solution against the most common isolates of root canal biofilm in the case of chronic infection *in vitro*.

Methodology Fifty-two patients aged from 25 to 45 years with chronic pulpitis and chronic apical periodontitis were selected and divided into 2 groups (PAD with PIU and traditional irrigation with 5% NaOCl solution as control). The treatment was done according to groups, following manufacturer's instructions. The root canal biofilm samples were taken and incubated separately for aerobic and anaerobic culture by microbial culturing technique using Columbia Blood Agar Base (M144) for Gr- and Gr+ bacteria and M1297A (Himedia, India) for *Candida* spp. Microbial counting was done using Scan 500 (Interscience, France). The efficacies of irrigation protocols were evaluated using a Reverse-Spinner RTS-1 bioreactor (Biosan, Latvia). Statistical evaluation of the data was performed using the Mann-Witney U-test ($P < 0.05$).

Results A total of 6 cultivated isolates were chosen including *Porphyromonas gingivalis*, *Fusobacterium nucleatum*, *Streptococcus sanguinis*, *Streptococcus mutans*, *Candida albicans* and *Candida krusei*. The inhibition of bacterial growth in the experimental group was significantly superior to the control group ($p < 0,025$). Growth inhibition of the *Candida albicans* isolate was indicated in 65,57%; it's turned out to be the most sensitive strain. The most resistant strain was the *Porphyromonas gingivalis* isolate, which showed a 51.47% growth inhibition.

Conclusions PAD with PUI is an effective approach that exhibited anti-microbial potential activity against root canal biofilm. However, it was identified the difference in bacterial and *Candida* spp. growth patterns.




ANTIMICROBIAL POTENTIAL OF HERBAL TINCTURES ON *ENTEROCOCCUS FAECALIS*

V. Opačić-Gajić¹, D. Pavlica², T. Kundaković-Vasović³, J. Radović³, M. Popović-Bajić³, D. Mitić-Čadanić⁴

¹Department of Restorative Dentology and Endodontics, School of Dental Medicine, University of Belgrade, Serbia
²Department of Microbiology and Immunology, School of Dental Medicine, University of Belgrade, Serbia
³Department of Pharmacognosy, Faculty of Pharmacy, University of Belgrade, Serbia
⁴University of Belgrade Faculty of Biology, Chair of Microbiology, Serbia

Aim

Examine the antimicrobial effect of different plant tinctures and their effect on the adhesion of *Enterococcus faecalis* to dentine relative to conventional irrigant (NaOCl and CHX).



Introduction

Enterococcus faecalis is the dominant species isolated after unsuccessful endodontic therapy or in persistent infections with a prevalence of over 70% [1]. Its ability to create biofilm, alone or with other species, increases resistance up to 1500 times in relation to planktonic bacteria [2,3]. Biofilm provides bacteria protection against physical forces. Biofilm organisms are more resistant to the lack of nutrients, pH change, activity of free radicals, disinfectants, and even antibiotics [4].

Materials and Methods

The antibacterial activity of tinctures was tested by agar diffusion test. The *Enterococcus faecalis* strain ATCC 29212. Six tinctures were tested:

- Neem leaf tincture, *Azadirachta indica* folium
- Neem oil tincture, *Oleum Azadirachti*, *Azadirachta indica*
- Clove ether oil, *Caryophylli floris aetheroleum*, *Syzygium aromaticum*
- Tea tree oil, *Malaleuca aetheroleum*
- 2% NaOCl
- 0.25% NaOCl
- 2% chlorhexidine (positive control)
- Physiological solution (negative control)

On Mueller Hinton agar with seeded bacterial culture, 32 wells (40mm and 4mm depth) were formed into which 300 µl of the tested solution were poured. The seed plates were incubated for 24 hours at 37°C. The inhibition zones were measured by a millimeter scale in three locations for each well, and the obtained values were statistically processed (Kruskal-Wallis test).

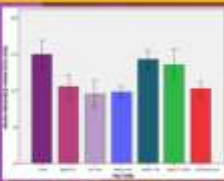

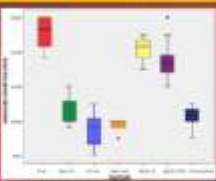
Materials and Methods


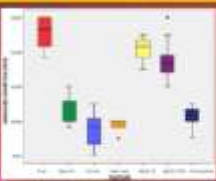
In the second part of the study, 20 single-root extracted teeth were used. The channels were washed with the Biotac system (B. Bunt, Bonteply, Suisse, Switzerland) with apical preparation #3 / J14 and irrigated with 2% NaOCl solution. The teeth are decontaminated and milled into self-curing acrylic. Acrylic blocks with dentine samples are vertically cut on water-cooled saw (Isodon 4000 Berlin, USA) and polished up to a thickness of 100 µm.



With the dentinal samples, the smear layer was removed, with 5min immersion in 2% NaOCl and 5 minutes in 10% citric acid. Samples were divided into 8 groups and irrigated with physiological solution (negative control), 2% chlorhexidine, 2% NaOCl, neem oil, neem leaf, clove oil and tea tree (30 minutes). Dentine blocks were incubated with 200 µl *E. faecalis* (10⁶ cells/ml) at 37°C for 96 hours. Positive controls were dentine blocks that were not treated with irrigant but were inoculated with bacteria.




Samples were stained with ethidium bromide/acridine orange and observed on a fluorescence microscope (Leica, DMIL, Vienna, Austria) with excitation filter 530/560 nm.




Results and Discussion

Despite the pronounced antibacterial effects, all high-concentration irrigant have a number of adverse effects. Chlorhexidine proved to be the most cytotoxic, followed by NaOCl and EDTA [5]. The need to introduce biocompatible irrigant puts more and more the focus of herbal tinctures as alternative irrigations. The largest *E. faecalis* growth inhibition was measured for the tincture of clove ether oil (mean 14.99). The antibacterial effect of clove oil was significantly higher in relation to positive control (chlorhexidine) (P<0.05). Tea tree showed a comparable antibacterial effect with CHX. Its active components terpinen-4-ol and α-terpineol are responsible for its antibacterial and antifungal activity. Tea tree inhibits the adhesion of *Enterococcus faecalis* to dentine more efficiently than CHX and NaOCl. By inhibiting the respiratory chain of microorganisms, it affects the preservation of adhesion, and therefore prevents the formation of biofilm on the surface of dentine.

Conclusion

Herbal tinctures have shown a significant antimicrobial effect as well as the effectiveness in preventing the adhesion of *Enterococcus faecalis* to dentine compared to the most commonly used irrigant and root canal medication. The greatest advantage of plant irrigant is their safety, easy availability, price and reduced ability to rapidly develop resistance to microorganisms. These findings confirm the great potential of bioactive components of natural plants as alternative endodontic irrigant. In order to use these plant tinctures in the treatment of infection in the root canal, in vivo research is necessary.

Keywords:
 1. Opačić V, Pavlica D, Radović J, Kundaković-Vasović T, Popović-Bajić M, Mitić-Čadanić D. Antimicrobial effect of different plant tinctures on *Enterococcus faecalis*. *Journal of Dental Research*. 2023;102(10):1023-1028.
 2. Kundaković-Vasović T, Radović J, Opačić V, Pavlica D, Popović-Bajić M, Mitić-Čadanić D. Effect of different plant tinctures on *Enterococcus faecalis* growth inhibition. *Journal of Dental Research*. 2023;102(10):1029-1034.
 3. Opačić V, Pavlica D, Radović J, Kundaković-Vasović T, Popović-Bajić M, Mitić-Čadanić D. Effect of different plant tinctures on *Enterococcus faecalis* growth inhibition. *Journal of Dental Research*. 2023;102(10):1035-1040.
 4. Opačić V, Pavlica D, Radović J, Kundaković-Vasović T, Popović-Bajić M, Mitić-Čadanić D. Effect of different plant tinctures on *Enterococcus faecalis* growth inhibition. *Journal of Dental Research*. 2023;102(10):1041-1046.
 5. Opačić V, Pavlica D, Radović J, Kundaković-Vasović T, Popović-Bajić M, Mitić-Čadanić D. Effect of different plant tinctures on *Enterococcus faecalis* growth inhibition. *Journal of Dental Research*. 2023;102(10):1047-1052.

Clinical reasoning of chlorhexidine application in treatment of combined endo-perio lesions.

*Baitokova A¹, Gromova S², Kiseleva N¹, Gaeva M¹, Vovk S¹

¹*Department of Cariology and Endodontics, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow,* ²*Department of Dentistry, Kirov State Medical University, Kirov, Russian Federation*

Aim To increase efficacy of dental treatment of endo-perio lesions.

Methodology Group 1 included 58 teeth in periodontal patients. The teeth were examined and treated. Pulp inflammation was caused by periodontal disease progression. Microbiota of root canal and periodontal pocket was studied. Then Group 1 was divided into two subgroups: 1a (n=28) and 1b (n=30). In group 1a root canals were irrigated with 2% chlorhexidine after a conventional preparation and periodontal pockets were treated with 0.05 % chlorhexidine. In group 1b photoactivation was applied after conventional treatment of root canals and periodontal pockets. After application of 2% and 0.005% CHX in root canal and periodontal pocket respectively, microbiological study of periodontal pathogens was performed in a root canal after irrigation and before obturation and in periodontal pocket after treatment. The following methods were used to determine statistically significant difference between groups: the Mann-Whitney U test was used to compare two independent samples, t-Student test - later

Results In periodontal patients (group 1) the prevalence of periodontal pathogens in root canals and periodontal pockets was as follows: *Porphyromonas gingivalis* (P.g.) - 19.2% , *Aggregatibacter actinomycetemcomitans* (A.a) – 42.3%; *Tannerella forsythia* (T. f)- 34.6%; *Treponema denticola* (T. d.)- 7.7%; *Prevotella intermedia* (P. i) - 15.4% of the total bacterial number. In group 1a root canal microorganisms were studied before and after endodontic treatment: P.g.- 63.6 before and 9.1 after (p=0.008); A.a.- 45.5 before and 9.1 after (p=0.05); T. f.- 36.4 before and 0.05 after (p=0.03); T. d.- 45.5 before and 9.1 after (p=0.05); P. i.- 36.4 before and 0.05 after (p=0.03). In group 1b root canal

microorganisms were studied before and after endodontic treatment: P.g.- 54.5 before and 45.5 after (p= 1); A.a.- 45.5 before and 36.4 after (p=0.07); T.f.- 27.3 before and 27.3 after (p=1); T.d.- 36.4 before and 36.4 after (p=1); P.i.- 36.4 before and 36.4 after (p=1).

Conclusions Application of 2% CHX during endodontic treatment in periodontal patients proved to be more effective in controlling periodontal pathogens in a root canal.

GE26

***Lactobacillus plantarum* lipoteichoic acid disrupts 3-week-old preformed biofilm**

*Kang MJ¹, Yoo YJ¹, Kim AR², Han SH², Baek SH¹, Kum KY¹

¹Department of Conservative Dentistry, Dental Research Institute, School of Dentistry, Seoul National University, Seoul National University Dental Hospital, ²Department of Oral Microbiology and Immunology, Dental Research Institute, BK21 Plus Program, School of Dentistry, Seoul National University, Seoul, Republic of Korea

Aim To investigate the effect of *Lactobacillus plantarum* lipoteichoic acid (Lp.LTA) on 3-week-old *Enterococcus faecalis* biofilm disruption and its antimicrobial performance in combination with conventional intracanal medicaments.

Methodology Lp.LTA was purified from *L. plantarum* through butanol extraction followed by sequential application of hydrophobic interaction column chromatography and ion-exchange column chromatography. *E. faecalis* biofilm (1.4×10^9 CFU/mL) formed on glass bottom dishes for 3 weeks were treated with/without 0, 3, 10, or 30 µg/mL of Lp.LTA for 1 hour. To investigate the synergistic combination of Lp.LTA with other intracanal medications, chlorhexidine (CHX, 0.0002%) and calcium hydroxide (CH, 25 µg/mL) were used alone or in combination with Lp.LTA (30 µg/mL) to treat 3-week-old preformed *E. faecalis* biofilm. All experiments were performed in triplet and data were statistically analyzed. The preformed *E. faecalis* biofilms formed on human dentine blocks (n =

5/group), intact, diminished, or disrupted biofilms after each treatment were observed by using scanning electron microscope (SEM).

Results Confocal microscopy revealed that preformed *E. faecalis* biofilm for 3 weeks were significantly inhibited by Lp.LTA compared to control ($p < 0.05$), in a dose-dependent manner. Pre-treatment of Lp.LTA significantly enhanced anti-biofilm performance of CHX and CH to disrupt 3-week-old *E. faecalis* biofilm ($p < 0.05$). SEM observations were in accordance with the confocal microscope results, showing markedly diminished preformed biofilms on root dentine when Lp.LTA was used with CHX or CH.

Conclusions These results suggest that Lp.LTA is a potential anti-biofilm agent for *E. faecalis*-associated endodontic pathosis.

Acknowledgements This study was supported by the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare (HI17C1377), Republic of Korea.

GE27

Analysis of the antimicrobial and physicochemical properties of different mixtures of EDTA

*Fernandes Zancan R¹, Estrela C², Maciel Batista Borges M¹, Bassani Camargo P¹, Ricci Vivan R¹, Camilleri J³, Tomson PL³, Hungaro Duarte MA¹

¹Department of Restorative Dentistry, Dental Materials and Endodontics, University of São Paulo, Bauru, Brazil, ²Department of Stomatological Sciences, Dental School, Federal University of Goiás, Goiânia, Brazil, ³Department of Restorative Dentistry, School of Dentistry & Birmingham Dental Hospital, University of Birmingham, Birmingham, United Kingdom

Aim In this study, antimicrobial activity, physical and chelating properties of EDTA, either alone or associated with antimicrobial substances were characterized.

Methodology The following were used as test solutions: 1. 17% EDTA; 2. 17% EDTA + 1% Benzalkonium Chloride; 3. 17% EDTA + Nacetylcysteine; 4. 17% EDTA + Chlorhexidine; 5. Saline solution. Dentine blocks were infected for 21 days with *Enterococcus faecalis*. After this period, blocks were immersed in the test irrigant solution for 5 minutes. Live/dead dye and a confocal microscope were used to measure the percentage of living cells. For the *E. faecalis* adhesion test, the dentine blocks were treated before the contamination of one hour. The analysis were made in the same way as described before. Smear layer formation was induced by means of polishing dentine blocks with abrasive paper. After, the blocks were treated with irrigant solutions for 5 minutes. Initial and post-treatment images of these blocks, obtained by SEM, were compared. For the following test, bovine teeth filled with AH Plus were submitted to the pushout bond strength test in a universal test machine type MTS 810. The irrigants were evaluated with regard to the measurement of dentine wettability after prior treatment, and by the sessile drop method using a goniometer. In addition, the surface tension of solutions was verified by the pendent drop test.

Results The mixtures did not change the EDTA smear layer removal capacity and increased it antimicrobial action. A lower adhesion and survival of *E. faecalis* was found after the treatment with Benzalkonium Chloride. Lower surface tension and better wettability of the irrigants was obtained by the association of EDTA with Benzalkonium Chloride or Chlorhexidine. Association with Benzalkonium Chloride was the solution that most favored the bond of AH PLUS cement to dentine and its wettability.

Conclusions The association with Benzalkonium Chloride favored better wettability and increased the bond strength of AH Plus to the dentine. It also improved antimicrobial action of EDTA against *E. faecalis* biofilm and might interfere with its mechanisms of adhesion to dentine.

Acknowledgements This study was supported by the FAPESP grant 2016/25133-1 and 2018/03554-0.

Intracanal temperature of sodium hypochlorite solution during endodontic treatment.

*de Hemptinne F, Vandendael M, Vandendriessche A, Delbeek M

Department of Endodontology, Vrije Universiteit Brussel, Jette, Belgium

Aim To determine the temperature of a sodium hypochlorite solution injected at room temperature, after stabilization at different levels inside prepared root canals in a clinical situation.

Methodology Sixty-five root canals in patients who were scheduled for an endodontic treatment were prepared to size 35, using C-pilot files, Reciproc and Mtwo size 35 files (VDW, Munich, Germany). Temperatures were recorded using a K-type thermocouple microprobe thermometer (Testo, Ternat, Belgium), which was able to reach 3 mm from working length. Three measuring positions were determined: coronal, middle and apical (Fig. 1). The coronal position was 2 mm beyond the canal access. The apical position was 3 mm from the working length. The middle position was the value in the middle of the two previous positions. For each root canal, a measurement was done after injection of NaOCl at room temperature, with a stabilization time of 5 min. Shapiro-Wilk test was used for the statistical analysis.

Results The mean temperature values were: 33.81°C (± 1.52) 34.47°C (± 1.03) 34.94°C (± 0.83), respectively for the coronal, middle, and apical positions. This is shown in the Figures below. A Friedman-test showed a significant ($p = 0.00$) difference between the three measuring positions. The Wilcoxon Signed Ranks Test show a significant ($p_1 = 0.00$, $p_2 = 0.00$, $p_3 = 0.00$) difference in between the positions themselves.

Conclusions The temperature of irrigant solutions inside root canals increased from coronal to apical. As we know from previous research, warmer irrigant is more efficient in tissue dissolving capacity and in bactericidal capacity. Thus, the higher apical temperature might be beneficial to the irrigation procedure as the apical portion is the most critical area.

Acknowledgements Our thanks go to Testo for material and technical support.

Antimicrobial efficiency of horseradish peroxidase incorporated nanoflowers against *Enterococcus faecalis* and *Candida albicans* biofilms.

Aslan T¹, Üstün Y¹, Didar T², Naghiyeva K¹

¹Department of Endodontics, Faculty of Dentistry, Erciyes University, Kayseri, ²Department of Analytical Chemistry, Faculty of Pharmacy, Turkey

Aim In recent years, nanoflowers (Nfs) have been received popularity due to their greatly enhanced antimicrobial and catalytic activities. The purpose of this study was to synthesis of nanoflowers (Nfs) from horseradish peroxidase (HRP) enzyme and copper ions (Cu²⁺) and show their antimicrobial efficiencies.

Methodology The antibacterial efficiencies of the free HRP and HRP Nfs against *Enterococcus faecalis* (ATCC 29212) and *Candida albicans* (ATCC 90028) biofilms on the root dentine discs prepared from extracted human teeth were tested using disc diffusion method and monitored by scanning electron microscope (SEM) and confocal laser scanning microscopy (CLSM). We simply prepared human teeth and the sterilize the dentineal discs, then they were inoculated with *E. faecalis* and *C. albicans* strains for 3 weeks. Infected dentine discs were exposed to free HRP and HRP Nfs, respectively in the presence of the hydrogen peroxidase (H₂O₂) for 15 minutes. Whereas, dentine discs were also exposed to phosphate buffer saline as a negative control. After treatment, We stained used mixture of SYTO 9 and propidium iodide (PI) at 1.67 and 18.3 mM, respectively for cell staining on dentine discs to show the alive and dead cells with CLSM in the biofilm.

Results The CLSM images showed that HRP Nfs have better microbial killing properties than the free HRP (p<0,05). Similar results were obtained by disc diffusion method. It was observed that HRP Nfs effectively kills a significant portion of microorganisms (around 32% cell death for *E. faecalis* and and 85% for *C. albicans*).

Conclusions According to the findings of this study, it can be concluded that HRP Nfs can be utilized as potential endodontic disinfectant. HRP Nfs, which has not been previously used in the field of endodontics, is promising for the elimination of microorganisms frequently encountered in root canals.

Acknowledgements This project was supported by Scientific Research Projects Unit (TSA-2019-8172) of Erciyes University in Turkey.

GE30

Synthesis of trypsin incorporated flower-shaped nanocomposites and their effective biofilm destruction towards *Enterococcus faecalis* and *Candida albicans*

*Üstün Y¹, Aslan T¹, Ildız N², Taşdemir D³, Kafdağ Ö¹

¹Department of Endodontics, Faculty of Dentistry, ²Department of Pharmaceutical Microbiology, Faculty of Pharmacy, ³Analytical Chemistry, Faculty of Pharmacy, Erciyes University, Kayseri, Turkey

Aim To investigate the antimicrobial activities of flower shaped hybrid nanostructures called nanoflowers (NFs) synthesized from the trypsin (T) enzyme and metal ions (Ag⁺ and Ca²⁺) towards *Enterococcus faecalis* and *Candida albicans*.

Methodology The antimicrobial effects of the NF solutions towards *Enterococcus faecalis* (ATCC 29212) and *Candida albicans* (ATCC 90028) were tested using disc diffusion method and confocal laser scanning microscopy (CLSM). Therefore, dentine discs prepared from extracted human teeth. Dentine discs were sterilized and then were inoculated with *E. faecalis* strain and *C. albicans* strain for 3 weeks. Infected dentine discs were exposed to T-NFs-Ag⁺ NFs and T-NFs-Ca²⁺ NFs, and phosphate buffer (negative control). After treatment, the dentine discs were stained with fluorescent LIVE/DEAD BacLight dye and assessed with CLSM to determine the proportion of dead cells in the biofilm. The antibiofilm efficacy of T-NFs were also monitored by the scanning electron microscope (SEM) and confocal laser scanning microscopy (CLSM). Minimum inhibitory

concentration (MIC), for the lowest concentration of the T-NFs and the disc diffusion method for the determination of the antimicrobial activity of the T-NFs were employed.

Results T-NFs-Ag⁺ NFs and T-NFs-Ca²⁺ NFs inactivated around 25% and 55% of *E.faecalis* and 63% and 95% of *C. albicans*, respectively. Additionally, removing of biofilm using both T-NFs-Ag⁺ NFs and T-NFs-Ca²⁺ NFs were observed via SEM images.

Conclusions We claim that even biomolecules can be effective antimicrobial agents with the formulation of nanoflowers.

Acknowledgements This project was supported by Scientific Research Projects Unit (TSA-2018-8023) of Erciyes University in Turkey.

GE31

Influence of acid and basic pHs on the antimicrobial action and biofilm dissolution of EDTA in different protocols treatment

*Borges MMB, Silva BR, Zancan RF3 Vivan RR, Duarte MAH

Department of Restorative Dentistry, Dental Materials and Endodontics, University of São Paulo, Bauru, Brazil

Aim To analyze the antimicrobial properties and biofilm dissolution of ethylenediaminetetraacetic (EDTA) treated with different pHs (3, 7 and 10) against *Enterococcus faecalis* and the influence of 1% sodium hypochlorite, and Calcium Hydroxide paste in its action.

Methodology For this study, an in vitro biofilm with *Enterococcus faecalis* was induced for 21 days on dentine blocks. Samples were divided into 10 groups (n=10). In G1, G2, G3 samples were treated with 17% EDTA with pHs 3, 7 and 10, respectively for 3 minutes. In groups G4, G5 and G6 blocks were irrigated with EDTA with the same pHs for 3 minutes, followed by irrigation with NaOCl 1% for 5 minutes. In groups G7, G8 and G9 samples were initially treated with calcium hydroxide paste (Calen, SS White Artigos Dentários Ltd, Rio de Janeiro, Brazil) for 7 days, then irrigated with EDTA,

at the same pHs for 3 minutes and with NaOCl 1% for 5 minutes. In group 10, after the use of antimicrobial medication for 7 days, the blocks were irrigated with 1% NaOCl for 5 minutes. The samples were analysed by Confocal Laser Scanning Microscopy to obtain the percentage of viable cells, and data were statistically compared ($P < .05$).

Results Among chelators G1 and G2 showed a smaller percentage of viable cells than control group ($P < 0.05$). In association with NaOCl, 17% EDTA pH 7 presented better results ($P < 0.05$). In general, the groups that presented the greater antimicrobial activity were G8 and G9, without statistical difference between them. In the biovolume, the use of EDTA alone independent of pH did not dissolve biofilm. Groups which calcium hydroxide paste was used presented the most effective biofilm dissolution.

Conclusions Calcium hydroxide paste showed better antimicrobial activity and dissolution of biofilm when compared to EDTA alone. At neutral or acid pH, EDTA exhibits antimicrobial activity but does not cause biofilm dissolution.

Acknowledgements This research was supported by FAPESP (2017/21734-3)

GE32

Analysis of physical / chemical and anti microbial properties of calcium hydroxide paste associated with phytotherapeutic agent

*Frank MC, Borges MMB, Zancan RF, Vivian RR, Andrade FB, Duarte MAH

Department of Dental Materials, Dentistry and Endodontics, University of São Paulo, Bauru, Brazil

Aim To evaluate the pH, solubility, Ca^{2+} and OH^- release and antimicrobial activity against biofilm of calcium hydroxide associated with 5% Benzalkonium chloride (G1) and 50% (G2), Arnica Glycolic Extract (G3), Green Tea Glycolic Extract (G4), Calen Paste with camphorated paramonochlorophenol (G5) and the Calen paste (SS White Dental Articles Ltd, Rio de Janeiro, Brazil) (G6).

Methodology Sixty acrylic teeth (n = 10) were filled with the experimental pastes, sealed and immersed in ultrapure water in a flask containing deionized water (10 mL) to measure hydroxyl (pH meter) and calcium ion release (atomic absorption spectrophotometer), at time intervals of 7, 15 and 30 days. To assess solubility, the acrylic teeth (N=10) were filled with the previously mentioned pastes and scanned by micro-computed tomographic imaging before (initial) and after 7, 15, and 30 days, the volume of the medications, in mm^3 , was measured and compared. For antimicrobial analysis, biofilms of *E. faecalis* were induced *in vitro* on blocks of hydroxyapatite. Afterward, they were treated with the pastes for 7 days. Live/Dead dye and a confocal microscope were used to measure the percentage of living cells and biovolume. Data were statistically compared ($P < 0.05$).

Results Calen paste showed the greatest alkalinity, without statistical differences between G1, G3 and G5. The highest Ca^{2+} ions release values were found in 7 days, in all groups. After between 7 and 15 days, were observed none significant difference on the volume of the pastes ($p < 0.05$). Benzalkonium chloride 5% e 50% showed the greatest antimicrobial action, with statistical differences between the other groups ($p < 0.05$). HC + Benzalkonium chloride 5% and Arnica + HC presented the lowest values about biovolume, with statistically significant differences with the positive control ($p < 0.05$).

Conclusions The association of calcium hydroxide with Benzalkonium chloride 5%, increased effectiveness of the medication against the *E. faecalis* biofilm, without interfering with the physicochemical properties.

Acknowledgements This research was supported by CoPq 7236

GE33

Root canal infection control: protocol to enhance calcium hydroxide pastes intradentinal penetrability

*Andrade FB, Vasconcelos LRMS, Pereira TC, Vivan RR, Bramante CM, Duarte MAH

Department of Endodontics, Bauru, Brazil

Aim The root canal infection of pulpless teeth can be controlled by utilization of calcium hydroxide (CH) pastes inside root canals, killing the intradentinal microorganisms that stimulate a persistent infection. This study evaluated the influence of the ultrasonic agitation (UA) of CH pastes for antimicrobial action and penetrability on infected dentin using Confocal Laser Scanning Microscopy (CLSM), analyzing the time necessary for this effect.

Methodology Cylindrical dentine specimens were infected with *Enterococcus faecalis* in BHI broth using a new contamination protocol of 5 days. They were divided into 8 groups and dressed with the CH pastes over 7 or 15 days, with the vehicle propylene glycol or distilled water and with ultrasonic agitation of the paste or no. The UA was performed for one minute in each canal, in both directions. After the medication's removal, the viable (green) and dead (red) bacteria in the infected dentinal tubules, with Live and Dead dye, were observed by CLSM. For the penetration test, the dye Rodamine B was added to CH pastes in other specimens and analyzed by CLSM.

Results All pastes demonstrated better penetration and antimicrobial activity with both vehicles when agitated with ultrasound, even in periods of seven days. The vehicle propylene glycol showed better results than distilled water.

Conclusions Therefore, ultrasonic agitation of CH pastes favored a greater penetrability of the calcium hydroxide into the dentinal tubules in less time, reducing the clinical time of intracanal medication to decontaminate the whole infected dentine.

Acknowledgements Funding source FAPESP 2010/20186-3

GE34

Antimicrobial properties and characterization of 3 endodontic sealers after contact with 2% chlorhexidine.

*Kapralos V¹, Sunde PT¹, Valen H², Camilleri J³

¹Department of Endodontics, Institute of Clinical Dentistry, Faculty of Dentistry, University of Oslo, Oslo, Norway, ²Nordic Institute of Dental Materials, Oslo, Norway, ³Department of Restorative Dentistry, School of Dentistry, University of Birmingham, Birmingham, UK

Aim The primary aim of root canal treatment is to eliminate the microbial burden from the root canal system. However, complete elimination of all microorganisms is a great challenge, as viable bacteria may remain on the dentine walls and inside dentineal tubules. The final irrigating solution and obturating material should ideally reduce the residual bacteria or create an environment that renders microbial colonization difficult. Chlorhexidine digluconate (CHX) is often used as the final irrigant during endodontic treatment due to its antimicrobial properties. There is limited information about any potential interaction between CHX remnants after irrigation and endodontic sealers. The aim of the present study was to evaluate the antimicrobial activity and reveal information about the chemical composition of three endodontic sealers after contact with CHX.

Methodology The antimicrobial activity of AH Plus, BioRoot™ RCS and Pulp Canal Sealer was investigated using a Modified Direct Contact Test for planktonic growth of *Enterococcus faecalis*, *Streptococcus mutans*, *S. epidermidis* and *S. aureus* *in vitro*. All sealers were either incubated in continuous contact with 2% CHX for 24 hours, or after 1 minute of contact time at 37°C in 100% humidity. Sealers not in contact with CHX were also prepared and incubated for 24 hours as controls. The characterization of all sealers was performed by X-Ray Diffraction analysis (XRD) and Fourier-Transform Infrared Spectroscopy (FT-IR). The different crystal phases or chemical compounds of the sealers were assessed when either CHX or saline was applied for 1 minute as the last irrigant in an ex vivo tooth model and in endo-training blocks.

Results CHX increased the antibacterial activity of all sealers investigated. Exposure to CHX and saline did not cause changes in the chemical compounds of the sealers. Differences were found in the amounts of the phases and the crystallinity of the sealers.

Conclusions CHX improved the antibacterial efficacy of all endodontic sealers tested, without compromising their phases. Irrigants used for endodontic treatment may interact with endodontic sealers in the root canal and affect their physical, mechanical and antibacterial properties. The potential interaction between endodontic irrigants and sealers needs to be further investigated.

GE35

Effect of the ultrasonic activation of calcium hydroxide paste on the metabolic activity of bacteria in root canals: a randomized clinical trial

Cazares RXR¹, Nardello LCL¹, Carvalho APL¹, Fernandes FS¹, Cunha LP¹, Mayer MP², Gavini G¹,

*Pinheiro ET¹

¹Department of Dentistry, School of Dentistry, ²Microbiology, Institute of Biomedical Sciences - University of São Paulo, São Paulo, Brazil

Aim To evaluate the effect of a treatment protocol including ultrasonic activation of calcium hydroxide paste (CHP) on bacterial activity in root canals.

Methodology Twenty teeth with asymptomatic apical periodontitis were randomly divided into two groups: CHP activated with ultrasound (n=10) and non-activated CHP (n= 10). The samples were collected from the root canals before (S1) and after chemomechanical preparation (S2); after passive ultrasonic irrigation (S3); and after 14 days of intracanal medication with CHP (S4). The samples were analyzed by qPCR based on ribosomal RNA (rRNA) and their respective genes (rDNA).

Results The rRNA/rDNA ratio was used for bacterial activity analysis. In the CHP activation group, there was a significant reduction in the number of infected canals between S1-S4 and S2-S4 samples (both with $p<0.05$). In the non-activated CHP group, the only difference was found between S1-S3 samples ($p<0.05$).

Conclusions It was concluded that the treatment protocol including chemomechanical preparation, passive ultrasonic activation and CHP activation was effective in reducing bacterial metabolism.

Acknowledgements FAPESP (Grant 2016/15473-0)

Irrigants/medicaments - canal cleaning

GE36

WITHDRAWN

GE37

Comparative study between removal of calcium hydroxide using ultrasonic irrigation vs. XP-Finisher® files.

*Flores V, Araya P, Vega-Marcich M, Araya M, Mancilla N, Mery G

Department of Endodontics, Andres Bello University, Santiago, Chile

Aim To determine the most efficient removal protocol of calcium hydroxide $[(CaOH)_2]$ between ultrasonic irrigation and instrumentation with files XP-Endo Finisher®.

Methodology 86 root canals from molars and premolars were prepared using mechanized system files Pro Taper Next® (X1, X2 y X3) with 5.25% sodium hypochlorite. Then these were medicated using $Ca(OH)_2$ Ultracal® mixed with green Chinese ink to facilitate the measuring in the microscope. Later these were divided into 4 groups: Ultrasonic removal protocol (group A=40 teeth), files XP-Endo Finisher (group B=40 teeth), Manual conventional technique (group C=4 teeth) and a control group of $Ca(OH)_2$ (2 teeth). After removal, these were sectioned at the level of its root longitudinally using a diamond disc and lever movements to separate the root into two leaving visible the canal in the center. Subsequently using the diamond disc, the outer surface of each half worn out, to have a thickness of approximately 1 mm, to be observed in the light microscope Olympus CX31.

Results Statistically significant differences between the ultrasonic irrigation and instrumentation with files XP- Endo finisher in the cervical third, middle and apical premolars and in the middle third

of molars were observed. By contrast, in the cervical apical third ($p = 0.171$) and ($p = 0.118$) molar, no significant indicating that probably due to random differences.

Conclusions The ultrasonic removal protocol was more effective than files XP-Endo Finisher®. None of the investigated protocols was able to completely remove the Ca(OH)_2 , observing a greater amount in the cervical third.

GE38

Comparative study of the removal of Calcium Hydroxide between Sonic Irrigation and XP- ENDO Finisher® Files, in curved root canals.

*Correa V, Vega-Marcich M, Riffo C, Broughton G, Flores V, Toloza R, Araya P

School of Dentistry, Andrés Bello University, Santiago de Chile, Chile

Aim To determine the most efficient Calcium Hydroxide (Ca(OH)_2) removal protocol between sonic irrigation and mechanized instrumentation, in curved root canals of circular cross section.

Methodology 120 mandibular molars, 90 samples were selected with canals with moderate curvature. These canals were instrumented with ProTaper Universal® files at -2 millimetres of LT, alternating irrigation with 3 mL of 5.25% sodium hypochlorite. Then irrigated with 17% EDTA for 1 minute, to be finally rinsed with 5.25% sodium hypochlorite. After instrumentation the samples were medicated with standardized mix of Ultracal XS® and black Chinese ink. After the medication, the samples were separated into 3 groups randomly according to the removal system used (XP ENDO Finisher®, Endoactivator® and Manual Conventional Technique). The area covered by Ca(OH)_2 was observed and delimited through an CX31 Olympus optical microscope associated with a computerized software (Micrometrics®).

Results The residual Ca(OH)_2 area obtained by each group had a significance level of $P > 0.05$, so there are no statistically significant differences between them. XP ENDO Finisher® files showed a

slight tendency for the total removal of Ca(OH)₂ over the other groups, but being a small N it does not reach to be representative to generate a significant difference.

Conclusions Although there is no system that removes all Ca(OH)₂ in root canals with moderate curvature, these systems manage to remove it without generating statistically significant differences between them.

GE39

Chemical and mechanical influence of root canal irrigation on biofilm removal

*Pereira TC^{1,2}, Petridis X¹, Dijkstra R¹, Andrade FB², van der Sluis L¹

¹*Center of Dentistry and Oral Health, University Medical Center Groningen, University of Groningen, Groningen, Netherlands,* ²*Department of Dentistry, Endodontics and Dental Materials, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil*

Aim To evaluate chemical (sodium hypochlorite 2% (NaOCl) and a basic salt solution :RISA (R) and mechanical effect (Ultrasound Activation with buffer solution (UA) and final flow) of root canal irrigation on biofilm removal, from lateral canal (LC) and isthmus (I) structures in polydimethylsiloxane (PDMS) models, by Optical Coherence Tomography (OCT) analysis. Besides, the stiffness and relaxation of biofilm after contact with the solutions was tested by Low Load Compression Testing (LLCT) analysis, verifying the viscoelastic properties of the biofilm.

Methodology A dual species biofilm was grown in a Constant Depth Film Fermentor (CDFF), in the LC and I models and on dentine disks (DD). LC and I were placed in PDMS root canal models and irrigation with buffer solution (B), R, NaOCl and (UA) was performed (n=10). Biofilm was analysed by OCT before and after treatment and, after final irrigation with B in higher flow rate (0,16 mL/second). Furthermore, dentine disks were divided in B, R and NaOCl groups for OCT and LLCT analysis.

Results In OCT analysis, for DD, NaOCl showed statistically significant difference in biofilm thickness reduction before and after treatment (14.20% - $p=0.011$). For LC, UA showed statistically significant difference in biofilm removal between pre-treatment and final irrigation (26.18% - $p=0$) and post treatment and final irrigation (15.71% - $p=0.008$). For I, all groups, with exception of B, showed significant difference between different steps of the experiment. In the comparison between groups, no significant difference was found for LC, I or DD, nor in the LLCT analysis for all tested parameters.

Conclusions Final flow was more efficient in the biofilm removal for LC and I than the chemical effect during irrigation. The tested substances had the same effect in the viscoelastic properties of biofilm as B, confirming the mechanical importance of the irrigation over the chemical action of the solutions.

Acknowledgements UMCG Abel Tasman scholarship (Netherlands) Coordination of Superior Level Staff Improvement (CAPES - Brazil)

GE40

Internal root resorption - development of methodology and evaluation of calcium hydroxide removal methods

*Göhringer I, da Silva BM, Tomazinho FSF, Leonardi DP, Farinhuk LF, Baratto-Filho F

Department of Dentistry, Positivo University, Curitiba, Brazil

Aim To evaluate the removal of calcium hydroxide paste in simulated internal root resorption (IRR), produced/simulated through two techniques, through the use of 5 different irrigation activation systems: Ultrasound, Eddy, EndoActivator, XP-endo Finisher and XP-endo Shaper by optical microscopy.

Methodology 70 maxillary central incisors with single root canal were selected. The teeth were shaped with Reciproc R50 and longitudinally cleaved to simulate IRR cavities, created 5 mm from the apex with a 1016 spherical diamond bur. The halves were posteriorly reunited and filled with

calcium hydroxide paste and sealed with a provisional plug. They were kept in 100% moist medium at 37°C for 2 weeks and then submitted to the irrigation solution agitation protocol (3 cycles of 20 seconds with 5% sodium hypochlorite, 17% EDTA and distilled water) by five different instruments: insert ultrasonic TOS E2 (CVDentus, São José dos Campos, SP); EndoActivator (Dentsply Sirona, Pennsylvania, USA); Eddy (VDW, Munich, Germany); XP endo Shaper and XP endo Finisher (FKG Dentaire, La Chaux-Fonds, Switzerland). The samples were cleaved, photographed and analyzed using optic microscopy. The IRR were split once more, cleaned and subjected to a protocol with 20% nitric acid for demineralization. After once again attached, the specimens were filled with calcium hydroxide. Irrigation procedures were repeated and a scoring system was used to quantify the residual calcium hydroxide. Statistical tests were used to compare the groups and the methodologies for creating IRR cavities.

Results There is a statistically significant difference between irrigation solution agitation methods and RRI creation methods

Conclusions XP endo Finisher and Eddy groups were more effective. There is a difference between RRI manufacturing methods.

GE41

Effect of microbubble irrigation on debris and smear layer removal

*Lee SH, Yoo YJ, Kim YS, Kum KY, Baek SH

Seoul National University, Seoul, Republic of Korea

Aim To assess the effect of final irrigation protocols using microbubbles on debris and smear layer removal.

Methodology Root canals of single-rooted human mandibular premolars (n = 50) prepared with ProTaper Universal up to master apical file of F4, and were randomly divided into 5 experimental groups according to the 2-step final irrigation protocols: group 1, distilled water and distilled water;

group 2, NaOCl and NaOCl; group 3, microbubble generated distilled water and microbubble generated distilled water; group 4, EDTA and NaOCl; group 5, EDTA and microbubble generated distilled water. Debris and smear scores were evaluated in the coronal, middle, and apical thirds of longitudinally fractured canal spaces using scanning electron microscopy. Statistical analysis was completed by using Cochran-Mantel-Haenszel statistic for comparing debris and smear score data among groups, and generalized linear analysis to identify the significant variables (use of NaOCl, EDTA, and microbubble generation) affecting the performance of the tested final irrigation protocols at different canal levels.

Results The tested irrigation procedures showed significantly lower debris scores than control ($p < 0.05$) without significant differences among them ($p > 0.05$). The smear layer scores were significantly lower in all tested groups than control ($p < 0.05$), and those of group 4 and 5 were significantly lower than the other groups ($p < 0.05$). Generalized linear model analysis demonstrated that all variables had independent positive correlation in debris and smear layer removal according to the canal levels ($p < 0.05$), except for the variable microbubble generation that was not significantly related to smear layer removal at all canal levels.

Conclusions As final canal irrigation procedure, the use of microbubble system combined with EDTA can improve the removal of root canal debris and smear layer.

Irrigants/medicaments - dentine disinfection

GE42

Dentineal tubule penetration of a novel silver nanoparticles root canal disinfectant

*Ostanina DA¹, Mitronin AV¹, Volkov DP¹, Mitronin VA¹

¹*Department of Cariology and Endodontics,* ²*Department of Prosthetic Dentistry and Gnathology,*
Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russian Federation

Aim To estimate the dentineal tubule penetrating depth of a novel 2.5% silver nanoparticle (Ag NPs) irrigant that applied with passive ultrasonic agitation. The biocompatibility of Ag NPs with periapical tissues was also examined.

Methodology A total of sixty single-rooted extracted human teeth were selected and randomly divided into groups in terms of three sequential trials. All samples were prepared to a final apical size of 30 using ProTaper system (Dentsply Sirona), irrigated with 2,5% fuchsine-stained silver nanoparticle solution and the passive ultrasonic irrigation (PUI) was performed using Piezon Master 700 (EMS) with a size 15-Piezo Endo Soft Tip. In the first and second phases of the experiment the most efficient PUI working mode that allows the deepest Ag NPs penetration was defined. Cross sections of teeth were made at $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ root length; stained area of canal walls was examined at 8 points under a stereomicroscope. A micrometric analysis was made using an ocular micrometer Carl Zeiss and an object micrometer that was placed on the tooth section. In the third phase, micro-CT analysis of experimental tooth sections was performed. Animal tissue reaction was evaluated against 2 different irrigants in 2 follow-up periods. Differences between groups were analysed by the Student's t-test and were considered significant for $P \leq 0.05$.

Results Ag NPs penetrating depth was at a peak-point during 60 seconds ultrasonic passive agitation with power range $W=1.8$. According to micro-CT analysis, no significant difference was observed between penetrating depth data in similar root levels ($P > 0.05$); the mean of depth penetration in the apical, middle and coronal parts was 740 nm, 570 nm and 120 nm, respectively. No statistically significant differences were reported among experimental and control groups in tissue inflammatory response.

Conclusions Within the parameters of this study, a novel 2.5% Ag NPs root canal disinfectant with enhanced physiochemical properties and reduced particle size (1-2 nm) could be considered as modern antimicrobials, especially in the case of chronic intracanal infection in response to its high antibiofilm activity and an opportunity to be deposited deep in root canal system.

Irrigants/medicaments - other

GE43

Scanning electron microscope and cutting efficiency study of a preheated CM wire machined endodontic file after exposure to different irrigants

*khalil HF¹, El-Mallah S²

¹*Department of Endodontics, Faculty of Dentistry The British University in Egypt, Cairo, ²Department of Endodontics, Faculty of Dentistry Fayoum University, Fayoum, Egypt*

Aim To examine and record the effect of seven different irrigants when applied for 10 minutes on the surface file topography and cutting efficiency of the preheated CM wire machined endodontic Mpro files.

Methodology Sixty three size 35 Mpro file were divided into seven main groups (9 files each) according to irrigant used: Group I Saline, Group II curcamin, Group III EDTA 17%, Group IV Lycopene, Group V Chitosan 0.3%, Group VI Chitosan 0.5% and Group VII sodium hypochlorite 5.25%. All files were scanned using scanning electron microscope with magnification (200x-500x) and photographed before and after immersion in irrigants for 10 minutes. All photomicrographs were examined by two different viewers who recorded the presence or absence of the following parameters per group; No visible defect, Pitting, Fretting, Micro fractures, Complete fracture, Metal flash, Metal strips, Blunt cutting edges, Disruption of cutting edge, Corrosion and presence of Debris (residual material). All files were used to prepare plastic blocks with simulative canals and the removed debris were recorded in milligrams.

Results Findings in photomicrographs were calculated as percentages per group for each parameter. Hundred percent of Groups I (Saline), V and VI (chitosan 0.3, 0.5%) showed no visible defects. Group II curcamin showed pitting, blunt cutting edges, disruption of cutting edge and residues of the irrigation on file, 66.67% of samples showed fretting. Group III EDTA showed pitting, blunt cutting edges, disruption of cutting edges. Group IV lycopene showed pitting, blunt cutting edges and

residues of the irrigation on file. Group VII sodium hypochlorite showed, fretting blunt cutting edges, disruption of cutting edges, 33.3% of samples showed micro fractures and metal flash defect. None of groups showed corrosion. Results for the cutting efficiency study showed a significant difference between all groups p value 0.000 with the lowest mean recorded by saline and the highest mean of debris recorded by Group V chitosan 0.3%

Conclusions Chitosan with its two concentrations 0.3 and 0.5 % did not affect the surface topography of the preheated CM wire machined file and the 0.3 % enhanced the file's cutting efficiency, so can be recommended to be used as irrigation.

GE44

Assessment of the interaction between sodium hypochlorite and edta at impact on organic tissues of pulp and the laboratory illustrating by the model

*Solopova AR, Rotova AA, Vedmyzkaya VV, Ostanina DA

Department of Cariology and Endodontics, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russian Federation

Aim To find out irrigation preferences of dentists through a survey. Determine the required irrigation protocol with sodium hypochlorite and EDTA for the complete dissolution of organic tissue of pulp on the laboratory model, as well as the adequate solution percentage.

Methodology Elements of shrimp tissue, each weighing 0.03 g were selected for the study. Sodium hypochlorite solutions were taken in 1%, 3% and 5.25%. In the first group, it was determined the time of the complete dissolution of organic tissues in these solutions. In the second group, 20% EDTA in a 2: 1 was added to test tubes with sodium hypochlorite and the time of complete dissolution was determined in the same way. Keeping the solutions was 5 minutes and then they were replaced, thereby taking into account the hypochlorite deactivation factor after interacting with organic tissue.

Results From a survey of dentists, it was found that most of them do not use intermediate irrigation with distilled water between EDTA and sodium hypochlorite. According to the results of the experiment, it is required 40% more time to dissolve organic tissue with 3% sodium hypochlorite than for a 5.25% solution. In turn, it took 1.7 times more time to dissolve with 1% solution than 3% and 2.4 times more than 5.25%. In the second group of studies in test tubes with the highest concentration of NaOCl (5.25% and 3%), dissolution took on average 2.7 times more than similar solutions of the first group. In a test tube with 1% sodium hypochlorite, there was no apparent dissolution for more than 1.5 hours.

Conclusions It was established that in the limited treatment time for adequate irrigation of the root canal and removal residues of organic tissue, using 3% and 5.25% NaOCl solutions will be justified. In the case of sequential using of sodium hypochlorite and EDTA solutions, intermediate canal washing with distilled water should be recommended. Irrigation with a solution of 1% NaOCl in a protocol containing EDTA is not recommended because of deactivation of most portion sodium hypochlorite.

GE45

Effect of chloroform and eucalyptus oil on Mineral Contents of Human Root Dentine

*Ajeti N¹, Stavileci M², Halimi Agran HA³, Violeta V², Perjuci F⁴, Shllaku FF²

¹*Department of Dental Pathology and Endodontics,, University of Business and Technology,*

²*Department of Dental Pathology and Endodontics, Dental Branch, Medical Faculty, University of*

Prishtina "Hasan Prishtina",³Department of Agronomy, University of Business and Technology,

⁴*Department of Oral Surgery, University of Business and Technology, Prishtina, Kosova*

Aim To evaluate the mineral contents of root-canal dentine before and after treatment with two commonly used gutta-percha solvents: chloroform and eucalyptus oil.

Methodology For this study were used twenty fresh intact human premolars extracted for different reasons. The teeth were stored in saline. Pulp tissue were removed with barbed broaches and then

divided in two groups (pretreatment and after treatment). Root canal of pretreatment were enlarged with Gates Glidden burs (#1,2 and 3) and then dentine chips were obtained and stored in Eppendorf epruvetes and serve as control group. Root canal of second group were treated with chloroform and eucalyptus oil for 10" and 20"(5 teeth for each group). Dentine chips were again obtained using were enlarged with Gates Glidden burs (# 4,5 and 6), and stored in Eppendorf epruvetes The levels of Ca, Na, K, Pb, Mg, Mn, and Fe, were analyzed with ICP-OES (Perkin Elmer Optima 8000). The values of chemical elements levels changes were recorded and statistically analyzed with Mann-Whitney test.

Results Our results showed a significant increase in Mg level after treatment with chloroform ($p<0.05$) The changes in other elements levels after treatment with gutta-percha solvents were minimal and statistically not significant. ($p>0.05$). Chloroform and eucalyptus oil did not show statistically significant differences at 10 and 20 minutes ($p>0.05$).

Conclusions Chloroform and eucalyptus oil presented similar results and they have effect on mineral content of root dentine.

GE46

Effect of apple vinegar associated with passive ultrasonic irrigation on the fracture resistance of human dentine: an *in vitro* study

*Böttcher DE Correa RS Waltrick SBG

Clinical Department, PUCRS, Porto Alegre, Brazil

Aim To evaluate the effect of the use of apple vinegar associated with ultrasonic irrigation (PUI) on the resistance of human dentine.

Methodology Sixty extracted human single rooted teeth, standardized at 13mm in length, were instrumented and randomly divided into 6 groups according to the final irrigation protocol: apple vinegar, apple vinegar + PUI, 17% EDTA, 17% EDTA + PUI, saline, saline + PUI. Three milliliters of each

solution were used for conventional irrigation for 3 minutes. For the ultrasonic activation, 1mL was agitated for 10 seconds, comprising 30s of PUI. After the completion of chemo-mechanical preparation, the canals were filled and the roots maintained at 37°C and 100% humidity for 7 days. The fracture resistance was evaluated with the Universal Test Machine EMIC-DL 2000. and the compression force was applied at a speed of 1mm/min, on each root, until the fracture occurred. The obtained data were compared through the 1-Way ANOVA test, considering a significance level of 5%.

Results Group 3 (17% EDTA + conventional irrigation) showed the lowest average of fracture resistance (1120.71 N). Group 4 (17% EDTA + PUI) presented the highest fracture resistance (1445.83 N). However, no significant differences were found throughout groups ($p=0.676$).

Conclusions Based on the obtained results and the experimental conditions of the present study, it was concluded that the use of apple vinegar, associated or not with PUI, did not interfere with the fracture resistance of human dentine.

GE47

***In vitro* study of the volume of sodium hypochlorite activated with ultrasonic irrigation, required in the removal of calcium hydroxide in oval canals**

*Cáceres C, Araya P, Vega-Marcich M, Paz Gomes M, Correa V, Ríos C6 Yévenes I

Department of Endodontic, Andrés Bello University, Santiago, Chile

Aim To determine the required volume of 5% sodium hypochlorite using ultrasonic activation is needed to remove calcium hydroxide when used as intracanal medication

Methodology 40 teeth with oval canals were used (premolars and/or canines), which underwent coronal slices to 19 mm from the root apex. Root canals were sequentially instrumented with Protaper universal® files with 5% sodium hypochlorite 3ml between files. Calcium hydroxide was applied as intracanal medicament, then the tooth was double sealed with temporary cements; To

stored them in a dry heat oven to 37°C and 100% humidity for 7 days. The medicament was removed by sequentially irrigating each tooth sample 10 times with 2 ml of 5% sodium hypochlorite (2 ml, 4 ml, 6 ml, 8 ml, 10 ml, 12 ml, 14 ml, 16 ml, 18 ml, 20 ml). The first volume employed was manually irrigated and the nine who followed were ultrasound activated (2 cycles/ 30 seconds). The solutions obtained from each irrigation (n= 400) were stored in 1.8 ml Eppendorf safe-lock tubes for its further chemical analysis using potentiometry

Results Statistical analysis showed that calcium ion has not normal distribution (Shapiro Wilks test, $p < 0.00001$). Kruskal-Wallis test exposed significant differences ($p \leq 0.05$) between calcium concentration and the volume used. Multiple comparisons were made between the volumes used and the calcium concentration corresponding, resulting in significant differences between different volumes (2, 12, 14 and 20 ml).

Conclusions The volumes that removed more ion calcium from the canal were 12 to 14 ml using ultrasonic irrigation protocol. 20 ml of 5% sodium hypochlorite used during removal of calcium hydroxide was not able to completely remove the intracanal medicament.

GE48

Comparison in the removal of calcium hydroxide root canal irrigation with sonic and ultrasonic irrigation working at different lengths.

*Vega-Marcich M, Araya P, Herman S, Jofré B, Gallardo AM, Flores V

Department of Endodontics, Andrés Bello University, Santiago, Chile

Aim To compare the removal of calcium hydroxide medication using different methods to finally establish superiority among them, also seeks to quantify the extrusion caused during therapy.

Methodology 148 straight root canals of human teeth were prepared using mechanized system files Pro Taper Universal® irrigating with 5.25% sodium hypochlorite. The root canals were dosed using Ca(OH)₂ Ultracal XS® mixed with black ink to facilitate viewing under a microscope. The teeth were

divided into 5 groups, disposal protocol was: manual conventional technique, sonic irrigation (EndoActivator®) -1 mm of the working length, sonic irrigation working length, Ultrasonic irrigation (Mectron®) -1 mm of the working length and Ultrasonic irrigation to working length. The apical extrusion was measured during the step of irrigation by method Huang X, after removal these the samples were sectioned longitudinally, the area covered by Ca(OH)₂ was observed and delimited through CX31 Olympus optical microscope associated with a computerized software (Micrometrics®). Finally the eppendorf content was analyzed to quantify the degree of extrusion caused during the clinical procedure.

Results Fewer Ca(OH)₂ attached to the dentine walls in the last 3 mm of the tooth, in those ultrasonic activation irrigant for removal of Ca(OH)₂ was used were observed, ANOVA ($\alpha=0.05$). Moreover, all those samples were subjected under ultrasonic activation of irrigant shown to have greater irrigant extrusion as detritus during the experimental stage, ANOVA $P>0.05$ no statistically significant differences.

Conclusions Activation by Sonic devices to -1 mm of the working length was found to be significant addition to achieving low percentage of extrusion, resulting in a cost-benefit for therapy. In turn, devices Ultrasonic method proved greater significance in the removal of calcium hydroxide medication both working length -1mm as this, but proved to be more invasive therapy by extrusion of detritus and large irrigant.

GE49

Effectiveness of different irrigation solutions to prevent the formation of para-chloroaniline

*Zincir ŞG¹, Özle O¹, Türkaydın D, İriboz E

Department of Endodontics, Marmara University Faculty of Dentistry, İstanbul, Turkey

Aim To evaluate the effectiveness of EDTA, citric acid, isopropyl alcohol, saline and distilled water to prevent the precipitate formed between sodium hypochlorite (NaOCl) and chlorhexidine (CHX).

Methodology One hundred and ten extracted single-rooted human teeth were decoronated, and the root canals were instrumented using ProTaper Next instruments. The teeth were randomly divided into 10 groups (n:10). Ten teeth served as positive and negative control groups. All canals were irrigated with 2.5% NaOCl, 17% EDTA and 2.5% NaOCl respectively. In the first five groups, intermediate flushes of 5 ml of EDTA, citric acid, isopropyl alcohol, saline, and distilled water were used between NaOCl and CHX. In the other five groups 10 ml of the same irrigants were used. The root canals were aspirated and dried with paper points between each solution change and in the final treatment. Then, the teeth were split along their long axis and subjected to stereomicroscopic examination. The amount of residue precipitated on the root canal walls were evaluated using a 4 grade scoring system under x30 magnification.

Results All of the groups had residue precipitated on the canal walls with similar amounts ($P > 0.05$). Although no statistical significance was found, EDTA group showed more orange-brown precipitate whereas citric acid showed less precipitate on the canal walls than the other groups. Amount of the irrigant did not effect the precipitate removal from the root canals.

Conclusions All solutions failed to prevent the precipitation of residues on canal walls following the use of NaOCl and CHX. Different irrigation solutions or amounts of intermediate flushes of irrigants should be studied in order to prevent the formation of the orange-brown precipitate.

GE50

Push-out bond strength of tricalcium silicate-based endodontic materials processed with irrigation solutions

Olca K1, Güven Pamukcu E2, *Ertürk E3, Ates Atav A², Turk T³

Department of Endodontology, ¹Medipol University, İstanbul, ²Okan University, İstanbul, ³Ege University, Izmir, Turkey

Aim To compare the push-out bond strength of Mineral Trioxide Aggregate and Biodentine processed with boric acid, citric acid and EDTA.

Methodology Samples were instrumented with rotary files (ProTaper, Dentsply, Maillefer, Ballaigues, Switzerland) to standardize the master apical file to be size 40 (F4). Next, Peeso reamers (Maillefer, Ballaigues, Switzerland), from #1 to #6, were used sequentially to obtain larger root canals. Between the use of each file, root canals were irrigated with 2 mL 2.5% Sodium Hypochlorite (NaOCl). Final irrigation was performed by using 2.5% NaOCl 5 mL (1 min) and EDTA 17% 5 mL (1 min). Next, canals were rinsed with sterile distilled water. CH paste prepared by mixing powder of calcium hydroxide with sterile distilled water (w/v 2:1) was placed into the root canals. The removal CH by 2.5% NaOCl samples were irrigated according to its group: Group 1: %17 EDTA (n=28), Group 2: %10 Citric acid (n=28), Group 3: 5% Boric acid (n=28), Group 4: Distilled water (n=28). After irrigation, each group were randomly divided into 2 subgroups. In one group MTA, in the other one Biodentine was used as coronal plug. After 3 days storage period, the coronal region of each root was horizontally sectioned. To express the push-out bond strength in MPa, the load at failure (N) was divided by the area of adhesion surface (mm²), calculated by using the following equation: $2\pi r \times h$, where π is the constant 3.14, r (mm) is the root canal radius, and h is the thickness of the root slice in millimeters.

Results Biodentine with EDTA was found to be higher than MTA with EDTA ($p < 0.05$) as Biodentine with citric acid ($p < 0.05$). MTA with citric acid ($p > 0.05$) was found to have no difference as MTA with EDTA ($p > 0.05$). Biodentine with citric acid and EDTA were found to be similar ($p > 0.05$).

Conclusions Biodentine showed higher push out resistance than MTA, with EDTA and citric acid.

Friday 13th September

Instruments – cyclic fatigue and fracture

GE51

Evaluation of the sodium hypochlorite solution in the electrochemical dissolution of thermally treated nickel-titanium instruments (GOLD).

*Cassol LG¹, Kowalczyk A¹, Laurindo CAH², Carneiro E¹, Westphalen VPD¹, Silva Neto UX¹

¹Department of Endodontics, ²Department of Mechanical Engineering, Pontifícia Universidade Católica do Paraná, Curitiba, Brazil

Aim To compare the influence of two solutions, fluoride solution and sodium hypochlorite both saturated with sodium chloride, during the electrochemical dissolution of instruments with conventional nickel-titanium alloy and thermally treated nickel-titanium (GOLD).

Methodology Three solutions were evaluated (NaF solution - NaF 12g / L + NaCl 180 g / L, NaOCl solution- NaOCl 2.5% + NaCl 180g / L) and distilled water (control group), by the polarization test of the Protaper Universal F1 instruments (PTU F1) and Wave One Gold Small (WOGS), with the sample of 48 instruments. The electrical current potentials were 0.5 V and 5 V for the NaF and NaOCl solution, respectively. The distilled water did not obtain results compatible with the dissolution of the NiTi alloys. The electrochemical cell composed of three electrodes for the polarization test of the instruments, which had 6 mm of the tip immersed in the solutions tested. The recording of electric current occurred for 540 seconds (s). If the complete dissolution of the immersed portion of the instrument occurred in less than expected time, the experiment was considered finished. The time variations (in seconds) of the instruments in the NaF, NaOCl solution were measured. The evaluation of the corrosion patterns of the instruments occurred by scanning electron microscopy (SEM). Data were submitted to statistical analysis using the Mann Whitney, Kruskal Wallis and Dunn tests.

Results NaF and NaOCl solutions presented a statistically significant difference ($p < 0.05$) in relation to the dissolution time of the instrument, with a mean of 12.9 s and 83.6 s, respectively. There was

no statistically significant difference ($p > 0.05$) in relation to the time in the dissolution comparison between both instruments.

Conclusions Both solutions have electrochemical dissolution capacity of PTU F1 and WOGS instruments. However, the NaF solution promoted dissolution of the instruments in less time.

GE52

Comparative evaluation of surface changes in XP-endo group files: a SEM study

*Mitronin YA, Mitronin AV, Ostanina DA

Department of Cariology and Endodontics, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russian Federation

Aim To investigate the surface changes of nickel-titanium XP-endo family files before and after several uses. The influence of EDTA, 5% sodium hypochlorite and chloroform solutions and sterilization procedures on the MaxWire instruments' surfaces examined.

Methodology A total of 60 XP-Endo Shaper, XP-Endo Finisher and XP-Endo Finisher R files were used. Mainly oval and C-shaped canals of 90 extracted teeth were selected and divided into 3 groups, respectively. Scanning electron microscopy (SEM) and X-ray energy-dispersive spectroscopy (EDS) were employed to analyse surface imperfections pre-operatively, after single use, after sterilization, after three and five uses. The same analysis was made with instruments immersed in 5% NaOCl, EDTA and chloroform solutions for 60 minutes. Statistical analysis was performed with Student t-test at a significance level of $P < 0.05$.

Results One file was fractured (1,6%) and two files were bent (3,3%) and they all belonged to the XP-endo Finisher group. Three XP-endo Shaper files were wound (5%), but none were fractured. Morphometric changes such as machining grooves and marks could be visualized by SEM in all new files; EDS revealed the existence of Ni, Ti, Si, O; it's proposed to be an oxide coating on the instrument's surface. Surface analysis of the files that were subjected to single use instrumentation

and sterilization procedures showed that all files appeared to have minimal morphological changes. XP-endo Finisher and XP-endo Finisher R files showed significant deteriorations after the third use. The surface of these instruments was extremely smooth though superficial transverse cracks and dimpled rupture were observed along the cutting edges. XP-endo Shaper files exhibited a statistically higher number of surface deteriorations just after the fifth use ($P < 0.05$). SEM data indicated that chloroform solution caused significant surface deteriorations on the oxide layer, but 5% NaOCl, EDTA and sterilization procedures did not cause significant surface irregularities.

Conclusions It appears that XP-endo group files have a high margin of working capacity and durability as they keep effectiveness up to the third use. According to the EDS, not only nickel and titanium were found in instruments' elemental composition, which may affect the increased fatigue resistance.

GE53

Cyclic fatigue resistance in new reciprocating files

Howait M, Abu-haimed TS, Almarshadi M, *Abumansour A

Department of Endodontics, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia

Aim To compare the cyclic fatigue of Endosequence Reciprocating files (ESR) and Reciproc Blue (RB) in static and dynamic settings.

Methodology Endsequence Reciproc File (ESR) tip size 25 with variable taper (Brasseler USA Dental), Reciproc Blue (RB) tip size 25 and 8 % taper (VDW, Munich, Germany) were tested for cyclic fatigue in static and dynamic motion (10 files each group), using an artificial canal with radius of 5-mm and 60° curvature. The number of cycles to fatigue (NCF) was calculated; the lateral surface and fractures face segments were examined using scanning electron microscopy (SEM). One-way ANOVAs was utilized for data analysis. Statistical difference was set at 0.05.

Results There was no significant difference in cyclic fatigue resistance between the types of files ($P > 0.05$). However, they showed significant difference in resistance to cyclic fatigue in different motions, as dynamic setting had a better resistance to cyclic fatigue in both files ($P < 0.05$). SEM of the fracture segment will be evaluated and be presented in the conference.

Conclusions No Difference in cyclic fatigue resistance between ESR and RB in both static and dynamic settings.

GE54

Comparison of mechanical properties of rotary endodontic Ni-Ti files made of two different types of Ni-Ti alloy

*Mocny-Pachonska K¹, Trzcionka A¹, Zytecka E¹, Brekalo-Prso I⁴, Paljevic E², Tanasiewicz M¹

¹*Department of Conservative Dentistry with Endodontics, Medical University of Silesia, Bytom, Poland,* ²*Department of Endodontics and Restorative Dentistry, Clinical Hospital Centre Rijeka, Faculty of Medicine, University of Rijeka, Rijeka, Croatia*

Aim To evaluate the effect of multiple dry-heat and autoclave sterilizations on mechanical properties of rotary endodontic Ni-Ti files made of two different types of Ni-Ti alloy- conventional Ni-Ti alloy (E3 system) and Ni-Ti alloy thermally treated (E3 Azure) (Poldent).

Methodology The basic set, which consists of three instruments: 08/30, 06/25, 04/30 for both types of alloy was examined. The instruments were divided into three sub-groups. The first one was a control group, where no sterilization and usage occurred. The second one, was a group where instruments underwent five times autoclave sterilization cycle. In the third group, each file was used to prepare a root canal in a plastic training blocks (VDW) and then it was sterilized five times. The instruments were tested upon resistance to fracture by twisting and angular deflection and resistance to bending 45°.

Results All tested endodontic instruments of control and study groups comply with ISO 3630-5 norm. In case of second group for the particular instruments of E3 Azure the increase of resistance to fracture by twisting and angular deflection: 08/30 -1.08 times (8.16%), 06/25-1.43 times (30.25%), 04/30-1.2 times (16.6%) in comparison to E3 instruments. The results obtained for the third group were: 08/30-, 06/25-1.07 times (7.04%), 04/30-1.39 times (28.12%). All E3 Azure had better resistance to bending 45° in comparison to conventional ones: 08/30 better in 52%, 06/25 in 61%, 04/30 in 62%- in the second group. The same tendency was observed in third group: 08/30, 06/25 and 04/30 E3 Azure were more resistant in comparison to conventional ones in 27.5%, 61% and 63%.

Conclusions The results presented in the study suggest that E3 Azure System files are characterized by better mechanical properties than instruments of E3 System. The obtained results may be explained with the fact that Azure System files are thermal treated in a production process. Both types of instruments are characterized by very good mechanical properties what causes that they can be widely used in endodontics.

GE55

Fracture rate of ProTaper Next among postgraduate students after preparation of molar teeth

*Khalil WA¹, Alghamdi F²

Department of ¹Endodontics, ²Pulp Biology, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia

Aim To evaluate the fracture rate of ProTaper Next nickel-titanium (NiTi) rotary instruments (PTN, Dentsply Sirona, Ballaigues, Switzerland) discarded after clinical use to prepare molar teeth.

Methodology A total of 624 PTN rotary NiTi discarded instruments were collected after clinical use by residents in a postgraduate endodontic program over 22 months. The collected files were the X1 (17/04), X2 (25/06) and X3 (30/07). The length of the files was measured and all files were examined under the stereomicroscope for defects and fracture. The fracture instruments' lateral view and

fractured faces were examined and photographed under the scanning electron microscope. The data were analyzed using a chi-square and Kruskal-Wallis test.

Results The defect rate of all files was 4.8% and fracture represents of 2.9% of the total defected instruments. The cyclic fatigue was the cause of 94.4% of fractured instruments. The most frequently fractured file was the X3 (55.6% of the total fractured files) due to cyclic failure.

Conclusions The cyclic fatigue was the most frequently cause of fracture in ProTaper Next and was more common in larger sizes.

GE56

Cyclic fatigue of new reciprocating instrument

*Morese A, Seracchiani M, Miccoli G, Di Nardo D, Testarelli L, Gambarini G

Department of Oral and Maxillo-Facial Sciences, "Sapienza" University of Rome, Rome, Italy

Aim To test and compare a new reciprocating instrument using in severe curvature, an *in vitro* cyclic fatigue study.

Methodology A cyclic fatigue study was performed using a device previously validated in many published studies to test and compare in vitro resistance to breakage of two different reciprocating instruments. The following instrument were tested: Wave One Gold Medium 35.06 (Dentsply, Sirona, Switzerland) and Edge One Fire medium 35.06 (EdgeEndo, Albuquerque, New Mexico). Twenty instrument for each brand were rotated inside a stainless steel artificial canal (90°, 2 mm radius of curvature) until breakage, using the same reciprocating motion (150° CCW - 30° CW with an every speed of 350 rpm) and motor (X smart plus, Dentsply Sirona). Time to Fracture and fragment length were recorded and data were statistically analyzed.

Results Data show a significantly differences between the two instruments with the Edge One Fire resulting an significantly higher resistance ($p<0.05$). Mean values for WoG were 14.67 ± 0.57 seconds

and for EoF mean values were 28.00 ± 2.64 seconds. No significant differences were found in the fragment length, mean values 2.41 ± 0.14 mm vs 2.44 ± 0.38 mm for respectively Wog and EoF.

Conclusions Edge One fire files were very recently commercialized, therefore there is no scientifically published paper comparing the two tested instruments. Since both are made by thermally treated Ni-Ti, and have a similar design and dimension, the finding of the present study could be related to the proprietary manufacturing processes, and more specifically to heat treatment. According to the manufacture's internal studies, the heat treated Fire-Wire NiTi provides unmatched flexibility and incredible strength compared to other instruments. The findings of the present study confirm the excellent properties of the Fire-wire alloy, even if testing device and canals were slightly different from the manufacture's one.

GE57

Influence of flat design on cyclic fatigue resistance

*Seracchiani M, Miccoli G, Di Giorgio G, Ferri V, Bossu M, Gambarini G, Testarelli L

Department of Oral and Maxillo-Facial Sciences, "Sapienza" University of Rome, Rome, Italy

Aim To evaluate the influence of flat side design on cyclic fatigue resistance of a one-file instrumentation technique.

Methodology A cyclic fatigue test was performed using a device already validated in previously published studies to evaluate and compare *in vitro* flexural resistance of F one 25.04 (Fanta Dental, Shanghai, China), an instrument with a proprietary flat side design on one side (group A) and the same instrument (prototype) without a flat designed surface (group B). Twenty instrument for each group were rotated in a stainless steel canal (90° , 5 mm radius of curvature) until breakage occurred. All instruments were rotated using the same speed, 500 rpm, and the same torque, 2N using an endodontic cordless motor (Eighteeth) Time to Fracture (TtF) and fragment length (FL) were recorded and data were statistically analysed using T-test, with a 95% significance.

Results Data show a significantly difference between the two different groups tested. The F-One, a flat designed instrumented, resulted in statistically significant higher cyclic fatigue resistance ($p<0.05$). No significant differences were found in the fragment length.

Conclusions The F-One is a recently commercialised instrument with a peculiar flat side design, which is intended to be a One-file system. Therefore all mechanical stress due to intracranal instrumentation will be applied to the instrument. This requires an increased mechanical resistance of the instrument. According to the manufacturer, the new design is meant to reduce both torsional and flexural stresses by improving cutting efficiency and reducing blade engagement and mass. Instruments are made by a special heat treated alloy, which is supposed to increase resistance to fatigue compared to traditional Ni-Ti alloys. Since manufacturer and alloy were the same, the results of the present study showed the influence of the new design on fatigue resistance. Of course, due to the limitation of this kind of study, further studies are needed to better evaluate the influence of flat surface on torsional resistance and cutting efficiency of Nickel-Titanium rotary instruments.

GE58

Efficacy of repeated sterilization cycles on the surface alterations of different rotary NiTi instruments

Özdemir O, Hazar E, Sağlam BC, Koçak MM, *Koçak S

Department of Endodontics, Bülent Ecevit University Faculty of Dentistry, Zonguldak, Turkey

Aim The chemical and physical reactions that occur during disinfection and sterilization may cause corrosion and/or deterioration of the instruments, leading to an early fracture. The aim of this study is to evaluate the effects of repeated sterilization cycles on the surface alterations of different rotary NiTi instruments.

Methodology A total of 24 new Ni-Ti instruments including; 2Shape, ProTaper Next, TF-Adaptive, and HyFlex CM files were used in the study. The tip of each file was separated to obtain a 5 mm

length specimen. Group 1 was selected as control without applying any disinfection or sterilization procedures, whilst in group 2, five cycles of sterilization procedure were applied for the specimens. Then, the samples were placed in the Atomic Force Microscopy (AFM) for topographic evaluation. The surface analysis in AFM was performed on 11 different regions located between first and third millimeters from the tip of the instrument. The RMS and depth values were recorded.

Results Before sterilization cycles, Hyflex CM demonstrated the highest RMS values and 2shape demonstrated the lowest values, significantly ($P \leq 0.05$). After sterilization procedures, significant increases occurred in TF-Adaptive and ProTaper Next RMS values ($P \leq 0.05$). The RMS values of HyFlex CM decreased after 5 sterilization cycles.

Conclusions The AFM analysis revealed that multiple autoclave sterilization cycles significantly affect the surface roughness of the instruments.

Canal filling – general

GE59

Comparative evaluation of root canal obturation techniques in teeth with internal resorption

*Sukhikh MO, Mitronin AV, Galieva DT, Khromova LA, Zablotskaia MV, Mitronin YUA

Department of Cariology and Endodontics, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russian Federation

Aim To compare quality of root canal obturation in teeth with internal resorption.

Methodology There were studied 19 upper central incisors extracted for clinical indications in patients aged 40-55 years. Canals were instrumented with Protaper system (S1,S2,F1,F2). Teeth were sectioned to simulate internal resorption. Teeth were cut perpendicular to their long axes using diamond disk (d=8mm), then a diamond bur was used to make a hole on a root canal wall to simulate resorption cavity, then tooth parts were glued. Teeth were subsequently divided into three groups and obturated with different techniques: Group 1 - lateral condensation, Group 2 - hybrid

vertical condensation, Group 3 - Thermafil. Comparative evaluation of obturated area of root canals was performed using X-ray and CBCT. The received data was statistically analysed using Student's t-test.

Results According to X-ray and CBCT data, differences were found in density of root canal obturation and filling of all the cavity of artificial resorption. Obturation density was greater in group 2 in comparison with groups 1 and 3. Obturation area was 7.6 mm² in group 2, 7.0 mm² - in group 1 and 6.2 mm² - in group 3 (frontal surface). In groups 1 and 3 the simulated cavity wasn't fully filled with obturation material.

Conclusions Comparing quality of obturation of teeth with internal root resorption, the best result was found in group of hybrid vertical condensation technique and composed 96%, that is 10% and 15% better than in other groups

GE60

Comparative study of the cytotoxicity and genotoxicity of silver zeolite and nano silver

*Negm AM¹, Nashaat YM², Elaasar MS²

Department of Endodontics, ¹Ahram Canadian University, ²October 6 University, Cairo, Egypt

Aim To compare the cytotoxicity and genotoxicity of silver-zeolite with silver nanoparticles.

Methodology MRC-5 cell line was used as an in vitro model. The cell viability was assessed using MTT cytotoxicity assay. Genotoxicity was tested by alkaline single cell gel electrophoresis (comet assay) for measuring DNA damage. Each material was tested in different concentrations (100mg/ml, 50mg/ml, 25mg/ml, 12.5mg/ml, and 6.25mg/ml).

Results The results showed that silver zeolite has lower cytotoxic effect than silver nanoparticles among all different concentrations used in the study. Also the results showed unaccepted cytotoxicity levels for silver nanoparticles on concentrations of 100mg/ml and 50mg/ml. Data

obtained from the Comet assay indicated that both silver nanoparticles and silver zeolite causes DNA damage with no significant difference between the two treated groups.

Conclusions No significant difference between silver zeolite and silver nano particles concerning their antimicrobial properties, cytotoxicity and genotoxicity.

GE61

Gutta-percha filled area of root canals with a modified protocol of Thermafil system

Ruiz Durán C, *Maldonado Arechaga A, Bascones Ilundain J, Gancedo Caravia L, García Barbero E

Department of Conservative Dentistry, Complutense University, Madrid, Spain

Aim To compare the percentage of gutta-percha filled area (PGFA) achieved in root canals filled with Thermafil, using the standard protocol and after replacing the carrier with gutta-percha cones.

Methodology Forty-five extracted single-rooted teeth were prepared to working length with Protaper Next instruments and randomly assigned to one of the three experimental groups (n=15): G1: root canal filling with Thermafil standard protocol; G2: 5 minutes after root canal filling with Thermafil, replacement of the plastic carrier with a 0.02 taper gutta-percha cone of the same diameter, and cold lateral condensation; G3: 24 hours after root canal filling with Thermafil, replacement of the plastic carrier with a 0.02 taper gutta-percha cone of the same diameter and cold lateral condensation. Roots were horizontally sectioned at five levels: Sections were digitally photographed under a stereoscopic microscope, and the PGFA of the root canal was measured on the images. PGFA of the different groups were compared with Kruskal-Wallis test.

Results PGFA was lower in G2 than in G1 at three of the 5 levels studied ($P < 0.05$). No significant statistical differences were found between G1 and G3 at any level.

Conclusions Within the limits of our study, we may conclude that replacing the carrier in the Thermafil technique 24 hours after root canal filling does not affect PGFA obtained in single-rooted canals.

Effect of periapical lesion existence on the overfilled root canals performed by undergraduate students

Altundasar E, Uzunoglu-Ozyurek E, *Ozcelik B

Department of Endodontics, Hacettepe University, Dental Faculty, Ankara, Turkey

Aim Working length control during root canal treatment is one of the major factors that affect the success of endodontic therapy. Underfillings or overfillings undermine the success rates of endodontic treatment. Chronic periapical lesion may affect integrity of apical construction and may complicate working length control during treatment especially for undergraduate students. Therefore, effect of the periapical lesion existence on the overfilled root canals performed by undergraduate students was evaluated in the present study.

Methodology One hundred and thirty-eight patients (F: 55.80%, M: 44.20%) with at least one overfilled root canal (confirmed radiographically), which were treated by undergraduate students, were evaluated in this retrospective study. Data was analysed with chi-square tests at $p=0.05$).

Results Average age of patients was 39.04 ± 16.27 (14-80). Total treated root canals were 245 and 67.35% of these canals were overfilled ($n=165$). Mandibular molars (25.4%) and maxillary incisors (25.4%) were overfilled with higher percentage compared other teeth groups (maxillary molars 16.7%, maxillary premolars 14.5%, mandibular premolars 10.9% and mandibular incisors 7.2%) ($p<0.05$). Considering overfilled treatments, periapical lesions were observed in the 67.4% of the patients, while it was not observed in the 32.6% of the patients radiographically ($p<0.05$).

Conclusions Overfilling was observed either with periapical lesion or without. However, overfilled root canals were observed frequently in teeth with periapical lesions. Less experienced practitioners might encounter with difficulties during obturation of teeth with periapical lesions.

Replication of root canal irregularities with different warm gutta-percha obturation techniques

*Santamaria-Peralta N, Garcia-Gomez L, Bascones-Ilundain J, Gancedo-Caravia L, Garcia-Barbero E

Department of Endodontics, Complutense University of Madrid, Madrid, Spain

Aim To compare the flow capacity of gutta-percha into simulated lateral canals and depressions of root canals using different warm gutta-percha obturation techniques.

Methodology A split-model was constructed with an extracted human maxillary canine. Lateral canals and depressions were made at coronal, middle and apical third of the root canal. The study included six experimental groups (n= 10 in each group), corresponding to different obturation techniques: System B downpack, removal of the coronal material, followed by injectable gutta-percha backfill (G1); System B downpack without removal of the coronal material, followed by injectable gutta-percha onto the space created by the plugger (G2); System B downpack without removal of the coronal material, followed by backfill with a 0.06 cone fitted onto the space created by the plugger (G3); System B downpack, removal of the coronal material, and a second heat wave at 100°C backfill (G4); Thermafil Plus (G5); Guttacore (G6). After filling the canal, the resultant mass of gutta-percha was removed from the tooth and photographs were taken under a stereoscopic microscope. On the images the penetration of gutta-percha into the lateral canals and depressions was measured to quantify the flow capacity of gutta-percha. The penetration was compared among the different groups using ANOVA and Tukey's post hoc test.

Results Penetration of gutta-percha was significantly higher in groups G1 and G2, at all measuring points (coronal, middle and apical third) tested ($p < 0.05$).

Conclusions Within the limits of our study, we may conclude that injection technique provides higher flow capacity of warm gutta-percha.

Assessment of root canal obturation quality in dynamic conditions - a pilot study

Đumlija P¹, Kodvanj J², Katić M³, Prpić-Mehičić G⁴, *Matijević J⁴

¹Private Dental Clinic Omega, ²Department of Engineering Mechanics, Faculty of Mechanical

Engineering and Naval Architecture, ³Laboratory for Length Measurements, Faculty of Mechanical

Engineering and Naval Architecture, ⁴Department of Endodontics and Restorative Dental Medicine,

School of Dental Medicine, Zagreb, Croatia

Aim To examine the root canal obturation quality after thermal and mechanical loading using a micro CT scanning technique.

Methodology This pilot study was carried out on single-root decoronated teeth (n=3). Teeth were prepared using different engine-driven systems (tooth 1-ProTaper Next, tooth 2-Reciproc, tooth 3-F360°) and were filled with AH Plus sealer and a single gutta-percha cone (tooth 1-ProTaper Next X3, tooth 2-Reciproc R40, tooth 3-Dia-ProISO GT.04). After PDL simulation was done, samples were scanned using Nikon XT-H 225 micro CT device, with structural resolution resulting from geometrical magnification set to 33 µm. Samples were then thermocycled for 1800 cycles in water baths between 5°C and 55°C, with dwell time of 10 seconds and transfer time of 2 seconds. After thermocycling, teeth were scanned for the second time and additionally prepared and subjected to mechanical loading. The composite material Luminos UN and Adhese Universal VivaPen adhesive were used for coronal build up with an angulation of 40 degrees to the horizontal plane. The teeth were loaded in a computer controlled testing machine LFV 50- HH according to following parameters: Fmax= 150 N, f= 1.5 Hz, N=2000, 130°, and scanned for the third time. Finally, all of three scans were compared using software that graphically and quantitatively evaluated dimensional changes of root canal filling material and void appearance.

Results Quantitative analysis indicated decrease in surface for all three samples, and increase in volume of samples number one and two as a final result of thermomechanical loading. Void

appearance is observed in sample number three. Graphical analysis shows areas of dimensional changes of up to $\pm 30 \mu\text{m}$.

Conclusions Based on the results of this pilot study, dynamic conditions had impact on the quality of root canal obturation. Possibility of subsequent bacterial leakage may cause endodontic treatment failure.

Acknowledgements This study is funded by Croatian Science Foundation, "Investigation and development of new micro and nanostructure bioactive materials in dental medicine" BIODENTMED No. IP-2018-01-1719.

Canal filling - leakage

GE65

Apical microleakage of eight root canal sealers: a comparative study

*Vula V¹, Ajeti N¹, Vula V², Stavileci M¹

¹*Department of Dental Pathology and Endodontics, University of Prishtina/Faculty of Medicine/Dentistry,* ²*Private Dental Clinic, Dental Clinic "Viodent", Prishtina, Kosova*

Aim Root canal sealers should ensure an impervious seal of the apical portion of the root canal system. The purpose of this *in vitro* study was to compare apical microleakage of eight root canal sealers.

Methodology For this study, 160 single rooted human teeth were used. They were divided into eight experimental groups and 16 teeth were divided into eight control groups. All of the teeth were instrumented using the step-back technique and sealed with cold lateral compaction of gutta-percha with Canason, Endomethasone, Apexit Plus, AH-Plus, ProRoot MTA, Fuji GIC, EndoRez, and Epiphany SREsilon. Apical microleakage was measured using dye penetration method of 2% methylene blue. The samples were incubated (at 37°C for 7 days and 100% humidity). Following longitudinal sectioning, linear dye penetration at the apical third of the roots was recorded with a

stereomicroscope at 20x and 30x magnification. The results were analyzed using descriptive statistics and T-test.

Results Average maximum dye leakage was observed in teeth sealed with Endomethasone (SB-Gr2E)($1.3 \pm 0.64\text{mm}$); while the average minimum dye leakage was observed in teeth sealed with Fuji GIC (SB-Gr6GIC) and Epiphany SE Resilon (SB-Gr8E-se-R)(0.06mm).

Conclusions There is a significant difference in dye penetration rate between all of the tested root canal sealers.

GE66

Saliva penetration in root canals filled with MTA and Biodentine

Vula V1, Ajeti N²

¹*Department of Dental Pathology and Endodontics, University of Prishtina, Medical Faculty,* ²*Dental branch, University of Business and Technology, Prishtina, Kosova*

Aim To evaluate and compare the saliva penetration in root canals filled with ProRoot MTA and Biodentine.

Methodology Forty extracted single rooted human teeth were prepared with ProTaper rotary files (Dentsply Sirona, Switzerland) using crown down technique. After preparation and irrigation with 2.5% sodium hypochlorite (Parcan, Septodont, France), root canals of 20 teeth were obturated with ProRoot MTA (Dentsply, Tulsa dental, Tulsa, OK, USA) (Group 1) and root canals of other 20 teeth were obturated with Biodentine (Septodont, Saint Maur des Fossés, France)(Group 2). The apical third of roots was immersed in thioglycolate broth, and coronal parts of obturated teeth were exposed against human saliva for 90 days. Turbidity of broth was the indicator of radicular saliva penetration and root canal contamination. The results were analyzed with Fischer exact test.

Results Five samples (25%) of root canals obturated with MTA and four samples (20%) of root canals obturated with Biodentine were contaminated in the period of 90 days. No statistically difference was found between both groups ($p>0.05$).

Conclusions Under the condition of this study, MTA and Biodentine showed similar results against saliva leakage.

Canal filling – MTA/calcium silicate cements

GE67

Sealing ability and bond strength of bioceramics as an apical seal material

*Howait M, Alsofi L, Alzamzami Z, Khawaji H, Abulkhair R

Department of Endodontics, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia

Aim To evaluate the sealing ability and handling technique of three different materials: BC sealer, BC putty, and MTA as retrograde filling.

Methodology 10 freshly extracted human premolars with single root canal were prepared using protaper difference files (X2, X3) and sizes (3,4) gates Glidden drills. The teeth were divided into three groups based on the type of the filling material (BC Root Repair material (RRM), BC putty, and MTA). Each tooth was mounted using putty base and then scanned under micro-CT to evaluate the volume of open pore space, porosity, and connectivity. After that, we remounted them in an acrylic base mount to facilitate resection. A diamond disc was used to resect 2mm thickness slices in each mounted tooth. The universal testing machine was used to obtain the maximum yield strength before debonding for each specimen. Analysis of variance with Tukey post Hoc was used to analyze the data with a level of significance.

Results The micro CT scans showed a superior sealing ability of MTA over BC putty and BC RRM, data did not show statistically significant differences from either MTA or BC putty. Roots filled with BC RRM, BC putty and MTA have the maximum yield strength of (25.19 ± 6.88 MPa), (28.69 ± 8.69 MPa)

and (32.52±11.1 MPa), respectively. One-way ANOVA showed no significant difference in the yield strength of the 3 different materials used.

Conclusions Within the limitation of this study. the micro CT scans showed a superior sealing ability of MTA over BC putty. However, BC ERRM data did not show statistically significant differences from either MTA or BC putty. There was no difference in the bond strength of MTA, BC putty and BC ERRM to root dentine as indicated by this study.

GE68

Influence of different intracanal laser assisted disinfection protocols on the bond strength of a bioceramic root canal sealer to intracanal dentine

*Bago I¹, Sandrić A¹, Beljic-Ivanovic K², Kapetanović G³

¹Department of Endodontics and Restorative Dentistry, School of Dental Medicine, University of Zagreb, Zagreb, Croatia, ²Department of Restorative Odontology and Endodontics, School of Dental Medicine, University of Belgrade, Belgrade, Serbia, ³Private Dental Polyclinic, Zagreb, Croatia

Aim To evaluate the influence of different intracanal laser assisted disinfection protocols on the bond strength of a bioceramic root canal sealer to root canal wall.

Methodology The study sample included 56 extracted human straight single canal teeth. The selected root canals were instrumented with ProTaper Next (PTN) technique (Dentsply Sirona Endodontics, Ballaigues, Switzerland) and randomly divided into experimental groups (n=10) and a negative control group (no treatment, n=6): Group 1. Photon initiated photoacoustic streaming (PIPS) of sodium hypochlorite (NaOCl) + ethylenediamine tetraacetic acid (EDTA) + NaOCl; Group 2. Diode laser irradiation (Epic Biolase, San Clemente, USA); Group 3. Photodynamic therapy (PDT) (Helbo, Bredent, Senden, Germany); Group 4. Conventional needle irrigation (NaOCl+EDTA+NaOCl); Group 5. Conventional needle irrigation NaOCl+EDTA+Chlorhexidine. After the protocols, the canals were filled with a bioceramic root canal sealer (BioRoot RCS, Septodont, Saint-Maur-des-Fosses,

France) and a PTN single gutta-percha cone. The specimens were fixed in a methacrylate resin and transversely sectioned to produce 1 mm thick discs of coronal, middle and apical canal third. The push-out test was preformed one month later. The results were analysed using Mann-Whitney U test and post hoc analysis with p value set at 0.05.

Results No statistical difference was found for coronal third among all group tested ($p>0.05$) except for PIPS group which showed the lowest bond strength values ($p<0.05$). In the middle and apical thirds, bond strength was highest in the diode laser group ($p<0.05$).

Conclusions The final irradiation of the root canal with diode laser improved bond strength of the bioceramic sealer. The PDT did not adversely affect the bond strength of the bioceramic sealer.

GE69

Micro-computed tomographic assessment of extruded material in furcation perforation repair

Correlo V¹, Viegas C²

¹3B's Research Group-Biomaterials, Biodegradables and Biomimetics, Department of Polymer Engineering-School of Engineering, University of Minho, Guimarães, ²Department of Veterinary Sciences, University of Trás-os-Montes e Alto Douro, Vila Real, Portugal

Aim To compare the volume of extruded material with micro-computed tomographic (microCT) after Furcation Perforation (FP) repair with Biodentine (BDT) or ProRoot MTA (prMTA) in dogs' teeth.

Methodology Forty dogs' teeth were divided into 2 groups: prMTA (n=20, FP repaired with ProRoot MTA), BDT (n=20, FP repaired with Biodentine). The animals were euthanized after 4 months. The volume of extruded material was quantified using microCT images. Statistical analysis was performed using independent-samples t-test in SPSS™. All differences were considered significant at $P\leq 0.05$.

Results Total volume of extruded material was significantly lower in BDT group than in prMTA group (BDT: $1.42\pm 0.80\text{mm}^3$; prMTA: $2.27\pm 1.67\text{mm}^3$; $P=0.049$). In both test material groups, microCT

showed continuity between the extruded repair material and the surrounding bone. Along with the study's included outcomes, further evaluation of microCT images allowed the identification of new mineralized tissue bridges over the remaining radicular pulp tissue in specimens of both test groups.

Conclusions The greater amount of extruded material found for prMTA group is consistent with its lengthier setting time, which may contribute to the unintended compaction of the unset material into the furcation defect. Even though Biodentine presented lesser extrusion, a concomitant histologic study revealed similar results concerning mineralized tissue formation.

GE70

Dental colour stability after placement of bioceramic materials when used in a regenerative procedure

*Lozano A, Iglesias M, Forner L, Llena C

Department of Stomatology, University of Valencia, Valencia, Spain

Aim To assess tooth colour stability after the placement of four different bioceramic materials in an in vitro study simulating a regenerative procedure.

Methodology Fifty human extracted teeth were used. Roots were cut 10 mm from the amelodentineal junction (ADJ), and the apical end removed. Root canals were shaped with a 25 Reciproc Blue file and irrigated with 5% NaOCl. A 1 mm Teflon layer was applied at 6 mm from the ADJ. 5 groups were prepared: 1, negative control (Teflon only); 2, ProRoot-MTA; 3, MM-MTA; 4, TotalFill BC-RRM; 5, Biodentine. Bioceramic materials and glass ionomer cement were placed over the Teflon since the ADJ. Both the pulp chamber and the canal's apical end were sealed with a composite resin. Sample was maintained in artificial saliva. Colour was measured before at baseline, after the material placement, at the first week, and at 1, 3, 6, and 12 months after, using a customized tray with an incisal and a cervical hole in the buccal aspect of the tooth, in order to reproduce the measurements in the same place. ΔE and distance to the pure White in each moment

of the study were recorded. Data were compared through the ANOVA test for repeated measurements.

Results After a 12-months follow-up, the studied colour indices maintained its values in the incisal area. In the cervical area results were almost the same, but group 2 showed bigger distance to pure white ($p < 0.05$).

Conclusions The analyzed bioceramic materials maintain colour stability 12 month after their placement except ProRoot MTA.

GE71

WITHDRAWN

GE72

Hardening time and surface characteristics of biodentine tricalcium silicate cement under naocl and ultrasound standard irrigation protocol

Buła K¹, *Palatyńska-Ulatowska A², Klimek L¹

¹Department of Dental Techniques, Department of Restorative Dentistry, ²Department of Endodontics, Department of Conservative Dentistry with Endodontics, Medical University of Lodz, Łódź, Poland

Aim To evaluate hardening time, roughness, surface characteristics and chemical analysis of Biodentine tricalcium silicate cement under the different concentrations of sodium hypochlorite with and without ultrasound activation in the different time of rinsing procedure.

Methodology 54 Biodentine samples were divided into 3 groups based on the material setting time. They were subjected to different modes and times of 2% and 5,25% NaOCl irrigation with or without ultrasounds, 12 minutes (group I), 45 minutes (group II) and 24 hours (group III) after the material mixing. Roughness (surface profile measurement) was made with a profilometer SJ-410 (Mitutoyo,

USA) standardized with the Mitutoyo model No. 178-601. A visual assessment of the samples surface and their chemical analysis were made with the use of scanning electron microscope (SEM) Hitachi S 3000N and Energy Dispersive Spectroscopy method. Additionally, in 6 specimens of Biodentine the hardening time of the material was tested using the iVicat appliance and method of hardness measurement with Clemex CMT device.

Results The hardening time of the material was approximately of 1,5 hour. Both concentrations of sodium hypochlorite alone and enhanced with ultrasonic activation visibly affected the Biodentine surface. All of the surfaces in groups II and III were altered and became more irregular compared to the control specimens. In some parameters of roughness the changes were also observed.

Conclusions On the basis of the obtained data the most dynamic hardening process takes place in the first quarter after material mixing, which is the setting time given by the manufacturer. However, the cement needs more time to bind and “mature” to withstand the following endodontic protocol. Both NaOCl irrigation and ultrasounds affected the surface of the material; however, they did not change its chemical composition. The irrigation enhanced by ultrasounds following the placement of Biodentine should be performed after a longer material setting time. The immediate use of ultrasound is not recommended.

Acknowledgements This work is supported by grant No 503/2-044-02/503-21-001-18 from Medical University of Lodz.

GE73

Influence of setting time and exposure to irrigant solutions on the push-out strength of two endodontic biomaterials

*Reboloso de Barrio E, Perez-Higueras Sánchez JJ, Gancedo Caravia L, García Barbero E

Department of Conservative Dentistry, Complutense University, Madrid, Spain

Aim To compare the push-out strength of mineral trioxide aggregate (MTA) and Biodentine (BD) when exposed to sodium hypochlorite (NaClO), etidronic acid solution (HEBP), or saline after 3 different setting times (1, 7 or 21 days).

Methodology 135 unirradicular permanent teeth were sectioned perpendicularly to their major axis to obtain a total number of 270 sections of 1mm thickness from their coronal third. The sections were drilled creating a circular hole of 1.4mm in diameter and were sealed with MTA or BD. After setting for 1, 7 or 21 days, they were exposed to one of the two irrigants under evaluation (NaOCL or HEBP) or saline. With all these independent variables (material, time and solution) we obtained a total of 18 experimental groups (n = 15). A push-out test was performed by means of a testing machine (Hounsfield H5000M, Metrotec) to register the push-out strength of every specimen. The mean push-out strength of the experimental groups were compared using t-Student, ANOVA and Tukey post hoc tests.

Results The push-out strength of MTA was higher after longer setting time. The strenght of BD increased between 1 and 7 days, but it decreased between 7 and 21 days. BD showed higher push-out strength than MTA at 1 or 7 days, but not at 21 days. HEBP increased the push-out strength of BD at 1 and 7 days and that of MTA at 1 day.

Conclusions Setting time and exposure to irrigant solutions have influence on the push-out strength of MTA and BD.

Canal filling - sealers

GE74

An *in vitro* study of nano-scaling biphasic calcium-phosphate ceramic/ hyaluronan as dentine coating material

*Gyulbenkiyan E, Gusiyska A, Vassileva R, Dyulgerova E

Department of Conservative Dentistry, Medical University - Sofia, Bulgaria, Sofia, Bulgaria

Aim The *in vitro* investigation was carried with nano-scaling biphasic calcium-phosphate ceramic/hyaluronan to be used as a dentine coating material.

Methodology A total of forty extracted single-rooted human teeth were used for the purpose of this *in vitro* assessment. Teeth were extracted due to orthodontic or periodontal reasons and were instrumented with rotary crown-down technique (ProTaper Universal, Dentsply, Maillefer, Switzerland). The final root canal preparation was done with file #F4. The teeth were allocated to each group: Group I (n = 20) – irrigation with NaOCl 2%, EDTA 15% and distilled water. After drying in root canals was applied hyaluronan (0,1%) and nano-scaling biphasic calcium-phosphate ceramic as paste with following obturation with the bioceramic sealer TotalFill BC (FKG, Germany) using single-cone technique; Group II (n = 20) – irrigation with NaOCl 2%, EDTA 15% and distilled water, afterwards directly obturation with the bioceramic sealer TotalFill BC (FKG, Germany) using single-cone technique. In 24 hours all samples were separated longitudinally and were SEM observed. The software program Image-Pro Plus 6.0 (Media Cybernetics, USA) was used for measurement the gap between the dentine wall and the sealer. The results are in micrometers and were statistically analyzed with Bootstrap for Independent Samples t-test.

Results All the teeth in Group I (prepared with hyaluronan 0,1%/nano-scaling biphasic ceramic) showed SEM better sealer adaptation (Mean 4,33 μm) than these in Group II (directly obturated with bioceramic sealer) (Mean 11,96 μm). There was statistically difference between Group I and II ($p < 0,05$).

Conclusions Application of hyaluronan 0,1%/nano-scaling biphasic ceramic showed adhesion to the root surfaces of dental canal dentine and also in interface with bioceramic sealer (TotalFill BC).

GE75

The influence of substrate, temperature and time of several endodontic sealers on their contact angle - an *in vitro* study

*Sotiropoulos G, Farmakis E

Aim Among the desired properties of an ideal endodontic sealer is to present with a low contact angle to ensure adequate distribution over dentine and gutta-percha. Seven endodontic sealers (Roth 801, AH26, MTA FILLAPEX, EndoSequence BC, GUTTA-FLOW BC, AdSeal and BJM Root Canal Sealer) were studied in relation to substrate (root dentin and gutta-percha), time (0,1,5min and 1h) and temperature (20 and 37 °C) over their contact angles.

Methodology Thirty droplets of 0.1mL of each sealer (prepared according to manufacturer's instructions) were placed accordingly onto human root dentine surfaces and onto gutta-percha surfaces, and for each temperature tested. New substrates were used every time. Photographs were taken under standardized conditions, Contact angles were calculated according to the equation: $2 \arccos(b/2h)$, with each droplet providing 2 recordings (left and right).

Results Since distribution of data was deviating from normality, non-parametric measures (for description) and models (for inference) were applied. Data were analyzed using Stata version 14.2(Stata Corp, USA). Alpha level was set at 0.05 . Results documented better distribution of sealers over dentine than gutta-percha, irrelevant to time, and/or temperature(Mann-Whitney, $p<0.001$). Conventional Eug-ZnO and epoxy-resin-based sealers (Roth, AH-26, Adseal) were found to wet dentine and gutta-percha better than newer-novel sealers (EndoSequence BC, MTA FILLAPEX, BJM, GUTTA BC) on dentine and gutta-percha after 0,1,5 and 60 minutes, respectively (Kruskal-Wallis, $p<0.001$). Statistically significant differences were also found between lower values of contact angles as the temperature was increasing (20 to 37°C) in most sealers(Mann-Whitney, $p=0.007$).

Conclusions Interactions of contact angles with other parameters (time and substrate, sealer and temperature, time and sealer, sealer and substrate) were proven statistically significant (median regression analysis, all p-values were <0.01). Concluding, contact angles are influenced by the composition of the sealer, the substrate applied on, and the substrate's temperature and are reducing gradually over time.

Voids in 3D printed teeth obturated with a bioceramic sealer and three different sealer application techniques

Tiwana JS¹, Seoudi N², Almasri M², *Prichard J²

¹*Faculty of Dentistry, BPP University, London, United Kingdom,* ²*Faculty of Dentistry, College of Medicine and Dentistry, Birmingham, UK*

Aim To evaluate how three different sealer placement techniques, using a TotalFill bioceramic (BC) sealer and single cone obturation technique (SCOT), influence the prevalence of voids in 3D printed artificial teeth.

Methodology Fifteen 3D printed teeth were instrumented in a standardised manner after being randomly allocated into three sealer application groups. Sealer alone, Sealer & Guttapercha (GP), Sealer & GP and spiral filler. Micro-Computed Tomography (μCT) and volumetric analysis was carried out using CTAn software (Bruker Skyscan) to calculate the median total percentage volume of voids (TPVV) within the selected volume of interest (VOI) which extended from the cemento-enamel junction (CEJ), to the apex. The VOI was subdivided into three regions, the coronal, middle and apical thirds. Correlations between individual groups and their respective subdivided regions of interest (ROI) were tested using the Mann-Whitney-test ($P=0.05$).

Results The Sealer alone group showed a significantly greater range of the median TPVV, compared to the other groups when examining the whole VOI and its subdivided regions. The median TPVV was fairly similar across all three groups when examining the whole VOI, and no statistically significant difference was identified ($P=0.466$). A significant reduction in the median TPVV was identified in the middle third region in the Sealer & GP & Spiral filler group compared to the other 2 individual groups. These differences were found to be statistically significant ($P=0.032$).

Conclusions A greater variability in the prevalence of voids was evident when obturations were carried out with sealer alone. This variability was reduced with the use of a GP cone and or a spiral filler when obturating. No particular sealer placement method appeared to be statistically superior to its counterparts, other than in the middle third of the root canal, where a statistically significant difference was noted between the sealer placement methods.

GE77

Dentine penetration ability of 4 different sealers which used 2 different obturation techniques

*Turkyilmaz A, Erdemir A

Department of Endodontics, Kırıkkale University, Kırıkkale, Turkey

Aim To investigate the tubular penetration depth of 4 different sealers on the radicular root dentine using 2 different obturation methods.

Methodology Eighty-four single-rooted teeth were enlarged until #F4 rotary file using ProTaper® (Dentsply, De Trey, Konstanz, Germany) files. Two roots were served as a positive control that includes smear layer and additionally two roots were served as a negative control after smear layer removal. The remain eighty roots were randomly divided into 4 groups (n=20) according to 4 different sealers (AH 26; AH Plus (Dentsply, DeTrey, Konstanz, Germany; RealSeal, SybronEndo, Orange, CA, USA; MTA Fillapex Angelus, Londrina, Brasil) and then each group was divided into 2 subgroups according to obturation methods (Cold Lateral Condensation, CLC and single cone, SC). Thereafter the roots were sectioned longitudinally and evaluated for scanning electron microscope (FEI Quanta FEG 250, Eindhoven, Holland) at 20 kV. The average depth of sealer penetration into dentineal tubules was measured at apical, middle and coronal sections. ANOVA and post hoc Tukey and Dunnett tests were used for statistical evaluation.

Results There were no statistical differences between obturation methods (CLC and SC) and sealers tested for penetration depth ($p>.05$). AH26 and RealSeal root canal sealers had the highest values with CLC and SC respectively.

Conclusions MTA Fillapex had acceptable results when compared with widely using epoxy resin-based and methacrylate-resin root canal sealers with different obturation methods.

Acknowledgements This research was supported by Scientific Research Projects Coordination Center (Project Number: 2012/094) of Kirikkale University, Kirikkale, Turkey

GE78

Evaluation of the bond strength of AH Plus sealer after irrigation of the root canals using of nano-silver irrigant and sodium hypochlorite.

*Nashaat Y¹, Negm A²

¹*Department of Endodontics, October 6 University,* ²*Department of Endodontics, Ahram Canadian University, Cairo, Egypt*

Aim To evaluate the bond strength of AH Plus sealer after irrigation of the root canals using of Nano-Silver and Sodium hypochlorite.

Methodology Sixty freshly extracted, sound maxillary anterior teeth with completely formed apices and straight roots were used in this study. Each tooth was decoronated to provide approximately 16 mm \pm 1 of root, root canals with initial apical file size #20 were selected to approximately standardize the canal diameter. The samples were divided into two groups 30 root each according to the irrigation protocol used through instrumentation: Group A: root canal preparation was performed using the Protaper Next system during instrumentation the root canals were irrigated using Nano-Silver irrigant 0.02mol/L = 2000ppm. Group B: root canal preparation was also performed using the Protaper Next system but during instrumentation the root canals were irrigated using Sodium Hypochlorite (NaOCl) irrigant 5.25%. Root canals of each group were then obturated using master

cones of #40/06 and AH Plus sealer in lateral condensation technique. 2mm thick slices of apical, middle and coronal root portion for all samples were prepared for assessment of push out bond strength for the two groups.

Results Results showed that AH plus sealer had a lower value of push out bond strength (1.223 ± 0.533) MPa in the group irrigated using nano silver than the second group irrigated with sodium hypochlorite (2.321 ± 0.650) MPa at the coronal third with statistically significant difference (0.004), also at the middle third it showed a lower value (1.732 ± 0.899) MPa than the sodium hypochlorite but with no statistically significant difference, and finally at the apical third it also a lower value of push out bond strength (2.103 ± 1.319) MPa than the other group irrigated with NaOCl (5.045 ± 1.397) MPa with statistically significant difference (0.001).

Conclusions Within the limitation of this study, it is recommended when using an antimicrobial irrigants; NaOCl is preferred than silver nanoparticles irrigant concerning their effect on bond strength between the sealer and dentine.

Restoration of root filled teeth

GE79

Optimization of fiber post luting procedure

Mitronin AV¹, Gavryushin SS², *Bobrovskaia AS¹

¹*Department of Cariology and Endodontics, Moscow State University of Medicine and Dentistry*

*named after A.I. Evdokimov,*²*Robotics and Complex Automation, Bauman Moscow State Technical University, Moscow, Russian Federation*

Aim Improving the efficiency of teeth postendodontic restoration using fibre posts.

Methodology A laboratory study was conducted using 370 posts of 3 different types (with an epoxy polymer matrix, methylmethacrylate (MMA) matrix and presilanized posts) luted with 2 different composite cements (total etch and self-etching). 18 experimental groups were formed depending on

the pretreatment procedures (silanization, phosphoric acid, hydrogen peroxide, etc.). Evaluation of the adhesive bond strength was carried out by torque-out test. Evaluation of the type of destruction (adhesive, cohesive or mixed) was carried out using a portable digital USB microscope at 50x magnification.

Results The highest values of adhesive bond strength were achieved in the experiment for groups of epoxy and MMA posts luted with total etching cement after pretreatment with 37% hydrogen peroxide for 10 minutes followed by silanization. It allowed to significant increasing of the bond strength for MMA posts from $17.79 \pm 3.72 \text{ N} \cdot \text{mm}$ to $68.60 \pm 11.43 \text{ N} \cdot \text{mm}$ (silanization only allowed to reach values of $42.98 \pm 10.56 \text{ N} \cdot \text{mm}$) and for epoxy posts from $26.84 \pm 9.44 \text{ N} \cdot \text{mm}$ to $76.03 \pm 7.10 \text{ N} \cdot \text{mm}$ (silanization result was $43.296 \pm 5.11 \text{ N} \cdot \text{mm}$). Fiber post pretreatment before silanization with 37% phosphoric acid, 96% alcohol or acetone also makes it possible to achieve adhesive strength values higher than in control groups and groups treated with silane only. This statement is true for all combinations of posts and cements, however, an increase in adhesive bond strength in this case is less significant than with the use of concentrated hydrogen peroxide. An adhesive type of destruction was detected in optical microscopy in most cases.

Conclusions Fibre post pretreatment with solutions that promote the dissolution of the polymer matrix before luting increases the adhesive bond strength compared to the control group without pretreatment and compared to presilanized posts. Post pretreatment with concentrated hydrogen peroxide followed by silanization allows to 4-5 times adhesion increasing.

Education

GE80

Students' perception of an endodontic education at the Faculty of Medicine in Hradec Králové

Kapitán M, Rýdlová Z, Vavříčková,

*Department of Dentistry, Charles University, Faculty of Medicine in Hradec Králové, Hradec Králové
Czech Republic*

Aim The aim of this study was to evaluate the endodontic education at the Charles University, Faculty of Medicine in Hradec Králové, the Czech Republic from the point of view of the students at the time of graduation.

Methodology A questionnaire survey was conducted. The questionnaire was created by the authors based on the questionnaires used in other published studies on similar topics. The questionnaires were distributed to all potential participants, i.e. 79 students of the fifth year at the very end of their studies. The participation in the study was voluntary and anonymous; each participant signed an informed consent. This method was proofed by the Ethical committee of the University Hospital Hradec Králové (ref. no. 201708 S12P) and by the dean of the Faculty.

Results A total of 60 filled questionnaires were returned by the students, making the response rate of 75.9%. There were a total of 40% of men (n=24) and 60% of women (n=36). The median age was 24 years (Q1=24 years; Q3=25 years). The average number of treated root canals was 17.6 on extracted teeth and 12.4 in patients. These totals were considered as insufficient by 51.7% of the respondents (n=31) for extracted teeth and by 93.3% of the respondents (n=56) for the patients. Out of the respondents, 87.1% (n=49) felt competent to perform a root canal treatment on anterior teeth; 86.7% (n=52) on premolars; and 48.3% (n=29) on molars. The number of endodontic teaching hours, the range of endodontic education and the quality of endodontic education were considered sufficient by 81.7% of respondents (n=49); 86.7% of respondents (n=52); and 83.3% of respondents (n=50) respectively.

Conclusions The dominant problem of the endodontic education at the Charles University, Faculty of Medicine in Hradec Králové, the Czech Republic found by this study was the insufficient extent of endodontic practice on the patients. To be considered sufficient the practice on the patients must be extended. The results of this study will be used as a valuable feedback to enhance the endodontic education in both theoretical and practical parts. Several ways of improvement were recommended by the respondents.

Influence of educational information and its delivery on patient understanding and perceptions of root canal treatment

*Sullivan LA¹, Chandler NP¹, Daniel B², Friedlander LT¹

¹*Sir John Walsh Research Institute, Faculty of Dentistry, ²Higher Education Development Centre, University of Otago, Dunedin, New Zealand*

Aim To develop written and multimedia educational material about root canal treatment (RCT) and investigate its effectiveness and mode of delivery.

Methodology Ethical approval was obtained and a mixed-methods approach was used to analyse data collected from patient questionnaires provided before and after receiving educational material and RCT. As part of the informed consent process, dentists were calibrated to provide patients with a standardized verbal description of RCT. Questionnaires collected information related to the educational material, prior knowledge of RCT, anxiety and treatment perceptions. Forty-six participants (23 male, 23 female) were recruited and randomly received either: 1. An existing pamphlet (control) 2. A new pamphlet with more detailed information or 3. Website information that contained the same information as 2 for viewing on any device. Data was analysed using descriptive statistics and thematic analysis.

Results Over 75% of participants found educational material helpful in addition to the verbal explanation from their dentist however there was no difference in the effectiveness of the different types of educational material or their mode of delivery. The dentist's explanation was perceived as most important for patient experience. Most patients knew about RCT and the reason for treatment and almost a third had received previous RCT. Anxious patients referred to the educational material more often during treatment and tended to be female. Participants who had previously received RCT were less anxious and providing educational material prior to treatment appeared to reduce anxiety.

Over half of the participants perceived RCT as better than they expected and 70% felt positively about having another RCT in the future.

Conclusions There appeared to be no difference in effectiveness of educational information or delivery method but educational material provided verbally and in written form is important for improving understanding of RCT and reducing patient anxiety.

Acknowledgements Supported by a Sir John Walsh Research Institute Fuller Scholarship

GE82

Is root canal therapy (RCT) dangerous? Myths vs facts

*Sami Shibani M, Gambarini G

Department of Endodontics, University of Rome Sapienza, Rome, Italy

Aim To investigate if root canal treatment RCT is associated with numerous systematic disorders according to the allegations of a Netflix documentary. A Netflix documentary showed an individual experience which claimed that RCT was the main reason for breast cancer, RCT was also blamed for other systematic disorder: heart attack, no scientific based evidence was provided, however, the documentary created a lot of attention in the media and social websites amongst practitioners and patients, present literature review was performed to investigate those claims with scientific approach.

Methodology This research was developed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. The literature search included all publications without a year limit. An electronic search was performed using MEDLINE (PubMed), Cochrane, and Scopus. Articles were selected that addressed the following research question

Results a large number of publications have suggested that oral infection, are a potential contributing factor to a variety of systemic diseases. Such as Endocarditis, However, there is still not sufficient evidence to claim a causal association between oral infection and other systemic diseases.

Conclusions Medical literature is full of risk factors which are more clinically relevant than dental diseases, moreover there is no based evidence to prove that root canal treatment is responsible for any systemic disease.

GE83

Advantages of 3D printed endodontic simulators for practical sessions in Endodontics

*Cousson PY, Decerle N, Francois O, Hennequin M

CROCE EA4847, University Clermont Auvergne, Clermont-Ferrand, France

Aim Historically, dental students are trained within their undergraduate pre-clinical courses to work on natural human teeth which are collected via dental practitioners. The evolution of bioethics laws and the inherent difficult hygienic standards regulation now question these practices. Moreover, the anatomical discrepancies of collected natural teeth generate some level of unfairness among students, as some of them could be evaluated on anatomically complicated teeth. This study is aimed at verifying the verisimilitude of 3D printed endodontic simulators before their use becomes standardized in the undergraduate curriculum.

Methodology Original endodontic simulators were designed using 3D modelling and produced by additive manufacturing with transparent and white resins (<https://createeth.fr>). They satisfy the requirements of learning objectives in endodontics and restorative dentistry in terms of coronary, root canal, and radicular anatomy. During a 2-hour practical session, 4th and 5th year students (n=174) who previously experienced endodontics on natural teeth, performed a complete endodontic treatment on a transparent lateral incisor, and on a white molar with curved root canals using a nickel titanium system (Wave One®). At the end of the session, students were asked to complete a questionnaire on the difficulties in performing the treatment with the simulator, the advantages of material transparency, the authenticity of their feedback, and the possibility of using natural teeth instead.

Results Essentially, 65% of students felt that simulators exactly matched the root canal anatomy and 69% throughout the canal content was comparable. Feedback on sensations from the simulator was identical to that perceived when working on natural teeth during the catheterization for 56% of students during the root canal shaping for 71%, during trying out the master cone for 39%, and during thermos-compaction for 72%. Few students experienced difficulties in finding the root canal orifice (7%) and catheterizing the root canal (4%), while 56% experienced difficulties during thermos-compaction. The simulator transparency was particularly appreciated during catheterization (96%), for estimating the working length (98%), the canal shaping with the Wave One[®] system (96%), trying out the master cone (96%), and during fillings (98%).

Conclusions 3D printed endodontic simulators produced by additive manufacturing may constitute an alternative learning experience to natural teeth.

Imaging

GE84

Comparison of diagnostic value of digital radiography and cone-beam computed tomography for recognition of horizontal and oblique root fractures. An *in vitro* study.

*Armata O, Bołtacz-Rzepkowska E

Department of Conservative Dentistry, Medical University of Lodz, Lodz, Poland

Aim Evaluation of the effectiveness of digital radiography (DR) and cone-beam computed tomography (CBCT) in imaging of horizontal and oblique root fractures.

Methodology The roots of 36 bovine lateral incisors were used in the study. Teeth were prepared and randomly divided into three groups: two experimental A and B in which horizontal and oblique root fractures were artificially created and one intact group C as control. All teeth were subjected to DR with the use of Kodak X-ray system (the right angle technique) and CBCT with CS 9300 CBCT machine (5x5 cm field of view, resolution 90 µm). Axial, frontal, sagittal, transsectional and

contiguous slices were used. The images were evaluated by two observers. Statistical analyses of each imaging technique were calculated at the significance level $p=0,05$. Statistical program SPSS 22.

Results Regarding horizontal root fractures the percentage sensitivity of CBCT scans was 100%, radiographs 45.8%. The inter-examiner agreement was adequately 1.00 vs 0.88 which means very high level of agreement. Frontal, sagittal, transsectional and contiguous slices in CBCT revealed 100% sensitivity. In a case of oblique root fractures the percentage sensitivity of CBCT scans was 95.8%, radiographs 33.3%. The inter-examiner agreement was 0.92 for CBCT (very high level of agreement) and 0.70 for radiographs (high level of agreement). The best diagnostic value in CBCT was for contiguous slices (100% sensitivity).

Conclusions The Cone-Beam computed tomography with small field of view and high resolution ensures higher diagnostic effectiveness in the detection of horizontal and oblique root fractures than digital radiography. The inter-examiner agreement was also higher for CBCT. CBCT should be a method of choice in early diagnosis of these kind of root fractures.

Acknowledgements University grant number 502-03/2-044-01/502-24-031.

GE85

Predictability of the length of a root canal, using only a diagnostic radiograph

*Callant R

VUB, Brussels, Belgium

Aim To assess if we can use a digital diagnostic radiograph to predict the length of a tooth, to be endodontically treated. A radiograph, amongst other diagnostic tools, is necessary to establish a correct diagnosis before starting a root canal treatment. Digital dental imaging software is already established in most dental practices.

Methodology In this study we compared measurements based on the diagnostic radiograph to the actual working length determined clinically using an apex locator of 20 teeth with 34 canals in the

maxilla and 12 with 25 canals in the mandibula. Diagnostic radiographs were taken using VistaScan (Dürr Dental) phosphorous plates mounted in a endodontic XCP Rinn (Dentsply Sirona) device. The X-rays were taken using the parallel technique. These exposed phosphorous plates were scanned using a VistaScan Mini Plus (Dürr Dental) and loaded into Mediadent v8 (ImageLevel). Only x-rays where the whole tooth was visible and without obvious visible deformations were included in this study. The polyline tool was used, without calibration, to measure the tooth. The clinical working length was established using a build in apex locator in the Reciproc Gold endo motor (VDW) and an iso 10 C-Pilot file (VDW) when patency was achieved. Statistical analysis was done using Prism (GraphPad).

Results In this small study the final working length was on average 2.95 mm (SD \pm 1.95) short of the predicted radiographical length.

Conclusions This tool can be used to predict a length of a tooth needing an endodontic treatment. However, this technique cannot be used to determine the final working length. Advantages of using this tool prior to the endodontic procedure can reduce the chance of perforating apically and helping to select the right file length.

Pulp and periapical tissue biology and pathology

GE86

Experimental study of the regeneration of dental pulp using multipotent stromal pulp cells and platelet-rich plasm

Krechina EK, Grudyanov AI, Volkov AV, *Abdurakhmanova ZU, Hajiyev AK

Department of Therapy, Central Research Institute of Dentistry and Maxillofacial Surgery, Moscow, Russia, Moscow, Russian Federation

Aim To study the possibility of using multipotent stromal cells for the regeneration of dental pulp (MSC).

Methodology The culture of stromal cells (MSC) was prepared from the pulp of extracted teeth of minipigs. They took the culture of the 3rd passage, at a concentration of 60-80% of confluence. The resulting cells had a phenotype characteristic of multipotent stromal cells. In an experiment on 3 mini-pigs (20 teeth), an opening of the tooth cavity was performed, the coronal pulp was removed, the opened root pulp was covered with a graft and covered with a seal from FUJI IX (GC, Japan). Animals were removed from the experiment after 2 weeks. (1st animal), 4 weeks. (2nd animal), 8 weeks. (3rd animal) with the help of euthanasia by overdose intravenously (solution of 100 mg / kg zoletil) in accordance with the Rules of work with the use of experimental animals (Order No. 755 of August 12, 1997) and the jaw blocks were collected. Histological examination of thin sections 40–50 µm thick, which were stained with acid fuchsin, and toluidine blue and celestial trichrome, was performed using an Axioplan microscope (Carl Zeiss, Germany).

Results An experimental study showed: after 2 weeks. after pulp amputation and transplantation of a tissue-engineering construct, the tooth cavity contains a basophilic cell structure - a cell transplant. The mouths of the root canals on the side of the cavity of the tooth on the inner surface contain areas with a cellular structure, rich in blood vessels and high cellularity. These structures resemble granulation tissue in appearance. Between the vessels a soft, loose fibrous matrix was noted, which reached 2/3 of the volume of the tooth cavity by 8 weeks. observations. By this time, dentine deposits are visible on the walls of the tooth cavity in the area of the bottom and side walls in the form of a dentinal bridge.

Conclusions Thus, the transplantation of autologous cell pulp in combination with platelet-rich plasma can be a promising direction in the study of pulp regeneration during its partial resection, as a model of accidental opening of a tooth cavity in clinical practice.

GE87

Radiographical study of pulp calcifications in patients with diabetes mellitus

*Araya P, Vega-Marcich M, Gallardo AM, Olivares K, Wilhelm C, Flores V

Aim To determine if there is a greater presence of calcifications in the pulp chamber, in dental radiographs of patients with Diabetes Mellitus versus patients without Diabetes Mellitus.

Methodology The sample was constructed based on the recording of digital periapical radiographic images of teeth of patients with Diabetes Mellitus and without Diabetes Mellitus periodontally healthy and unharmed, who attended the dental clinic between 2017 and 2018, with registration of PSR (Periodontal Screening Recording) and initial periodontogram. The data was recorded for further analysis and study. A level of statistical significance of α 0.05 was used.

Results Out of a total of 1.727 clinical records collected, 22 corresponded to patients with Diabetes Mellitus (Group A) and 23 to patients without Diabetes Mellitus (Group B). In terms of radiographic records, the above is extrapolated to 999 teeth, 434 teeth (43.44%) Group A and 565 teeth (56.55%) Group B. Of the 999 teeth, only 617 met the inclusion criteria and were used in the study, which were divided into groups: molar, premolar and anterior (incisors and canines). The average age of both groups was 54 years, where the range was between 29 to 81 years, being 14 men and 31 women. Of a total of 617 teeth, it was observed that of 228 teeth of Group A, 114 had pulpal calcifications, whereas 389 teeth of Group B, 101 had pulpal calcifications, which was statistically significant Fisher Test ($p < 0.001$)

Conclusions Patients with Diabetes Mellitus demonstrated that they are more prone to form intracameral pulpal calcifications, due to the increase of glucose present in the blood that activates osteopontin.

GE88

Conventional endodontic therapy combined with surgical decompression in the treatment of extensive radicular cyst

*Melian A, Giuroiu CL, Hamburda T, Guzu EC, Salceanu M

Aim To demonstrate that a true cyst can heal by minimally invasive treatment and to validate a methodology for conservative treatment of radicular cysts of endodontic origin by conventional endodontic therapy combined with surgical decompression.

Methodology Twenty-four radicular cysts with a periapical index of at least four (PAI 4) were treated according to orthograde root canal treatment and surgical decompression. Disinfection of the root canal system was achieved by passive ultrasonic irrigation using 2.5% sodium hypochlorite. The intracanal dressing was a calcium hydroxide paste followed by coronary seal with glass ionomer cement. This protocol was performed at the beginning of the treatment and then repeated every three weeks until the X-ray showed a maximum periapical index two (PAI 2), followed by radicular obturation using guttapercha and bioceramic sealer. Surgical decompression was performed from the beginning of the treatment with minimal access for a cannula of 2-3 cm in length inserted into the depth of the cavity cyst and fixed with sutures. The irrigation was made through the cannula with saline and chlorhexidine gluconate 0.12 % and stopped two weeks after root filling when the cannula was removed. It was reevaluated the periapical index (PAI) after one month, three months and six months. Simultaneous, haematoxylin-eosin staining in combination with the detection of an apoptotic biomarker, Active Caspase-3 were used for apoptosis detection on tissue slides. The data were collected and analysed using ANOVA statistical technique.

Results Healing occurred in twenty-two cases in four to six months and the process was in correlation with histological and immunohistochemical results.

Conclusions The elimination of all possible irritative causative factors from root canals and cyst cavity associated with the available drugs and the therapeutic methods might inhibit the proliferation of the epithelial cell rests and therefore the healing would occur by apoptosis and by regression of the lining epithelium of the apical cyst. The demonstration of this hypothesis will allow

the introduction of our proposed method as first line mandatory stage of the radicular cysts treatment protocol, which can be applied by dentists and maxillofacial surgeons.

GE89

Enzymatic isolation, amplification and characterization of Dental pulp stem cells

*Pilbauerova N¹, Suchankova Klepova T¹, Soukup T², Suchanek J¹

1Department of Dentistry, 2Department of Histology and Embryology, Charles University Faculty of Medicine in Hradec Kralove and University hospital Hradec Kralove, Hradec Kralove, Czech Republic

Aim To isolate the Dental pulp stem cells (DPSC) from the extracted teeth using the enzymatic digestion (ED) method, investigate their proliferation capacity, analyze phenotype, cell viability, relative telomere length in chromosomes of DPSCs in different passages and determine their ability to differentiate into mature cells.

Methodology Before enzymatic isolation using 0.05% trypsin, we used a homogenization method in order to obtain a fine homogenate from the solid pulp tissue, isolated from extracted teeth. The stem cells were cultivated in a modified cultivation media for mesenchymal adult progenitor cells containing 2% fetal bovine serum, growth factors and Insulin-Transferrin-Selenium supplement. The cell viability and cell count were examined using a Vi-Cell analyzer and Z2-Counter. The phenotype analysis was performed using a flow cytometer Cell Lab Quanta. For differentiation in chondroblasts, osteoblasts and adipocytes, we used commercially available differentiation media.

Results For this study, we were successfully able to isolate 10 populations of DPSCs. The vitality of DPSCs did not drop below 90% during entire cultivation. Most of the DPSC populations growth beyond the Hayflick's limit. However, the DPSCs showed a significant decrease in the relative telomere length number with increasing passaging ($P < .05$). Isolated DPSCs highly expressed the CD markers: CD29, CD44, C90, CD13, CD73 and CD166. Oppositely, CD markers CD31, CD106, CD34 and

CD45 were negative or low positive. We confirmed the high osteogenic and chondrogenic potential. Unfortunately, we were not successful in the initiation of adipogenesis.

Conclusions We were successfully able to isolate populations of DPSCs with no change in cell morphology, phenotype or with any signs of cell degeneration or spontaneous differentiation during entire cultivation. Plus, we were able to shorten the enzyme activity time during DPSCs isolation and therefore reduced a potential risk of cell damage. We were the first to demonstrate the trypsin as the enzyme used for the enzymatic digestion method with the viability over 90% of isolated DPSCs using this method.

Acknowledgements The authors declare no conflict of interest. The study was financially supported by the Charles University's program PROGRES Q40/13 and PROGRES Q40/06.

Conservative treatment of a large radicular cyst in mandible deciduous tooth: a case report.

C.L. Giuroiu, T.H. Hamburda, M. Salceanu, C.A. Brinza, A. Melian
Department of Endodontology, Faculty of Dentistry, Iasi, Romania

Aim. To confirm a technique for conservative treatment of radicular cyst in deciduous teeth with endodontic origin by using conventional and micro-surgery therapy.

Introduction. Radicular cyst (RC) is the most common odontogenic cyst of inflammatory origin affecting the jaws, but it is relatively rare to have a radicular cyst in deciduous dentition.



Fig. 1. Preoperative OPG with large periapical radiolucency at 7.4. and 7.5. and with divergent expansion of 3.4. and 3.5.

Case Presentation. A 7-year-old boy patient presented pain and swelling of the lower left 4 and 5 (deciduous molars) and the radiographic exam confirmed the presence of a large radicular cyst. Micro surgical decompression was performed with minimal access for a cannula of 1-2 cm in length inserted into the depth of the cavity cyst and fixed with sutures. The irrigation with normal saline and calcium hydroxyl solutions was made through the cannula, simultaneous with an orthograde root canal treatment of deciduous teeth and temporary root filling with calcium hydroxide. The cannula was removed after four weeks and after six months were extracted the lower left 4 and 5. The radiographic exam after one year and three months showed healthy periapical periodontal tissue with healthy eruption of the lower left 4 and 5 definitive teeth.

Discussion. This method refers especially to cases of large cysts, for which the current solution consists of surgical enucleation of the cyst and in this case, with loss of premolars accompanied by a large bone defect. The resulting edentulism require complex and expensive orthodontic and prosthetic treatments.

Conclusion & Clinical Relevance. The success of complex treatment is proven by the nice bone healing shown during the regular recalls. Periapical cysts responde very well to conservative treatment and should be considered as primary treatment option.

Fig. 2. Postoperative OPG with healthy periodontal tissue at 3.4. and 3.5 and also they erupted in normal places.



References

1. Marin S, Kirnbauer B, Rugani P, Mellacher A, Payer M, Jakse N. The effectiveness of decompression as initial treatment for jaw cysts: A 10-year retrospective study. *Med Oral Patol Oral Cir Bucal*. 2019 Jan 1;24(1):e47-e52. doi: 10.4317/medoral.22526.
2. Rodrigues JT, Dos Santos Antunes H, Armada L, Pires FR. Influence of surgical decompression on the expression of inflammatory and tissue repair biomarkers in periapical cysts. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2017 Dec;124(6):561-567.

Comparison of Wave One Gold and ProTaper Next techniques in the eradication of bacteria from root canals of teeth with chronic apical periodontitis – a clinical study

*Sesar A¹, Budimir A², Anić I³, Bago I⁴

¹Department of Endodontics with Restorative Dentistry, Oral Medicine and Periodontology, Dental Polyclinic Zagreb, ²Department of Medical Microbiology and Parasitology, School of Medicine, University of Zagreb, ³Department of Endodontics and Restorative Dentistry, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

Aim To compare the antimicrobial efficacy of a reciprocating and a rotary instrumentation technique during single visit treatment of root canals with chronic apical periodontitis.

Methodology Forty patients with apical periodontitis on single-rooted teeth, which were closed, were included in this clinical study. The selected root canals were instrumented by one operator using either reciprocating Wave One Gold (Dentsply Sirona, Ballaigues, Switzerland) (Group 1.) or rotary ProTaper Next (Dentsply Sirona) (Group 2) technique. The irrigation protocol was standardized for both groups and included 8 ml of 2.5 % sodium hypochlorite (NaOCl) during instrumentation and final protocol with 4 ml of NaOCl and 5 ml of 15% ethylenediaminetetraacetic acid (EDTA). Microbiological samples from the root canals were collected at baseline, after chemo-mechanical instrumentation and after final irrigation protocol. DNA was extracted from the samples and subjected to quantitative real-time polymerase chain reaction analysis. The isolated bacteria were identified microscopically and by using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDITOF) (Bruker Daltonics, Germany). Mann-Whitney U and Kruskal-Wallis test were used for intragroup and intergroup analysis.

Results Bacteria were detected in all baseline samples (median 5.5×10^6). Both systems were highly effective in reducing the bacterial counts ($p < .05$) and significant further reduction of bacteria was

observed after final irrigation protocol ($p < .05$). There were no significant differences between the instrumentation systems ($p > 0.05$).

Conclusions Both, the reciprocating single-instrument system and the rotary multi-instrument system were highly and equally effective in reducing the bacteria counts in root canals of teeth with chronic apical periodontitis.

Microbiology

GE92

Active bacterial community in primary endodontic infections

*Nardello LCL¹, Carvalho APL¹, Fernandes FS¹, Cunha LP¹, Mayer MP⁵, Gavini G¹, Pinheiro ET¹

¹Dentistry, School of Dentistry, ²Microbiology, Institute of Biomedical Sciences - University of São Paulo, São Paulo, Brazil

Aim The development of molecular biology techniques has improved the knowledge of microbial diversity in endodontic infections. However, DNA-based methods have their own limitations as they may detect both active and dead bacteria. This study aimed to identify the active bacterial community in primary endodontic infections using a new generation sequencing (NGS) approach based on ribosomal RNA (rRNA).

Methodology Microbiological samples were taken from 10 root canals of teeth with asymptomatic apical periodontitis. RNA was extracted from the samples and cDNA was synthesized using reverse transcription reaction. The 16S rRNA genes (V3-V5 variable regions) were amplified and subjected to Illumina (Miseq) to determine the bacterial composition.

Results The most prevalent phyla were: Firmicutes (40%), Bacteroidetes (39%), and Proteobacteria (16%). A total of 1,287 different OTUs were identified, comprising mainly non-cultivable bacteria (90.7%). The results showed a highly complex bacterial diversity; each sample contained a mean of 334 metabolically active species/ phylotypes. A total of 148 OTUs were common to all patients.

Conclusions Metatranscriptomic analysis confirmed the bacterial diversity of primary endodontic infections. A high proportion of uncultivated bacteria were active suggesting that they may participate of the etiology of apical periodontitis.

Acknowledgements FAPESP (grant 2016/15473-0) APES (scholarship)

GE93

WITHDRAWN

Biocompatibility and bioactivity

GE94

Electrochemical potentials of adhesive and conventional cementing of cobalt chrome suprastructure on titanium abutment

Vukmanović LJ¹, Čuljak ČI², Friganović KF³, Kovačević TK⁴, Perica JP⁵, *Karlović ZK⁶, Cifrek MC³, Matijević JM⁶

¹School of Dental Medicine, Zagreb²Department of Electronic Systems and Information Processing, Faculty of Electrical Engineering and Computing, Zagreb, ³Department of Electronic Systems and Information Processing, Faculty of Electrical Engineering and Computing, Zagreb, ⁴Faculty of Electrical Engineering and Computing, Zagreb, ⁵Private dental practice, Community Health Center of Koprivnicko-krizevacka County, Đurđevac, ⁶Department of Endodontics and Restorative Dental Medicine, School of Dental Medicine, Zagreb, Croatia

Aim Titanium is a material with osseointegration and passivation ability. Because of these properties, it is the most commonly used material in implant prosthetics. One of the reasons of implant failure is material corrosion, mostly galvanic and pitting. Galvanic corrosion is a result of coupling a titanium implant with suprastructure made of a different alloy. Different electrochemical potentials of metals within the oral cavity, where saliva functions as electrolyte, cause galvanic

corrosion. High concentration of fluoride ions in low pH environment may be the cause of pitting corrosion. The aim of this study was to analyze the existence of electrochemical potentials of conventional and adhesive cementing of cobalt chrome suprastructure on titanium abutment.

Methodology In the study, titanium abutments (Bredent GmbH & Co. KG, Senden, Germany) were one electrode and sticks made of cobalt chromium alloy (Heraeus Kulzer, Hanau, Germany) were another. They were immersed in different freshly mixed cements. Specimens were divided in four groups depending on type of the cement: Group 1. SpeedCEM Plus, self-adhesive cement (Ivoclar Vivadent, Schaan, Liechtenstein), Group 2. iFix, glass ionomer cement (i-dental, Siauliai, Lithuania), Group 3. Fuji Plus, resin-reinforced glass ionomer cement (GC Europe, Leuven, Belgium), Group 4. Phosphate Cement, normal setting (Heraeus Kulzer, Hanau, Germany). For each of the groups three measurements were performed during the period of 24 hours. SPSS 17.0 was used in statistical analysis using descriptive and nonparametric statistics.

Results The highest values of electrochemical potentials were observed in phosphate and glass ionomer cement groups. The lowest electrochemical potentials were measured in self-adhesive cement group.

Conclusions Dental cements are mainly acid-based systems with low initial acidity. In this study, the influence of cement type on the electrochemical behaviour during the cementation of cobalt chromium and titanium abutments was measured. Electrochemical potentials were detected during adhesive and conventional cementing of cobalt chromium on titanium abutment.

Endo-perio-ortho-implant relation

GE95

Cone-beam computed tomography for diagnosis and treatment of endodontal-periodontal lesions. Clinical case.

Rotova A.A., Mitronin A.V., Aparina E.A., Solopova A.R.

Purpose

Determination of the most accurate method of diagnosis in the endodontic treatment of molars and premolars of the upper jaw, the study of types and frequency of medical errors leading to the development of odontogenic sinusitis after endodontic treatment.

Methodology

The analysis of 85 CBCT, orthopantomograms and intraoral radiographs was carried out.

Clinical case. The patient complained of soreness of the tooth 1.6. when biting. The tooth previously endodontically treated. The CBCT shows heterogeneity of the root canal contents, MB-2 is not sealed, in the maxillary sinus on the right there is blackout with clear contours of 1.5 x 2 cm in size, communicating with the medial-buccal root.

Treatment: canal filling, mechanical and medical treatment of MB-2. The channels were sealed with Calasept for a period of 1 week, then repeated mechanical and medical treatment and Metapex sealing for a month, then the channels were sealed with lateral condensation with AH+ and restored with a ceramic tab. On the CBCT after 6 months, there is a decrease in the size of the blackout in the maxillary sinus to 1x0.5 cm.

Results

The most accurate method of diagnosis in the endodontic treatment of molars and premolars of the upper jaw is cone-beam computed tomography.

Based on the results, it was found that 19.6% of the upper jaw molars and premolars subjected to endodontic treatment have errors in instrumental treatment and root canal obturation, which in most cases is due to the lack or lack of information about the anatomical and morphological features of their structure. Low-quality instrumental treatment of root canals of teeth was noted in 58.9%, incomplete and non-uniform root canal obturation-in 53.6%, insufficient depth of obturation - in 45.3%, removal of filling material behind the top – 12.7%, root perforation-in 7.6% of cases.

Conclusion

The using of CBCT in clinical practice provides the most accurate diagnosis in the endodontic treatment of molars and premolars of the upper jaw, which reduces the probability of occurrence of odontogenic sinusitis.

Epidemiology

GE96

Prevalence of apical periodontitis and frequency of root-filled teeth in a population of elite athletes competing at the Rio 2016 Olympic Games

*Tinoco JMM¹, Santos AEC², Marques AP³, Evans PLS¹, Sassone LM¹, Tinoco EMB¹

¹Department of Dental Clinic, Faculty of Dentistry, State University of Rio de Janeiro, ²Department of Dental Clinic, Faculty of Dentistry, Federal University of Rio de Janeiro, ³Department of Radiology, Faculty of Dentistry, State University of Rio de Janeiro, Rio de Janeiro, Brazil

Aim The aim of this cross-sectional study was to assess the prevalence of apical periodontitis (AP) and the frequency of root-filled (RF) teeth in a population of elite athletes competing at the Rio 2016 Olympic Games.

Methodology Electronic invitations were sent by cell phone to all 11,238 athletes participating at the Rio 2016 Olympic Games, and all the National Medical Committees were informed about the study before the beginning of the Games. Individuals who agreed to participate were clinically examined at the Polyclinic in the Olympic Village and digital panoramic radiographs were taken. The periapical status of all teeth (except third molars) was categorized by one experienced observer using the full-scale Periapical Index (PAI) as described by Ørstavik *et al.* (1986). PAI scores 1 and 2 were considered healthy and scores 3,4 and 5 considered as AP cases. Intra-examiner calibration to PAI was performed (Cohen's Kappa = 0.87). In addition, the frequency of RF teeth was recorded. Data were analyzed using the chi-square test and 95% Confidence Intervals (95CI) were calculated.

Results 617 athletes (57.5% males; 42.5% females; mean age= 25.4 years) participated in the study and 15,239 teeth were examined. AP in one or several teeth was identified in 209 individuals (33.9%; 95CI: 30.2-37.7%) and in 357 teeth (2.3%; 95CI: 2.1-2.6%). AP was significantly higher in men (n=134; 64.1%; 95CI:57.4-70.3%) than in women (n=75; 35.9%; 95CI:29.7-42.6%)(p<0.05), and molars (n=250; 70%; 95CI: 65-74.5%) were significantly more affected than premolars and/or incisors (n=107;30.0%;

95CI:25.4-34.9%)($p<0.05$). 42.6% of the individuals with AP ($n=89$; 95CI:36.1-49.3%) showed 2 or more teeth with periapical lesions. There were 552 (3.6%; 95CI: 3.3-3.9%) RF teeth in 226 (36.6%; 95CI: 32.9-40.5%) individuals, with no difference between men ($n=125$; 55.3%; 95CI: 48.8-61.6) and women ($n=101$; 44.7%; 95CI: 38.3-51.2%)($p>0.05$). 189 (34.2%; 95CI: 30.4-38.3%) of the RF teeth showed AP lesions, and 158 (44.3%; 95CI: 39.2-49.4%) of the teeth with AP were not root-filled.

Conclusions Apical periodontitis, in both RF and non-RF teeth, was frequently detected among olympic athletes, indicating a high endodontic treatment need in this population. The potential impact of this inflammatory burden on sports performance and systemic health warrants further investigation.

GE97

Managing older adults requiring endodontic treatment – A New Zealand practice-based pilot study

*Hamadani PS¹, Chandler NP¹, Daniel B², Friedlander LT¹

¹*Sir John Walsh Research Institute,* ²*Higher Education Development Centre, University of Otago, Dunedin, New Zealand*

Aim To pilot and evaluate an online survey tool designed to gain understanding of New Zealand (NZ) dentists' attitudes and practices in managing older adults (65+ years) for endodontic treatment.

Methodology A mixed-methods approach using an online questionnaire survey containing Likert scale and open-ended questions collected data related to ageism, scope of practice and attitudes towards providing endodontic treatment to older adults. The survey tool was developed and piloted to seven general dental practitioners to evaluate its use in a larger study.

Results The survey was effective in collecting data required for the study. All participants enjoyed treating older adults however medical co-morbidities meant treatment was perceived as 'more complex' and 'requiring skill and patience'. The endodontic requirements of older adults were variable and most wanted to retain their teeth. Preserving the dentition with root canal treatment

(RCT) rather than extraction and replacement was deemed cost effective, however the cost of RCT was often a barrier for patients and vital pulp therapy is frequent. Clinicians performed up to 10 RCT procedures per week which tended to occur in longer or multiple appointments. Teeth identified as difficult e.g. calcified canals and retreatment cases were frequently referred to endodontists as better results were anticipated. Participants indicated their desire to undertake further continuing professional development related to the management of older adults for endodontic treatment.

Conclusions The survey was effective for use in a larger study. Participants had a positive attitude towards older adults while recognising the complexities associated with managing their variable endodontic needs and how this impacts on patient-centered treatment planning.

Acknowledgements This study was supported with funding from the Ministry of Health Oral Health Research Fund.

GE98

Influence of diabetes and tobacco smoking on the prevalence of apical periodontitis in a sample of an adult population of the Lodz region, Poland.

*Bołtacz-Rzepkowska E, Sopińska K

Department of Conservative Dentistry, Medical University of Lodz, Lodz, Poland

Aim To evaluate the influence of diabetes and smoking on the prevalence of apical periodontitis in the population of the region of Lodz.

Methodology The study involved 815 first-time, randomly selected patients. The study consisted of a questionnaire and a radiological part. Panoramic radiographs showed the presence of apical periodontitis (AP) and the presence of root canal treatment. The statistical analysis included data of 760 patients, who were divided into three groups: Group I (patients with diabetes) - 57; Group II (patients addicted to smoking present or in the past) - 386; Group III (control group - patients without addiction to tobacco and diabetes) -317. Level of statistically significant difference was set

at $p < 0.05$. In the case of the possibility of multidimensional analysis, a multiple logistic regression was applied, the OR and their 95% confidence intervals were calculated,

Results Teeth with AP were observed more frequent in Group I (14.5%) and in Group II (7.2%) than in control group (5.2%) ($p < 0.0005$). In the teeth without root canal treatment, the AP was observed more frequently in Group I (9.2%) and Group II (3.5%) than in Group III (1.9%) ($p < 0.0005$). In the endodontically treated teeth, AP was observed more frequently in Group I - 50.4% than in Group III - 35.8% ($p < 0.006$), there was no statistically significant difference between Group II (37.6%) and Group III (35.8%) ($p = 0.451$).

Conclusions Patients with diabetes and smokers are a group of an increased risk of AP. Higher prevalence of periapical lesions in endodontically treated teeth in people with diabetes indicates lower effectiveness of the treatment and the higher failure rate in this group of patients.

Acknowledgements University grant number 502-03/2-044-01/502-24-065

GE99

Epidemiological inquiry about the use the Pulpotec® in the private sector of Casablanca, Morocco

*Jabrane K, Dhoum S, Benkiran I, Karami M

Department of Odontology Restorative Endodontics, Faculty of Dentistry, Casablanca, Morocco

Aim To know how these dentists have got informed about this product; To determine the number of dentists who use Pulpotec®; To determine if the practitioners understand the principles of this therapy with its advantages and drawbacks.

Methodology A questionnaire of 15 questions was sent to 300 practitioners randomly selected from a list provided by the National Order Council of the Dentists (NOCD).

Results The results show that 45.3% of these dentists use Pulpotec® in their dental practices, which prompted us to ask about their reasons and arguments on its use in daily practice. The analysis of the results show with that the majority of those dentists were informed of Pulpotec® through their

colleagues and the product is provided by most of suppliers of dental equipment. According to some practitioners, the results showed that Pulpotec® presents some drawbacks and generates complications. The results of this study have showed that the perception of the majority of private practitioners in Casablanca on the use of Pulpotec® in their daily treatments is not generally consistent with any current scientific evidence.

Conclusions The use of Pulpotec® must be limited to the temporary treatment of an irreversible pulpitis on a permanent tooth, because of the various complications caused by this product and the insufficiency of the scientific evidence on its efficiency.

GE100

Identification of MIF gene polymorphisms as exacerbating factors of periapical periodontitis

*Retana Cristina RC¹, Freer Andrea FA², Martínez Luis C MLC²

¹ *Department of Endodontics, Costa Rica University, San José, Costa Rica*, ² *Department of Endodontics, Autonomous University of San Luis Potosí, San Luis Potosí, S.L.P., Mexico*

Aim To analyze the risk of endodontic exacerbation in carriers of two polymorphisms in the macrophage migration inhibitory factor (MIF), genes have been associated with inflammatory diseases (-794 CATT5-8 and -173G> C).

Methodology A cross-sectional study with 120 patients of both sexes between 18 and 72 years old diagnosed with periapical periodontitis at the endodontic clinic. Anthropometric data and clinical history were collected from all patients. The individuals were classified into two groups according to a clinical assessment. Group A included 60 patients with pulp necrosis associated with acute abscess or phoenix abscess. Symptoms could vary from moderate to severe including intraoral/extraoral edema, exudate, tumefaction, and pain on palpation or percussion.

DNA was isolated from blood obtained by venous puncture and preserved at -80 ° C. The allelic discrimination was performed from blood DNA; the repeat polymorphism -794 CATT5-8 was

genotyped by sequencing, while the -173G> C MIF polymorphism was determined by real-time PCR using TaqMan probes. The associations between MIF polymorphisms, haplotypes and the risk to exacerbate apical periodontitis were estimated.

Results The Allele CATT7 was associated with the risk of periodontitis with a stage of acute inflammation (OR = 4.13, 95% CI, 1.82-9.63, P = <0.001). Regarding the -173G> C MIF polymorphism, a process of exacerbation of inflammation was only associated with the CC genotype (OR = 4.1, 95% CI, 1.02-20.84, P = 0.045). The analysis of the haplotype showed that the combination CATT7 / C increases the risk of exacerbation of the chronic periapical periodontitis (OR = 3.57, 95% CI, 1.038-13.3, P = 0.021).

Conclusions -173G> C MIF gene polymorphisms and the combination CATT7 / C increases the risk of exacerbation of the chronic periapical. This is the first report where MIF polymorphisms are associated with an acute inflammatory condition of periapical periodontitis.

GE101

An estimation of current trends in using endometers, magnification and rubber dam in endodontic practice in Croatia

*Sovic J¹, Segovic S², Tomasic I³, Galic N², Pavelic B²

¹Private dental practice, Private dental practice, Koprivnica, Croatia, ²Department of Endodontics and Restorative Dentistry, School of Dental Medicine University of Zagreb, Zagreb, Croatia, ³School of Innovation, Design and Engineering, Mälardalen University, Västerås, Sweden

Aim To assess the usage of rubber dam, magnification and endometers during endodontic treatment among doctors of dental medicine in Croatia.

Methodology This research is observational, retrospective and cross-sectional type and is conducted by an anonymous survey method that dentists voluntarily and individually fulfill. Three proportional

odds models were constructed to assess the use of rubber dam, magnification, and endometer. All the models were adjusted for age, use of continuous education, experience, and level of education.

Results We have collected 90 completely filled questionnaires. Characteristics of the responders:

96% of the responders were doing endodontic treatments, whereas 77% were doctors without specialization in endodontics. Most of the responders studied at University of Zagreb (91%), Croatia.

87% responded that they have participated in at least one endodontic congress, whereas 81% reported they had a course or a congress visit within the scope of his/hers continuous education in the last 5 years. Median and interquartile range for the responders birth year is 1974(1962-1985),

whereas the graduation year is 1999(1987-2010). 77% of responders were non-specialist, 3.3% residents, and 5.6% specialists in endodontics. Proportional odds logistic regression analysis: The presence of additional endodontic education during the last 5 years is associated with higher

likelihood for using endometer, rubber dam, as well as magnification usage ($p=0.019$ for all three), with increased log of odds: 1.3, 0.8, 0.8, respectively. Specialist and residents in endodontics were more likely to use endometer ($p=0$) with increased log of odds 15.8 and 15.4 compared to non-

specialists. Similarly for the rubber dam usage, specialist and residents were more likely to use it with log odds 2.3 and 2.9 respectively ($p=0$). For the magnification usage however, specialists were more likely to use it (log odds 0.9), whereas the residents were less likely to use it (log odds -0.3).

$p=0$ in both cases.

$p=0$ in both cases.

Conclusions Our findings show a significant difference in the behavior of specialists and residents in endodontics compared to non-specialists. Furthermore, the additional continuous education has been shown to have a strong impact on the implementing of endometer, rubber dam, and magnification in endodontic practice in Croatia.

Saturday 14th September

Evaluation of a technique/materials

GE102

WITHDRAWN

GE103

Micro-CT evaluation of the quality of four different fillings of straight root canals

*Šimundić Munitić M¹, Stijak J², Katić M³, Anić I⁴, Bago I⁴

¹Department of Endodontics and Restorative Dentistry, Dental polyclinic Split, Split, ²School of Dental Medicine, University of Zagreb, ³Department of Materials, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Zagreb, ⁴Department of Endodontics and Restorative Dentistry, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

Aim To analyse the presence of voids in root canals obturated with three bioceramic sealers in combination with single cone technique (SC) and an epoxy based sealer in combination with the SC and a thermoplastic technique.

Methodology Sixty single-rooted extracted human teeth were prepared using Protaper Next rotary instruments and randomly divided into five experimental groups (n=12) according on used root canal sealer: Group 1. TotalFill Bioceramic Sealer (TotalFill BCS, FKG, La Chaux de Fonds, Switzerland) and SC technique; Group 2. BioRoot sealer (BioRoot RCS, Septodont, Saint Maur des Fosses, France) and SC technique; Group 3. MTA Fillapex (Angelus Solucoes Odontologicas, Londrina, Brazil) and SC technique; Group 4. AH Plus sealer (Dentsply DeTrey, Konstanz, Germany) and SC technique; Group 5. Epoxy resin- based AH Plus sealer (Dentsply DeTrey, Konstanz, Germany) and thermoplastic guttapercha (Guta-Core, Dentsply Tulsa Dental Specialities, Johnson City, USA). After two months, the samples were scanned with micro-computerized tomography scanner and the percentage of

voids inside the sealer was calculated. Analysis was made using Mann-Whitney U test at the level of significance 0.05.

Results All materials showed the presence of voids. The TotalFill BCS with SC resulted in the smallest percentage of voids inside the sealer (mean 0.006%). However, significant superiority was found only over the AH Plus sealer with thermoplastic guttapercha group ($p = 0.026$). There was no significant difference among other materials ($p > 0.05$).

Conclusions Although without significant superiority, the TotalFill BCS with SC technique resulted in a lowest percentage of voids inside the canal and the largest number of canals without voids.

GE104

Assessment of gutta-percha points calibration used for root canal filling

Mocny-Pachońska K¹, Kuśka A¹, *Trzcionka A¹, Lipka A¹, Buchalik K¹, Twardowska A¹, Tanasiewicz M¹, Brekalo Prso I²

¹Department of Conservative Dentistry with Endodontics, Medical University of Silesia in Katowice, School of Medicine with the Division of Dentistry, Bytom, Poland, ²Department of Conservative Dentistry with Endodontics, Clinical Hospital Centre Rijeka, Faculty of Medicine, University of Rijeka, Rijeka, Croatia

Aim To assess the accuracy of gutta-percha points calibration, according to ISO standards, used for root canals filling during endodontic treatment.

Methodology Material consisted of gutta-percha points produced by 3 Companies (1VDW. 2. Endostar 3. Meta Biomed) in sizes 20,25,30,35,55,60 and a taper 2% and calibrating ruler for gutta-percha points with 2% taper produced by Dentsply. 50 gutta-percha points of each company in size 20,25,30,35 and 40 points of each company in size 55 and 60 were used in the study. Statistical analysis was made. The percentage of the points inconsistent with the size specified by the manufacturer was calculated and the data was compared between all of three manufacturers.

Results The study found significant variation of the points among every size which was different between all the companies. The biggest percentage of variance between actual size and the size specified by the manufacturer was found among Endostar gutta-percha points (only 36,77% in correct size), and the smallest among VDW points (81,43% in correct size). 42,14% of Meta-Biomed gutta percha points were in correct size. The worst results were obtained for gutta percha points size 40. Only 39% of points produced by VDW were in correct size, 2% of those produced by Meta-Biomed and 1% of Endostar gutta-percha points.

Conclusions The calibrating ruler for gutta-percha points should be always used during endodontic treatment in order to control the size of gutta-percha points and to perform tight and accurate filling of the apical foramen.

GE105

Evaluation of pH changes produced by TheraCal, Biodentine, and MTA Flow: an in vitro study

*Kot K¹, Kucharski Ł², Marek E¹, Lipski M¹, Safranow K³

¹Department of Preclinical Conservative Dentistry and Preclinical Endodontics, ²Department of Cosmetic and Pharmaceutical Chemistry, ³Department of Biochemistry, Pomeranian Medical University of Szczecin, Szczecin, Poland

Aim The purpose of this in vitro study was to observe time-related changes that occur in the pH values of TheraCal, Biodentine and MTA Flow.

Methodology Three calcium silicate-based materials were selected for this study: TheraCal LC, Biodentine and MTA Flow. Plastic tubes with an internal diameter of 4 mm and a height of 5 mm were used for sample preparation. All materials were mixed in accordance with manufacturer's instructions, except for TheraCal LC which was packaged in a syringe and light-cure material. After all materials set, each filled tube was then placed into a separate conical tube containing 10 ml of

deionized water. The pH was analysed immediately after immersion (baseline) and after 1 hour, 3 hours, 1 day, 2 days, 3 days, 1 week, 2 weeks, 3 weeks and 1 year with a pH meter.

Results All testing materials had alkaline pH. The pH levels of TheraCal LC varied from 9.79 to 10.72, Biodentine from 9.65 to 12.19, and MTA Flow from 10.5 to 12.22. The alkalinity of Biodentine was increased gradually by time of experiment. Differences in pH levels between 1 day and 1 year were statistically significant for all tested materials.

Conclusions All tested materials exhibited continuous hydroxyl ion release resulting in a rise in pH until the end of time of experience. Because of the highly alkaline pH values of these materials, they possess biointeractivity properties (realising bioactive ions), which make them useful in vital pulp therapy.

GE106

SEM evaluation of a bioceramic sealer

*Gambarini G, Seracchiani M, Morese A, Ferri V, Donfrancesco O, Relucenti M, Nottola SA

Department of Oral and Maxillo-Facial Sciences, "Sapienza" University of Rome, Rome, Italy

Aim In the last decades, mineral trioxide aggregate (MTA) became the gold standard among the materials used for retrograde filling and perforation repair. Recently bioceramic materials like EndoSequence Root Repair Material (ERRM) (Brasseler USA, Savannah, GA) has been introduced thanks to their useful properties and an improved handling and setting.

Methodology A root canal preparation was performed on sixty freshly extracted upper incisors. Teeth were horizontally cut 3mm away from the apex and a retrograde preparation was performed. In order to create 2mm disk samples for SEM observation, a second horizontal cut was then performed more coronally. The disk samples were then obturated simulating a retrograde filling, with ERRM. Samples were then stored at 37°C in humidity and analyzed at different time intervals, after 1 day, then after 7 days and 1 month. Samples were observed using VP SEM (variable pressure

scanning electron microscope) (Hitachi SU-3500). The presence of gaps was noted and measured by dedicated software. Measurements were replicated at the different time intervals by superimposing images. Data were recorded and statistically analyzed.

Results In all samples, ERRM was found to exhibit a well-preserved apical marginal adaptation to the dentine wall. The mean \pm standard deviation of the average gap at dentine - ERRM interface was 3.91 (\pm 2.5) at 24 hours, 4.49 (\pm 2.53) at one week, and 4.81 (\pm 2.85) at one month. No significant differences were found among the three

Conclusions Endosequence Root Repair proved to be a material allowing an excellent marginal adaption, which stay stable after the initial setting time (less than 24 hours). In the present study a long observation period allowed to state the dimensional stability of the material. The good results in term of marginal adaption can be explained by the physical and mechanical properties of the material given by the particle size of calcium silicate–based materials, that having a smaller particle size show a favorable flow characteristics.

GE107

Effect of new manufacturing process on the surface of new reciprocating instruments

*Valenti Obino F¹, Donfrancesco O¹, Testarelli L¹, Relucenti M², Familiari G², Seracchiani M¹,
Gambarini G¹

¹Depatment of Oral & Maxillo Facial Science,²Depatment of Anatomy, Histology, Forensic Medicine and Orthopaedics, University La Sapienza Rome, Rome, Italy

Aim To microscopical evaluate the surface treatment of the EdgeOne Fire (EdgeEndo, Albuquerque, New Mexico) to evaluate the eventual presence of surface defects.

Methodology 25 new EdgeOne Fire has been underwent to Scanning Electronic Microscope (SEM) to evaluate surface pitting. The instruments were mounted on aluminium stubs with adhesive carbon tape and samples were observed with scanning electron microscope Hitachi SU 3500 (Hitachi,

Japan). Magnification between 50X and 1000X was used to analyse surface. The images evaluation was performed with the Microscope dedicated software.

Results Images analyses shows that only 2 instruments presents surface pitting.

Conclusions The process of manufacturing of NiTi instruments sadly lead to surface defects influencing the cutting surfaces of the instrument, resulting in both lower cutting efficiency of the file and in a decreased resistance to fracture. In order to modify the surface of NiTi instruments for minimising or eliminating the inherent defects of the manufacturing process and at the same time enhancing hardness/flexibility, improving cyclic fatigue resistance and cutting efficiency of the files The EdgeEndo recently introduced on endodontic market the Edge One Fire, a thermally treated reciprocating file. In order to better evaluate the manufacture process, the surface of this instrument has been undergone to a Scanning Electronic Microscope (SEM) analysis. The results of this study show the very low presence of surface defects on EdgeOne Fire, positively evaluating the surface treatment of the alloy. This study may position this instrument in a high rank between the endodontic instruments on the market.

INFLUENCE OF OPERATOR MOTIONS ON ROTARY INSTRUMENTATION

Gianluca Gambarini^{1,3}, Marco Seracchiani², Valerio Ferr², Alessandro Mazzoni², Alessio Zanza², Federico Valentini Obino³, Luca Testarelli⁴.

1 - Professor, MD, Sapienza University of Rome, Dept. of Oral&Maxillofacial Science
 2 - Student, Sapienza University of Rome, Dept. of Oral&Maxillofacial Science
 3 - DDS, PhD student, Sapienza University of Rome, Dept. of Oral&Maxillofacial Science
 4 - Professor, DDS, PhD, Sapienza University of Rome, Dept. of Oral&Maxillofacial Science

AIM

The purpose of the present study was to verify if different operators using the same instrument with the same instruction for use could result in different operative torque and instrumentation time, in vitro.

INTRODUCTION

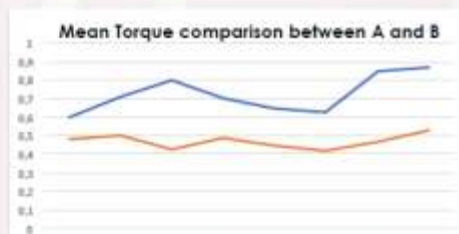
40 resin block were randomly divided in two groups and randomly assigned at two different operators: A and B. Each operator performed single file root canal instrumentation using F-One 25.04 (Fanta-Dental, Shangai, China). Strictly following manufactures instruction for use (500 rpm, 2.5 Ncm). An analysis of operative torque was performed using the same methodology validated in previous published study. Mean operative torque and instrumentation time were recorded and statistically analyzed.

RESULTS

A significant difference was noted in the two groups concerning operative torque between the two operators ($p < 0.05$), with operator A producing more operative torque, moreover operator A instrumentation resulted in significantly less time ($p < 0.05$)

Table 1. Mean torque values and mean instrumentation time.

	Mean Torque (Ncm)	Mean Time (s)
A	$0,72 \pm 0,09$	$39,66 \pm 3,69$
B	$0,47 \pm 0,04$	$55,00 \pm 6,78$



CONCLUSIONS

Results showed that small differences due to the slightly difference operative motion (amplitude of pecking, pressure, etc) may result in a more or less stressful instrumentation and differences in operative time. In the present study lower stress were related to a longer instrumentation time. It may be suggested that setting of the torque limits should not only depend on the instrument used but also on the operators skills.

REFERENCES

Gambarini G, Seracchiani M, Piatecki L, Valentini Obino F, Galli M, Di Nardo D, Testarelli L. Measurement of torque generated during intracanal instrumentation in vivo. Int Endod J. 2018 Nov 16.

The effect of exenatide and metformin on the healing of periapical lesions. Animal experiment study

*Ozturk H, Simsek N, Akinci L

Department of Endodontics, Inonu University Dentistry Faculty, Malatya, Turkey

Aim Metformin(MET) is a well-tolerated antihyperglycemic biguanide drug. Exenatide(EXE) is a synthetic GLP-1 agonist consisting of 39 amino acids. Both drugs have been used in patients with type-2 diabetes and have positive effects on bone metabolism. In this study we aim to evaluate of the effects of exenatide and metformin drugs on bone formation in rats with defect in skull bones.

Methodology 27 female Sprague-Dawley albino mature rats were used, each weighing 190–250 g. In parietal bones of rats, a 3 mm diameter unilateral defect was created by using trepan burs. Animals were divided into 3 groups (n=9). MET group received 100 mg/kg metformin (Glifor 1000 mg) daily by using intra oral gavage and EXE group received intra peritoneal 3 µg/kg exenatide (Byetta 10 mg/40 ml) daily. No medication was given to the control (CON) group. After 10 days, the rats were sacrificed by overdose anesthesia and the skull bones were scanned using micro computerized tomography (SkyScan 1172; Bruker, Belgium). Bone volume and density were measured using CTan (Bruker, Belgium) software in areas where defects were formed after scans were completed. Three-dimensional reconstruction images were also generated using CTvox (Bruker, Belgium) software. The results were evaluated using Kruskal-Wallis Test and Variance Analysis and p value <.05 was considered statistically significant.

Results Although clinically and quantitatively, defects in the EXE and MET groups healed more than the CON group, no statistically significant difference was found between the groups in terms of density (p = 0.496) and volume change (p = 0.317).

Conclusions According to the results of the present study, exenatide and metformin drugs have same effect on bone healing and density/volume change. Diabetes mellitus could be seen as a factor

that complicates endodontic infections and may weaken the healing of periapical lesions especially in uncontrolled periods.

GE110

Discolouration potential of different pulp capping materials

Samira de Lima J¹, Conte Lofredo L¹, Vavassori de Freitas J², Zorzin J³ Petschelt A³, Lohbauer U³, Ebert J^{3*}

¹Dentistry Department, University Univille, Joinville, Brazil, ²Dentistry Department, University Positivo, Curitiba, Brazil, ³Dental Clinic 1 - Operative Dentistry and Periodontology, University of Erlangen-Nuremberg, Erlangen, Germany

Aim To measure colour change of teeth following simulated pulp capping *in vitro* over a period of up to nine months.

Methodology Eighty intact human anterior teeth were assigned to eight different groups with equal distribution of the tooth shades within groups. Each tooth was embedded in an individual specimen holder to enable reproducible measurements with a Vita Easyshade V colour measuring device. Cavities of approximately 2x2 mm were prepared into the palatal surface, leaving a thickness of 2 mm to the buccal surface. No material (negative control), blood (positive control), ProRoot MTA, MTA Angelus, EndoSequence putty, a bioactive silicone-based material, Dycal or Biodentine was placed at the bottom of the cavity and covered with a flowable composite of suitable colour. Colour measurements were performed at different time points up to nine months of storage in artificial saliva. CIE L*a*b* data were collected and statistically analyzed.

Results Before and after cavity preparation, no significant differences were apparent among groups. Following filling placement and different storage times, significant differences were found for many of the possible comparisons according groups and time points (L, a, b, ΔE; p<0.05, Kruskal-Wallis, Mann-Whitney and Friedman tests). Significances regarding L, a, and b were more marked than

regarding ΔE . Blood and MTA angelus darkened, the other materials besides ProRoot MTA lightened the teeth. MTA angelus shifted “a” values to green, blood, EndoSequence and Biodentine to red. Blood and MTA angelus shifted “b” values to blue, the other materials besides ProRoot MTA to yellow. Most changes occurred within the first month, only blood and MTA Angelus caused a continuously darkening over time. The measured colour changes (differences of 0 up to 6) were low compared to former studies.

Conclusions Within the limits of the study, all tested materials showed the potential to change the colour of teeth, however to different directions. The differences in L, a and b should be taken into account besides ΔE .

Acknowledgements The authors want to thank our photographer, Mr. Achim Gress. This study was supplied with materials and partly funded by Coltène/Whaledent, Altstätten, Switzerland.

GE111

Influence of optimum torque reverse motion or continuous rotation on dentineal cracks after root canal preparation with two nickel-titanium rotary systems

*Hassan R¹, Khallaf M²

¹Department of Endodontics, Minia University, ²Department of Restorative and Dental Materials Research, National Research Centre, Cairo, Egypt

Aim To assess the effect of root canal instrumentation using ProTaper Next (PTN) and ProTaper Gold (PTG) instruments with different kinematics; optimum torque reverse motion (OTR) and continuous rotation on crack formation.

Methodology Fifty distobuccal roots of human maxillary first molars were randomly divided into 5 equal groups (n = 10) as follow: Group I: ProTaper Gold Full rotation, Group II: ProTaper Gold OTR mode, Group III: ProTaper Next Full rotation, Group IV: ProTaper Next OTR mode, teeth in the control group were left unprepared. After mechanical preparation, all the roots were sectioned

perpendicular to the long axis at 3, 6 and 9 mm from the apex. Digital images of each section were captured at 25X magnification using a digital camera attached to a stereomicroscope. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, data showed non-parametric (not normal) distribution. Friedman, Wilcoxon, Kruskal Wallis and Mann Whitney test were used to compare between groups with a statistical significance of $P \leq 0.05$.

Results Results showed a statistically significant difference found between Protaper next- Full rotation, Protaper next- OTR, Protaper gold- Full rotation, Protaper gold- OTR and Control where ($p=0.003$), There were significantly more cracks in the Protaper Gold OTR group than other groups.

Conclusions Both nickel-titanium instruments tested caused dentineal cracks. The motion kinematic used seems to have an impact on dentineal crack formation.

Acknowledgements Authors would like to thank J. MORITA CORP. MIDDLE EAST for providing the Tri Auto ZX2 motor.

GE112

The roles and uses of the Er, Cr: YSGG laser in endodontics – a systematic review

*Hong AN

Department of Odontostomatology, University of Medicine and Pharmacy, Ho Chi Minh City, Vietnam

Aim To evaluate the efficiency of the Er, Cr: YSGG laser in endodontic applications.

Methodology A computer-based search was performed utilizing the Pubmed database. From January 1971 to February 2019, 308 results were found based on the keywords “YSGG”, “laser”, “endodontics”. All abstracts were read and those which met the purpose of this study were then evaluated in full-text. From the 113 full-texts, 54 articles met the requirements, following revision. All applications were categorized into groups. There were 4 types of outcome assessment in the comparison of laser against conventional methods: equal, advantageous, disadvantageous and unknown.

Results The 9 applications categories included “Apical surgery”, “Retro-preparation”, “Antibacterial effect”, “Irrigation”, “Shaping”, “Access opening”, “Obturation”, “Pulp capping”, “Pulpotomy”.

Results were as follows: Apical surgery: 5 advantageous, 1 disadvantageous, 1 unknown. Retro-preparation: 7 advantageous, 1 unknown. Antibacterial effect: 4 equal, 8 advantageous, 3 disadvantageous. Irrigation: 3 equal, 8 advantageous, 1 disadvantageous. Shaping: 1 equal, 1 advantageous, 1 disadvantageous, 3 unknown. Access opening: 1 equal. Obturation: 2 equal, 1 disadvantageous. Pulp capping: 3 advantageous. Pulpotomy: 1 advantageous.

Conclusions In the trenches of endodontics, laser shows real promise in the near future in becoming a true asset for endodontic treatment. Especially, Er, Cr: YSGG is now proving its stand as the “modern weapon” of endodontics, with its many advantages and benefits. However, more publications should be published to establish clear and consolidated protocols to help clinicians enable themselves with an unprecedented level of service to their patients.

Acknowledgements I would like to thank Dr.Nguyen for his support in this article.

New clinical techniques and materials

GE113

Treatment of acute apical periodontitis using depot phoresis and cold argon plasma

Zablotskaya NV¹, Mitronin AV¹, *Zablotskaya MV¹, Kiselyova NV²

¹Department of Cariesology and Endodontics, Moscow State University of Medicine and Dentistry

named after AI Evdokimov, ²Moscow National Health, Fifth State Dental Polyclinic, Moscow, Russian

Federation

Aim Determination and practical evaluation of a novel method for the treatment of acute apical periodontitis using current physio-chemical techniques.

Methodology The method here presented included application of depot phoresis with copper-calcium hydroxide (CCH) and treatment of a root canal (RC) with cold argon plasma in addition to

anesthesia and conventional instrumental preparation. First, a focused plasma beam was used followed by diffuse plasma for RC treatment. A comparative evaluation of 32 patients with acute apical periodontitis using either the traditional or the proposed method was performed after RC obturation.

Results All patients underwent one treatment session using the proposed method. Clinical and X-ray examination was performed 7 days, 1 month, and 6 months after treatment. No signs of acute or chronic inflammation of periapical tissues were observed. Scanning electron microscopy (SEM) showed that dentineal tubules of untreated teeth were entirely filled with microorganisms at various depth levels. Focused cold argon plasma exposure resulted in openings of dentineal tubules to become unclosed. Subsequent diffuse cold argon plasma exposure resulted in the lumens of dentineal tubules to be free of microorganisms up to a 300 nm depth. Cold argon plasma removed microorganisms from the lumens of dentineal tubules and thus effected successful treatment.

Conclusions A statistical analysis of short- and long-term clinical scores revealed a significant advantage in the new treatment method over the traditional one. This new approach makes it possible to increase effectiveness by a mean of 25% and reduces the length of time for treatment.

Use of cold atmospheric plasma and ozone therapy in the treatment of severe endo-periodontal lesion



Božidar Pavelić, Sanja Šegović, Ivona Bago, Ivica Anić
University of Zagreb, Croatia



Department of Endodontics and Restorative Dentistry, School of Dental Medicine

Aim

To present clinical use of cold atmospheric plasma and ozone therapy in the nonsurgical treatment of severe endo-periodontal lesion.

Introduction

The cold atmospheric plasma and ozone therapy treatment can be used as an antimicrobial agent for the treatment of the hard and soft tissues diseases in the oral cavity. Cold atmospheric plasma is defined as partially ionized gas composed of various components, such as electrons, positive and negative ions, free radicals, photons and other components. Ozone was effectively used as an antibacterial agent to treat a different oral infections. The treatment of severe true endo-periodontal lesion requires a complex therapeutic approach.

Case Presentation

A 49-year-old male patient was reported with the complaint of pain and swelling in the area of right maxillary second molar. Radiographic analysis showed severe bone loss related to a periapical lesion (Fig. 1). Clinical examination confirmed a single periodontal pocket with 11 mm probing depth (Fig. 2), affected furcation area (grade II), along with purulent exudate and extensive tooth mobility (GERT, grade IIb).



Figure 1. Preoperative X-ray



Figure 2. Deep pocket probing depth

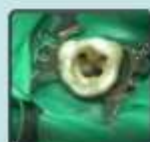


Figure 3. Prepared access cavity



Figure 4. Cold atmospheric plasma therapy



Figure 5. Intracanal ozone application with KP syringe (left tip)

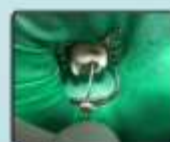


Figure 6. Application of calcium hydroxide



Figure 7. Cold atmospheric plasma therapy



Figure 8. Ozone application with KP syringe (supillary tip)

First appointment

After clinical examination, access cavity was prepared (MB₁, MB₂, DB, P) (Fig. 3), necrotic pulp tissue remnants were removed and chemo-mechanical debridement was performed: cleaning and shaping with H- and K-files, chelating with Glyde paste (Maillefer, Ballaigues, Switzerland), copious rinsing with 2.5% sodium hypochlorite (10 ml pro canal) and proper drying with paper points (DiaDent, Burnaby, Canada). Cold atmospheric plasma was applied directly into the access cavity (PA probe, level 100 / 30 seconds / canal, Ozonix, Biozonix, Munich, Germany) (Fig. 4). Ozone was generated and applied by special KP syringe (2.2 ml / 525 ppm O₃, Biozonix, Munich, Germany) (Fig. 5). Calcium hydroxide paste CalciCur (VOCO GmbH, Cuxhaven, Germany) was used for intracanal medication (Fig. 6), covered with sterile cotton pellet and sealed with temporary filling material Cavit (Espe, Seefeld, Germany). Following non-surgical periodontal therapy (scaling and root planing), plasma therapy (level 100 / 60 seconds in furcation and deep pocket / 60 seconds in the remaining subgingival area) (Fig. 7) and ozone therapy (2.2 ml / 525 ppm O₃) (Fig. 8) were performed.



Figure 9. Clinical finding, second appointment



Figure 10. ProTaper Universal set and root canal instrumentation



Figure 11. Cold lateral condensation technique



Figure 12. Control X-ray after the treatment



Figure 13. Control X-ray after 2 years

Second appointment (after two days)

During clinical examination changes in color and consistency of the gingiva were clearly recognizable (Fig. 9). Swelling and pain were almost completely absent. Final root canal cleaning and shaping were performed: ProTaper Universal rotary instrumentation technique (Fig. 10) using conventional sequence (SX, S1, S2, F1, F2, F3) (Maillefer, Ballaigues, Switzerland) combined with H-Files, chelating paste Glyde, 2.5% sodium hypochlorite, and paper points. Cold atmospheric plasma and ozone therapy were applied before final root canal filling (cold lateral condensation: guttapercha points (DiaDent, Burnaby, Canada) and AH-plus (Dentsply De Trey, Konstanz, Germany) (Fig. 11). Finally, the cavity was cleaned, covered with sterile cotton pellet, sealed with temporary filling and patient was referred for a control X-ray (Fig. 12).

Third appointment (after nine days)

Absence of all clinical symptoms was observed. Temporary filling was removed, the root canal orifices were covered with calcium hydroxide in order to achieve better sealing and demarcation (for core buildup), and finally the cavity was sealed using Fuji IX glass ionomer cement (GC, Tokyo, Japan). The patient was scheduled for the fourth control appointment after three months, with a recommendation for further periodontal, restorative and prosthetic therapy. However, the patient missed the upcoming appointment.

Fourth appointment (after two years)

Patient came to our Department after two years, but for another reason. The complete healing and reduction in size of periapical lesion of tooth 17 was confirmed (Fig. 13). In the meantime the composite filling was placed by his general dentist. Periodontal examination revealed healthy gingiva without signs of inflammation with physiological tooth mobility, reduction in pocket depth (from 11 to 3 mm), and the furcation involvement Grade I.

Discussion

The true endo-periodontal lesion, characterized by the association of periodontal and pulpal disease, requires both endodontic and periodontal treatment simultaneously. The prognosis is often poor and depends on the type of clinical procedure. In the present case, cold atmospheric plasma and ozone therapy were successfully used in the management of the severe endo-periodontal lesion. In endodontic therapy they were used as an additional antimicrobial therapy while in periodontal treatment as basic antimicrobial therapy without other antimicrobial agents.

Conclusion & Clinical Relevance

Cold atmospheric plasma and ozone therapy showed a positive therapeutic outcome in the treatment of severe endo-periodontal lesion and could be utilized as a primary therapy or as a supportive therapy to other treatment modalities.

References

- Schmidt JC, et al. Treatment of periodontal-endodontic lesions – a systematic review. *J Clin Periodontol*. 2014; 41: 779–90.
- Pan J, et al. Cold plasma therapy of a tooth root canal infected with enterococcus faecalis biofilms in vitro. *J Endod*. 2013;9(1):105–10.
- Schaudinn C, et al. Evaluation of a nonthermal plasma needle to eliminate ex vivo biofilms in root canals of extracted human teeth. *Int Endod J*. 2013; 46(10):930–7.

Endodontic revitalization/regeneration

GE115

Retreatment of failed regenerative endodontic therapy of an immature permanent tooth: a case report

Dr Charmaine Meiling She, Dr Jeen-Nee Lui
Department of Restorative Dentistry, National Dental Centre Singapore

Aim

The aim of this case report is to present a clinical case of regenerative endodontic retreatment of an immature permanent central incisor.

Case presentation

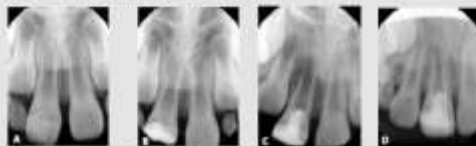
A healthy 9-year-old Chinese boy was referred for management of an immature right permanent central incisor (#11) due to persistent sinus tract after regenerative endodontic therapy (RET) (Fig. 1).



Fig. 1 Buccal sinus tract associated with #11

Dental history revealed trauma to tooth #11 a year ago, which resulted in complicated crown fracture. Patient visited his general dental practitioner who placed calcium hydroxide dressing over the exposed pulp and cemented the tooth fragment back before referring the patient for specialist treatment (Fig. 2A). Cvek pulpotomy was performed 3 days after the accident (Fig. 2B) and 10 days later #11 developed a buccal abscess. RET was attempted (Fig. 2C), however buccal sinus tract was observed during a 4-month review. Periapical radiograph taken prior to retreatment showed increase in root length and width despite presence of infection (Fig. 2D). A diagnosis of previously treated (regenerative endodontic therapy) with chronic apical abscess was given. Regenerative endodontic retreatment was the treatment of choice due to the thin dentinal walls present.

Fig. 2 Series of radiographs taken after various treatments



A. After direct pulp cap; B. After Cvek pulpotomy; C. After 1st RET; D. Sinus tracing prior to 2nd RET

Local anesthesia was administered using Scandonest 2% with 1:100000 adrenaline. After rubber dam isolation, access cavity was made through existing composite resin crown. Upon removal of MTA, some bleeding, along with tissue fluid and pus was noted in the canal. Working length radiograph was taken with size #80 K-file at length 23mm (Fig. 3). Paper point showed bleeding at 18mm, indicating incomplete hard tissue growth circumferentially. Light debridement of canal wall was done along with copious irrigation with 20ml of 2N NaOCl and 20ml of 17% EDTA, delivered with a size 27-gauge side vent needle, positioned 1mm short of working length. Calcium hydroxide was placed followed by a temporary dressing.

Patient was seen after 2 months, the buccal sinus tract had healed and the tooth was asymptomatic. Local anesthesia was administered using Scandonest 3% plain. Calcium hydroxide dressing was removed via irrigation with 20ml of 17% EDTA. Bleeding was induced in the canal by passing a size #70 K-file 1-2mm out of apex. Blood clot was formed up to the level of 3mm below cemento-enamel junction (Fig. 4). A sterile collagen membrane barrier was placed over the blood clot and 3mm of Biodentine™ was packed up to the level of the cemento-enamel junction.

Glass-ionomer-cement base was placed and access was sealed with composite resin. A post-operative radiograph was taken (Fig. 5).



Fig. 3 Working length radiograph



Fig. 4 Clinical photo showing blood clot



Fig. 5 Post-operative radiograph

Patient was seen after 11 months for a review with no complaints and #11 was asymptomatic and functional. The tooth was discoloured and non responsive to electric pulp testing and cold test (Fig. 6). Patient was not concerned about the discolouration at this point of time. Radiographic examination revealed diffuse intracanal calcification at the apical third of the canal and a radio-opaque calcified bridge can be seen between Biodentine™ and root apex (Fig. 7).



Fig. 6 Clinical photo at 11-month review



Fig. 7 Radiograph at 11-month review

Discussion

Despite the presence of bacterial infection, "failed" RET still led to increase in root width and length. Zizka *et al.* (2016) also reported 2 similar cases root maturation by unsuccessful revitalisation. Chen *et al.* (2012) concluded that continued root development in immature permanent necrotic teeth is dependent on the survival of Hertwig's epithelial root sheath. Even though the tooth in this case report showed increase in root length, the periapical lesion persisted, and hard tissue was not formed circumferentially around the root. Retreatment of the tooth led to favourable clinical and radiographic outcome with resolution of sinus tract and evidence of hard tissue formation. Based on Chen *et al.* (2012) classification, a type 5 tissue response can be observed where a hard tissue barrier is formed in the canal space between the coronal Biodentine™ and root apex. With a longer term follow up, a type 4 tissue response with pulp canal obliteration may be possible as some calcifications are already noted in the apical third of the root.

Conclusion

This case shows continued root growth is still possible in teeth with apical pathology. It is possible to perform RET as a retreatment option for immature permanent tooth with chronic apical abscess.

References

1. Zizka R, Buchta T, Voborna I, et al. Root maturation in teeth treated by unsuccessful revitalization: 2 case reports. *J Endod* 2016;42:724-9.
2. Chen MY, Chen KL, Chen CA, Tayebaty F, Rosenberg PA, Lin LM. Responses of immature permanent teeth with infected necrotic pulp tissue and apical periodontitis/abscess to revascularization procedures. *Int Endod J* 2012;45:294-305.

Effect of human derived concentrated growth factor on adhesion of pulp stem cells on biomaterials and dentine

Borazan B¹, Nalbantsoy A², *Turk T³

Departments of ¹Endodontology, ²Bioengineering, Ege University, Izmir, Turkey

Aim To describe the in vitro isolation of dental pulp stem cells (DPSC) from human molar teeth and evaluation of the effect of human-derived concentrate growth factor (CGF) on adhesion and proliferation of stem cells on biomaterials and dentine by immunohistochemistry, colorimetric assay and scanning electron microscopy.

Methodology Dental pulps were obtained from sound human molars. Carefully extracted pulp tissue was minced into small pieces. The tissue blocks were cultured in alpha modification of Eagle medium, supplemented with 20% fetal bovine serum and a complex of 100 U/mL penicillin G and 100 mg/mL streptomycin. DPSC, characterized by flow cytometric analysis. Additionally, to control stem cell nature, cultured cells differentiated into osteocytes and adipocytes. To obtain root canal fragments, single root teeth were collected. After separation of the crowns at cemento-enamel junction, roots were instrumented and vertically divided into two pieces. Samples divided into 12 groups and were set up as follows; in group 1: only dentine, group 2: only cells, group 3: dentine and MTA, group 4: dentine and Biodentine, group 5: only MTA, group 6; only Biodentine. Biomaterials were placed into half-length of canals. The stem cells were seeded into samples with culture medium. Group 7-12, were formed symmetrically like first 6 groups, diversely cells were seeded onto samples with CGF. After 14 and 21 days, MTT and ALP Activity tests were performed. The samples were stained with Alizarin Red S to evaluate calcium ions. Finally, samples were examined by SEM.

Results The groups with Biodentine demonstrated the significantly higher number of cells compared to MTA used groups. The ALP activity was higher in the presence of dentine that was also

demonstrated on alizarin red s staining. Treatment of CGF significantly enhanced proliferation and differentiation of dental pulp stem cells on dentine.

Conclusions Presence of dentine increased odontoblastic differentiation of DPSC. CGF, a new generation of platelet concentrate product, appears to have promising applications in regenerative endodontic therapies.

GE117

Differences in root evolution following pulp revitalization procedure depending on intracanal medication: literature review

*Galan Martin AI, Garrido Ovejero M, Garcia Barbero E, Martinez Pinar AI, Gancedo Caravia L

Department of Endodontics, UCM, Madrid, Spain

Aim To compare the results of apical closure, dentine thickening and root length increasing after the procedure of pulp revitalization in immature permanent teeth, depending on the intracanal medication used.

Methodology A bibliographical search is performed in different databases (SCIE, Medline, SCOPUS).

Key words: regenerative endodontics procedures, triple antibiotic paste, pulp revascularization, immature necrotic teeth. Selection criteria: clinical cases or systematic reviews from 2004 to the present, with follow-up, detailing the procedure performed and the results obtained. 238 clinical cases published in 20 articles of impact journals have been analyzed. Percentages of success are calculated according to the intracanal medication used and results of cases treated with calcium hydroxide (Ca(OH)₂) front 2 groups (cases treated with triantibiotic paste (TAP)) and (cases treated with triantibiotic past (TAP), diantibiotic paste (DAP), monoantibiotic paste, formocresol or with no medication) are compared.

Results TAP cases: n=109. 63.3 % occurs apical closure, 64.2 % dentine thickening and 62.3 % increasing root length. Cases with all protocols but not with Ca(OH)₂: n=169. 66.8 % occurs apical

closure, 62.7% dentine thickening and 63.9 % increasing root length. Ca(OH)₂ cases: n=69. 92,7 % occurs apical closure, 98.5 % dentine thickening and 72.4% increasing root length.

Conclusions It can be seen that after pulp revitalization procedure occurs clinical cure of infectious processes, considering this as “success”, but not in all cases root development continues, this being what would justify this procedure against using a MTA barrier. The influence of the intracanal medication used on root development is evaluated, looking for differences between the current protocol with Ca(OH)₂ and the first protocols used (TAP, DAP...). According to the results obtained, it is possible to achieve clinical success with all protocols, although better results can be seen in cases treated with Ca(OH)₂ compared with the others protocols.

Endodontic surgery

GE118



'INTENTIONAL REPLANTATION: AN OPTION TO CONSIDER'



MÁSTER EN ENDODONCIA Y ESTÉTICA. INSTITUCIÓN UNIVERSITARIA MISSISSIPPI.

INTRODUCTION:

Andrés Hernando C., Juárez Navarro L., Reviejo Fragua M.

In cases of primary root canal treatment failure, orthograde retreatment is the mostly indicated. When endodontic retreatment is not successful, two alternatives remain: periapical surgery or intentional replantation. The latter is a surgical procedure in which the tooth is extracted and replanted into the alveolus after extra-oral treatment of the canals.

CLINICAL HISTORY AND EXPLORATION:

- 33 y.o. Male
- ASA 1
- Non Smoker
- Tooth mobility grade I
- 6 mm vestibular probing depth

DIAGNOSIS:

Previously treated +
Asymptomatic Apical
Periodontitis

CASE PRESENTATION:

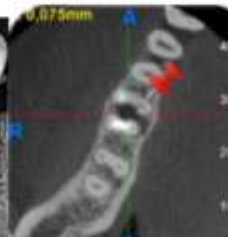
CLINICAL PROCEDURE:



Initial situation



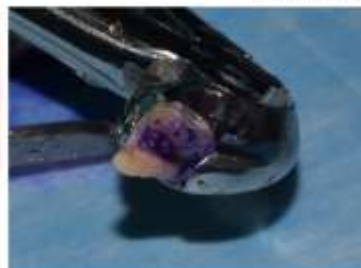
After retreatment
Composite direct
Restoration



CBCT before retreatment showing
furcal lesion with difficult access and ML
missed canal



Extraction



Apicoectomy



Replantation

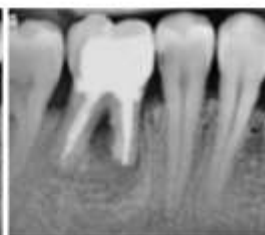
RX FOLLOW-UP:



After retreatment



1-month



6-month



1-year

CONCLUSION AND CLINICAL RELEVANCE:

-“Intentional replantation is an alternative treatment in case of failing endodontic (re)treatment. - Survival rates of 88% after intentional replantation have been reported in the literature (Torabinejad, 2015)(1)”

-“There is a protocol described (Grzanich,2017), thus there seems to exist a wide variation in techniques and associated outcomes possibly stemming from the lack of an accepted protocol, as well as lack of adherence to modern endodontic surgery principles (2)(3)”



REFERENCES:



Effect of platelet-derived materials(PRF, CGF) on new bone formation after endodontic microsurgery

*Lee HJ¹, You JS¹, Choi HI¹, Lim LR¹, Jung GW¹, Seo YS², Jo HH³

¹Department of Oral and Maxillofacial Surgery, ²Department of Maxillofacial Radiology, ³Department of Conservative Dentistry, School of Dentistry, Chosun University, Gwangju, Republic of Korea

Aim Platelet rich fibrin(PRF) and Concentrated growth factor(CGF) are considered to be new generation biomaterial in bone regeneration. There is little information about the effect of these materials acquired in endodontic surgery. The aim of the study is to evaluate and compare the volumetric changes following endodontic microsurgery using platelet-rich fibrin (PRF) and concentrated growth factor (CGF).

Methodology A total of 30 patients(control n=10, PRF n=10, CGF n=10) with maxillary incisors with apical lesion were included in this randomized controlled clinical trial. The mean of osteotomy size was 10.0 and retrograde filling of the apical root canal with mineral trioxide aggregate was 3.0mm. After the surgical procedure, the osseous defects in apical regions of 20 patients of two experimental groups were filled with each materials(10 by PRF and 10 by CGF). The unfilled cavities of the 10 patients were used for control purposes. Surgical procedure were performed by one single surgeon. Cone beam computed tomography(CBCT) examination was performed prior to surgery and 1 month and 3 months after surgery. The radiographic examination showed healing of the apical lesion. The data were analyzed using one-way ANOVA.

Results The best results were noted for the CGF groups, while the bone healing rate was lowest for the control group. It was found that the defects grafted with CGF and PRF had higher new bone formation after 1 months, although the difference was not statistically significant. The amounts of bone regenerated remained similar after 3 months for these three group of this study.

Conclusions This study was successfully managed by endodontic therapy followed by surgical intervention. The CBCT images revealed the marked apical bony regeneration after surgical endodontic treatment in biomaterial group compared to the control group. Given the results of the present study and the current lack of information in the literature regarding postoperative infection, long-term success rates and pain, further study in this area is recommended. Additional large-scale prospective clinical studies are needed to further evaluate possible benefits of other biomaterials in endodontic surgery.

APICAL SURGERY APPROACH TO THE CUT IN THE MESIAL ROOT OF THE MAXILLARY FIRST MOLARS

Arsoo J.¹, Pinto A.², Freitas V.¹

¹ Post graduation students in Endodontics, IUCS- CESPU

² Assistant of the department Conservative Dentistry- IUCS- CESPU



Objective: The objective of the present study was to evaluate the approach of apical surgery to the traditional cut vs the invasive cut taking into account the complex anatomy of the root canals.

Key Words: Mesio Buccal root canal, Maxillary first molar, cone-beam computed tomography, dental pulp cavity

Introduction

Endodontic surgical treatment is a reliable procedure with high success rates. Nonetheless, for a variety of reasons, Endodontic failure still occurs, and the presence of clinical signs and symptoms, with radiographic evidence of periapical bone destruction/ loss, show the need for retreatment.¹

Surgical endodontics involving root resection/apical filling is often performed when retreatment by non-surgical endodontic procedures is not possible.² The success of root canal treatment is secured only by complete root canal cleaning and adequate obturation of the root canal. It is difficult to completely remove all tissue present in the root canal system.³

Endodontic failure related to microorganisms can be caused by anatomical difficulties or procedural errors such as root perforation, separate instruments, lost channels.^{4,7} Major factor in the failure of root canal treatment is the anatomical complexity of the root canal system² so, a complete understanding of the three-dimensional (3D) configuration through the coneBeam system is essential for the delivery of successful endodontic therapy.^{4,7}

There is general agreement that treatment of the root canal of the first maxillary molars is difficult² since the root canal system has complicated anatomical morphology, and this anatomical complexity, including apical ramifications, renders removal of debris difficult.¹

This anatomical variability, consequently, makes the first maxillary molar a considerable object of scrutiny.⁴

Discussion

A good diagnosis and a correct evaluation of anatomical structures is fundamental to the endodontic success.³ Surgical treatment is necessary when traditional treatment makes it impossible to remove the complexities of the radicular when their disinfection, instrumentation and filling is not possible. The first and most important step for retreatment is to determine the cause of endodontic failure. Many studies report that microorganisms in root canals or periradicular lesions play an important role in the persistence of apical periodontitis lesions after treatment of the root canal⁵. Bacteria can be located without a portion of the root canal previously lost or not instrumented as is the second mesio Buccal canal in maxillary molars. These lost or untreated canals contain necrotic tissue and bacteria which contribute to chronic symptoms and non-curative periapical lesions.²

The canal systems of the 1st molars is quite variable.^{1,4} These have a complex anatomy as accessory channels, isthmus or deltas apical and difficult to access and view, making the approach of this tooth more complex.² The importance of these ramifications for endo-perio problems are obvious.² All of these channels ramifications are not found in the same area in the root, with variations in relation to nr, region, tooth type, age, and intrinsic factors. Apical anatomy plays an important role in the prognosis of root canal treatment. The study performed by De Deus (1975) exposes the frequency, location and direction accessory channels, secondary and lateral channels. De Deus (1975) documented the presence of these ramifications in 27.4% of the cases mostly found in the 3 mm apex.² The goal of apical surgery are to remove the portion of the root that may contain irritants and bacteria and prevent new infections². The amount and degree of end resection are of extreme importance.⁶ In the mesio Buccal root of the maxillary molars and other teeth with long roots in the bucco-lingual to 45° and it's described as more conservative, according to Stropko et al (2006) 98% of apical canal anomalies and 93% of ramifications of canal systems are 3 mm from the apex and it is essential that at least 3 mm of the apex be removed. Nevertheless, the use of long bevels requires a greater removal of the structure to include 3 mm from the apex of the root so if the bevel is as close as possible to 0° of inclination (short bevel), more root structure can be conserved, crown / root proportion as well as to remove most of the apical ramifications.^{2,8}

Ideally the root bevel is kept short and the most perpendicular along the axis of the root making it possible the complete resection and exposition of the ramifications at the apical level nonetheless, after the identification of the characteristics on the bevel surface, adjustments may be necessary, for example the presence of isthmus when there is more than one channel in the root, being present at level 4mm.¹⁰

Another study by Degerness (2008) shows that 80% of the accessory channels of the MB root are located within the 3-6 mm apical root. This study suggests that the surgical cut should be done at the 4 mm level in order to reduce the incidence of the accessory channels to 20% once the recommended resection at the level of 2 to 3 mm of the apex may result in treatment failure.³ Resection at this level will not only reduce the incidence of accessory channels, but it will also allow for greater channel wall thickness and access to isthmus areas, if possible, for proper sealing.² Apical surgery may then be the treatment of choice. In performing apical surgery, resection of the root should be extended sufficiently in the coronal direction to remove at least the apical collection of accessory channels.²

There is much to consider when performing the final root procedures⁹, but when evaluating the exact frequency, and the direction of these ramifications, the clinician is helped to evaluate the role of these channels in the diagnosis and treatment of endodontic, periodontal and endodontic-periodontal problems.³

Conclusion: Apical surgical resection, according to several authors, is recommended at 3mm. However, in the case of maxillary first molars, a slight increase in the resection up to 4mm would lead to an improvement in the success rate since, it would ensure a more effective elimination of ramifications and accessory channels. Nevertheless, more scientific studies are needed to support this theory, considering they're not as conservative treatments and lead to an impairment of dental structure.

1. Song M, Kim HC, Lee W, Kim E (2011) Analysis of the cause of failure in nonsurgical endodontic treatment by microscopic inspection during endodontic microsurgery. *Journal of Endodontics* 37, 1516-19.
2. Degerness R, Bowles W (2008) Anatomic determination of the mesio Buccal root resection level in maxillary molars. *Journal of Endodontics* 34, 1162-6.
3. Yamada M, Ito Y, Matsunaga S, Kato H, Nakagawa K (2011) Three-dimensional analysis of mesio Buccal root canal of Japanese maxillary first molar using Micro-CT. *The Bulletin of Tokyo Dental College* 52, 77-84.
4. Park JW, Lee JK, Ha SH, Choi JH, Parkparyayagan H (2009) Three-dimensional analysis of maxillary first molar mesio Buccal root canal configuration and curvature using micro-computed tomography. *Oral Surgery Oral Medicine Oral Pathology Oral Radiology Endodontics* 106, 437-42.
5. De Deus (1975) Frequency, location, and direction of the lateral, secondary, and accessory canals. *Journal of Endodontics* 1, 351-6.
6. Stropko J DG, Guimaraes J (2006) Root-end management: resection, cavity preparation, and material placement. *Endodontic Topics* 11, 121-61.
7. Weda, M., Tatesa, T., Nakamura, K., Arita, K., Nagahama, F. and Yamazaki, M. (2016). Clinical study of refractory apical periodontitis treated by apicectomy Part 1. Root canal morphology of resected apex. *International Endodontic Journal* 31, 52-58.

Root canal retreatment

GE121

Clinical Case of Successful Retreatment of Chronic Apical Periodontitis

M.Sh. Gaeva, D.T. Galieva, V.A. Mitronin, A.D. Baitokova

MSUMD, Department of Cariesology and Endodontics

Moscow, Russia

Aim: Nowadays problem of retreatment of endodontically treated teeth is rather widespread. The aim of our report is to prove that nonsurgical treatment of chronic apical periodontitis can be an alternative to surgical treatment.

Case presentation: Patient K., 36y.o. presented to MSUMD clinic with complaints of pain in tooth 44 when biting. Objectively: tooth 44 had been treated endodontically and restored with a filling. Periapical X-ray of tooth 44 showed periapical bone resorption of 2mm (Fig. 1). Canal wasn't filled to the full length and there was no uniform density of obturation. Percussion and palpation were painless. Diagnosis: chronic apical periodontitis of tooth 44. The treatment included two appointments. Appointment 1: root-filling was removed, chemo-mechanical instrumentation was performed of 1 root canal (Protaper S1, S2, F1, F2, 3.5% NaOCl, 17 % EDTA,). The canal was temporarily filled with calcium hydroxide for 2 weeks.

Appointment 2: No complaints, calcium hydroxide was removed, chemo-mechanical instrumentation was performed, ultrasound was applied (20seconds / 3 times). The canal was filled with guttapercha, AH Plus sealer (Fig. 2). Coronal sealing was done. Further monitoring and follow-up X-ray (6 months later) showed improvement and elimination of periapical lesion in tooth 44 which indicates success of non-surgical treatment (Fig. 3).

Conclusion: Endodontic retreatment which includes proper diagnosis, performing all technical steps of endodontic treatment can be successful. Success of retreatment was proved by absence of relapse and decrease of bone lesion on the periapical X-ray in 6 months (Fig. 3).



Fig.1. Pre-op X-ray tooth 44.



Fig.2. Post-op X-ray tooth 44.



Fig.3. X-ray tooth 44 after 6 months.

GE122

The efficacy of different techniques in removal of root canal filling during retreatment of oval shaped root canals

Atasoy Ulusoy Öi

Department of Endodontics, Gazi University Faculty of Dentistry, Ankara, Turkey

Aim To compared the efficacy of different irrigation activation techniques for the removal of root canal filling from oval shaped root canals.

Methodology Forty oval shaped distal canals of extracted mandibular first molars were prepared and obturated. Root canals were retreated with rotary retreatment files. All specimens were randomly assigned into three experimental and one control groups, according to the activation procedures as follows; passive ultrasonic irrigation (PUI), Self Adjusting File (SAF) and XP Endo finisher (XPF). The percentage of residual filling was assessed by micro-computed tomography (μ CT) and digital radiographic imaging. Then, the root canal walls were examined and debris removal was scored by using scanning electron microscope

Results None of the techniques completely removed the root canal filling. According to the μ CT and radiographic analysis significantly less residual filling materials were recorded in PUI, SAF, and XPF groups when compared to control group ($p < 0.05$). There was no difference between the SAF and PUI groups in any of the evaluation methods ($p > 0.05$).

Conclusions Additional use of PUI, SAF, and XPF improved the removal of filling materials from root canals. XPF activation following retreatment files increased the cleanliness of the root canal walls.

GE123

Efficacy of nickel- titanium instruments used different kinematics in the removal of root filling material

*Koşar T, Çelik D, Taşdemir T

Department of Endodontics, Karadeniz Technical University, Trabzon, Turkey

Aim To evaluate the efficacy of various nickel-titanium instruments used in different kinematics movement for root canal retreatment.

Methodology Seventy-five extracted human maxillary central incisor were selected for the present study. The root canals were prepared using K-type hand files up to size #40.02, then the teeth were obturated using continuous wave of condensation technique with Beefill system and AH Plus Jet root canal sealer. The root canals were then randomly allocated into five groups (n = 15), and the root canal fillings were removed with Endo-Eze Genius, ProTaper Next, Reciproc Blue, Tango-Endo and Twisted File Adaptive instrument systems using the kinematics recommended by the manufacturer via orange oil. The teeth divided into two as buccolingual and stereomicroscope images were captured. The amount of residual filling material in the coronal, middle and apical thirds was assessed using Zen 2 Lite software. Statistical analysis was done through the one-way ANOVA and Tukey post-hoc tests (P = 0.05).

Results Tango-Endo group was found to have more residual filling material as compared to the other groups in apical and middle thirds ($p < 0.05$). Twisted File Adaptive group demonstrated less amount of residual filling material in comparison with Tango-Endo, Reciproc Blue and ProTaper Next in coronal thirds ($p < 0.05$). When we evaluated the total area, Tango-Endo group had more percentage of residual filling material compared to the other groups except Reciproc Blue ($p < 0.05$). Additionally when the root thirds are examined regardless of the file system used, no significant difference was found between the amount of residual filling material ($p > 0.05$).

Conclusions Tango-Endo group had failed to remove root canal filling from root canals compared to other groups. Furthermore, complete removal of root canal fillings didn't occur with any of the kinematics movement. Additional techniques are needed to improve cleaning of root canal.

Acknowledgements This work was supported by Karadeniz Technical University Scientific Research Projects Commission (project number: 2018-7186)

GE124

The efficacy of two irrigation activation methods in removing bioceramic root canal sealer and gutta percha during retreatment

Hazar E, *Coşkun E, Koçak S, Sağlam BC, Koçak MM

Department of Endodontics, Zonguldak Bülent Ecevit University, Faculty of Dentistry,, Zonguldak, Turkey

Aim The removal bioceramic sealer and canal filling material may be complicated during the retreatment procedures. The aim of this study was to evaluate the efficacy of ultrasonic activation and XP Endo finisher on the removal of root canal fillings.

Methodology Forty-five maxillary central incisors were selected. After root canal instrumentation, the canals were obturated with Well-Root ST bioceramic sealer and gutta percha using the cold lateral compaction technique. The root canals were retreated with ProTaper Retreatment instruments. The specimens were split longitudinally and inspected with dental operation microscopy under x25 magnification. Then the roots were reassembled, coated with wax and placed into the eppendorf tubes. The specimens were randomly divided into three equal groups, as follows, according to irrigation procedure; group 1: Needle irrigation; group 2: Ultrasonic activation (PUI); group 3: XP Endo finisher file activation. After activation techniques were completed, the roots were separated and the final images were obtained under the same magnification value. The images were transferred to a computer, and the total canal space and remaining filling material were quantified. The ratio of remaining filling material to the root canal periphery was calculated using a software. The mean percentages of remaining filling material were statistically compared.

Results None of the techniques completely removed the filling material. The needle irrigation group demonstrated significantly higher percentage of remaining filling material compared to XP Endo finisher group ($P < 0.05$). XP Endo finisher showed lower percentage of remaining filling material than PUI activation.

Conclusions The use of irrigation activation systems enhanced the removal of bioceramic root canal sealer and gutta percha.

GE125

Retreatability of a bioceramic root canal sealing material with the Reciproc system: an in vitro study

*Cornelissen B, Buttiens L, Bottenberg P, de Hemptinne F

Department of Preventive and Conservative Dentistry, Endodontology, Vrije Universiteit Brussel, Brussels, Belgium

Aim To evaluate the time required for complete removal (tcr) of a bioceramic sealer compared with an epoxy sealer as well as the re-establishment of patency (tp) using two different Reciproc files.

Methodology Sixty single rooted teeth with straight roots were standardized at 15 mm and the canals were prepared with a Reciproc M-wire (VDW, München, Germany) to working length, followed by an apical enlargement with a MTwo 35 taper 04 file (VDW). The canals were obturated with either Topseal (Dentsply Maillefer, Ballaigues, Switzerland) using warm vertical compaction or Endosequence BC sealer (Brasseler, Savannah, USA) using a single cone technique. The teeth were randomly subdivided into 4 groups of 15 teeth for retreatment with either a Reciproc M-wire (VDW) or a Reciproc blue (VDW): the epoxy M-wire group (EM), the epoxy blue group (EB), the bioceramic M-wire group (BM) and the bioceramic blue group (BB). The experimentally obtained data were subjected to one-way ANOVA followed by a Tukey's multiple comparisons test.

Results One tooth in the EB group was excluded because patency could not be re-established. The mean tcr and tp (in seconds) of the EM group is 237,1 ($\sigma=104,6$), respectively 88,33 ($\sigma=39,36$); of the EB group = 230,9 ($\sigma=71,53$), respectively 93,21 ($\sigma=43,32$) ; of the BM group= 319,1 ($\sigma=81,36$), respectively 180,5 ($\sigma=49,49$) and of the BB group = 333,7 ($\sigma=122,4$), respectively 221,5 ($\sigma=94,21$). There is a significant difference in tp ($p < 0,0001$) between the bioceramic groups and the epoxy groups. In tcr there is a significant difference ($p = 0,0060$) between the BB group and the epoxy groups, not between the BM group and the epoxy groups. There is no significant difference in tcr or tp according to the type of instrument, within each sealer group.

Conclusions It takes longer to regain patency in teeth filled with a bioceramic sealer in comparison with an epoxy sealer, regardless of the type of file used. The total retreatment time is longer in teeth filled with a bioceramic sealer than in teeth filled with an epoxy sealer when a reciproc blue file is used.

Clinical outcome studies – endodontic surgery

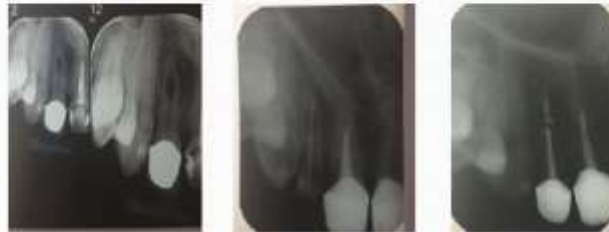
GE126

INTERNAL ROOT CANAL RESORPTION, ENDO SURGICAL THERAPY

ALBIN LUMEZI, MARIJANA MOLNAR, BRANKA MIKICA SEPIC MATANOVIC, BORIS PAZIN
DENTAL CLINIC ZAGREB, DEPARTMENT OF ORAL MEDICINE, ENDODONTICS AND
PERIODONTOLOGY

Aim: presenting a case of internal root canal resorption, surgical treatment with mineral trioxide aggregate MTA

Introduction: root canal intern resorptions can present a problem in endodontic therapy which often results in failure.



Case report: Right maxillary lateral incisor of a 19-year-old female was showing a sinus track on the mucosa. Radiographically, a regularly shaped and perforating internal resorption area was seen at the middle third of the root canal, with radiolucency on the mesial side of the root. A right path through the canal, with endodontic instrument was not possible.

Calcium hydroxide CH was applied, and after 3 months a full flap surgery was performed, the canal and the perforation were obdurate with MTA filling. At 3 months and one year follow up the tooth was clinically asymptomatic and showing radiographical appearances of the hard tissue repair.



Discussion: internal root resorption can be a challenge for treatment, so many avoid it with extraction and implant placement, but as always, an old fashion way of endo-surgical therapy can be an answer.

Conclusions and Clinical Relevance : When Simple surgery with right endo therapy can resolve the problem and still leave enough time for implant placement in later life.



References: Endodontic management of root perforating internal replacement resorption. Subay RK, Subay MO, Tuzcu SB. Eur J Dent. 2018

GE127

WITHDRAWN

Clinical outcome studies – root canal treatment and retreatment

GE128

To compare quality of life of patients undergoing either root canal treatment or tooth extraction.

*Wigsten EW¹, Kvist TK¹, Jonasson PN¹, Davidson TD²

¹Department of Endodontology, Institute of Odontology, The Sahlgrenska Academy, University of Gothenburg, Gothenburg, ²Centre for Medical Technology Assessment, Department of Medical and Health Sciences, Linköping University, Linköping, Sweden

Aim To evaluate the effect of root canal treatment in terms of quality of life (QoL) and Quality-Adjusted Life-Years (QALY) weights compared to patients that underwent tooth extraction.

Methodology Patients with either root canal treatment or extraction were recruited from 6 clinics in the general public dental service during a predetermined period of 8 weeks. Three different instruments were used: Oral Health Impact Profile (OHIP-14) evaluated the oral health-related QoL (OHRQoL), EQ-5D-5L the health-related QoL (HRQoL) and QALY weights, and a disease-specific questionnaire which evaluated the satisfaction regarding root canal treatment. The evaluation was assessed at the initiating of treatment and after one month. Pre- and postoperative characteristics were obtained from dental records.

Results Eighty-five patients were included. The distribution between the genders were even, 43 women and 42 men. The mean age was 51.1 years. 48 patients (56.5%) had tooth extraction and 37 patients (43.5%) initiated root canal treatment. The response rate of the questionnaire at baseline was 95.3% and at one month follow-up 74.1%. Two relevant and comparable groups were obtained after exclusion of the extracted 3rd molars (n=20), leaving 65 patients for further analyses. There

were no statistical significant differences between the groups at baseline in respect to OHIP-14 and EQ-5D-5L. At follow-up, the statistical significant differences within or between given groups were few. There were no statistical significant differences in total scores. The patients who initiated root canal treatment registered a significant improvement in perceived HRQoL according to QALY-weights ($P=0.021$ respectively $P=0.010$), which was not observed among the patients who had tooth extraction. Patients initiating root canal treatment registered a general high satisfaction.

Conclusions Patients in need of root canal treatment or tooth extraction registered a negative impact in OHRQoL. The possibility to save the tooth with root canal treatment, gave a positive impact in perceived HRQoL. Patients in general dental practice registered an overall high satisfaction regarding root canal treatment. By introducing QALY-weights, further research enables cost-effectiveness analyses and prioritizing in dental care.

GE129

Effects of bacterial reduction on treatment outcome after root canal preparation with single-file or multifile systems followed by calcium hydroxide medication

Rôças IN

Molecular Microbiology Laboratory, Department of Endodontics, Faculty of Dentistry, Estácio de Sá University, Rio de Janeiro, Brazil

Aim To compare the antibacterial effects and the healing rate of teeth with apical periodontitis following endodontic treatment using a single-file or a multifile instrumentation system, and calcium hydroxide intracanal medication.

Methodology Eighty root canals of single-rooted teeth with apical periodontitis were treated by using either Reciproc or BioRaCe instruments, NaOCl irrigation, and calcium hydroxide intracanal medication. For microbiological evaluation, samples were taken before treatment and immediately before filling and examined for total bacterial counts by a quantitative real-time polymerase chain

reaction (qPCR) assay. Patients were followed up and the treatment outcome was evaluated by clinical and radiographic (PAI - periapical index) criteria. Cases with decreasing lesions were classified as either success in a loose criterion or failure in a rigid one.

Results The follow-ups sessions were carried out on 47 patients and were available for bacteriological and outcome evaluation. All initial samples were positive for bacteria. In the BioRaCe and Reciproc groups, 11 of 22 (50%) and 7 of 25 (28%) root canals yielded negative qPCR results before filling, respectively ($p>0.05$). Quantitative bacterial level reduction was similar between groups ($p>0.05$). The median follow-up period was 18.5 months for BioRaCe and 18 months for Reciproc ($p>0.05$). The success rate of BioRaCe group was 95.5% and 77% in the lenient and rigid criterion, respectively. In the Reciproc group, corresponding figures were 88% and 76%. Differences in outcome were not significant ($p>0.05$). All diseased cases were positive for bacteria at the time of filling. A difference of more than 1 Log₁₀ counts was observed between healed and diseased cases.

Conclusions Endodontic treatment of teeth with apical periodontitis using a single-file or a multifele system for preparation, associated with NaOCl irrigation and calcium hydroxide intracanal medication, showed comparable antibacterial efficacy and clinical/radiographic outcome.

Acknowledgements This study was supported by grants from Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brazilian Governmental Institutions.

GE130

Assessment of pain intensity after instrumentation by MPRO and Hyflex rotatry files in molars with irreversible pulpitis

*Elmallah SM¹, obeid MO¹, Khalil HF²

¹Department Endodontics, Faculty of dentistry, Fayoum University, Fayoum, ²Department Endodontics, Faculty of Dentistry, British University, Cairo, Egypt

Aim Assess the pain intensity in a two visit treatment of molars with irreversible pulpitis after instrumentation with two rotary files- Mpro - Hyflex file.

Methodology This study is a randomized controlled clinical trial in Ain Shams University. Teeth were divided into two groups according to file used. Teeth in each group was isolated , access cavity prepared and instrumented. Files were used to prepare teeth according to manufacture's instructions. Patients were asked to scale the pain using NRS scale at different time intervals after instrumentation at 3 ,6 , 24 ,48 and 72 hours. Patients were recalled for second visit obturation and coronal restoration. Data was tabulated and statistically analyzed

Results Data was analyzed using IBM SPSS Statistics version 2.0 for windows. KruKal-m Walli9s and Friedman's test were performed to compare the numerical rating scale mean values between different times within each rotary system. Mann- Whitney U Test was conducted ton compare NRS values between both rotary systems at each interval. results of the Mpro group showed a decreasing mean from 3 hours to 72 hours and showed a statistical difference between three hours and all other observation periods with the three hours recording the highest mean(3.72 \pm 1.88), p value 0.000. 6 hours showed a significant difference with the 48 and 72 with the 6 hours recording the highest mean (1.19 \pm 1.21) and a non significant difference between the 48 and 72 hours. Results of hyflex showed a decreasing mean from 3 hours to 48 hours and no difference between mean at 48 and 72 hours. 3 hours showed a significant difference to other observation periods p value 0.000. there was no significant difference between the 6, 24, 48 and 72 hours observation periods. results showed significant difference between the two file systems along all observation times p value <0.05 s with the hyflex showing lower means of NRS.

Conclusions Hyflex files showed a lower pain intensity in comparison to Mpro files when used during instrumentation of molars with irreversible pulpitis

Association between Type 2 Diabetes and Apical Periodontitis before and after Endodontic Treatment in an Adult Population in the United Arab Emirates

*AlMutawa A¹, Al Mesmar H², Al-Salehi S¹

¹Hamdan Bin Mohammed College of Dental Medicine-MBRU, ²Dubai Health Authority, Dubai, United Arab Emirates

Aim To determine the association between type 2 diabetes and apical periodontitis (AP) before and after Endodontic treatment in an adult population in the United Arab Emirates. The null hypothesis that type 2 diabetes has no effect on the size of AP lesions

Methodology An initial sample of 38 patients with type 2 diabetes were selected from a data base in a specialist Endodontic unit who had received endodontic treatment on one tooth. These were matched in terms of age and gender with a non diabetic control group who received Endodontic treatment on the same tooth. For each group, the size of the AP lesion was recorded using the Periapical Index (PAI) scoring system preoperatively and one year post endodontic treatment. The 38 diabetic patients were made up of 21 controlled and 17 uncontrolled (HbA1c value of 8% or higher) diabetics.

Results The mean PAI score for the uncontrolled diabetic group (n=17) prior to endodontic treatment was 3.2 compared to 2.5 for the matched non diabetic control group. A paired t-test revealed that this was statistically significant ($p=0.023$) indicating that uncontrolled type 2 diabetes influences the size of the AP lesion. These figures were reduced to a mean PAI score of 2 in the uncontrolled diabetic group and 1.6 in the healthy control group in the one year follow up periapical radiographs. The corresponding mean PAI value prior to endodontic treatment were 2.6 and 2.8 in the controlled diabetic patients and their matching control group respectively. The differences were not statistically significant ($p=0.28$). For the sample as a whole (n=38), the mean PAI value for both diabetic and non diabetic groups reduced to 1.8 on the one year post Endodontic periapical

radiographs. Paired t-tests revealed a statistically significant improvement in healing in both these groups ($p < 0.001$).

Conclusions PAI scores, prior to endodontic treatment, were significantly higher in the uncontrolled diabetic group compared to the controlled diabetic group. In all cases the endodontic treatment significantly reduced the size of the AP lesions.

GE132

A 5 years follow up of root canal fillings performed by Sudanese undergraduate students on Molars, Radiographic technical quality and clinical assessment outcome. Cross-sectional study.

Ismail AY

Department of Endodontics, University of Medical Sciences and Technology, Khartoum, Sudan

Aim To assess radiographic and clinical outcome of root canal filling on molars on 2013, to assess and to compare radiographically and clinically the present periapical status with initials and to correlate the success of RCTs in relation to the type of coronal restorations.


Methodology cross-sectional among 166 molars treated on 2013 during final semester 10 (2012-2013) by undergraduate students from the university of Medical Sciences and Technology, Sudan. Length density and taperness were assessed radiographically for all the studied populations from X-rays data bases in the radiology department. Contact phone numbers were recruited from the records of the treated patients and they were called for checkup clinically and radiographically. Voluntary participation and free of charges were assured. After clinical and radiographic examination, the treatment outcome was classified as 'success' (healed/healing) or 'failure' (uncertain/unsatisfactory healing). Data were subjected to statistical analysis using Intra-examiner and inter-examiner agreements were checked with intra class correlation coefficient and Cohen's kappa. Comparison between non parametric variables by Chi square test with the level of statistical significant set at p value < 0.05 .

Results out of 166 treated molars, 29 patients responded and participated in the study. The overall radiographic quality of RCTs were found acceptable by 52.6%. Amalgam fillings as coronal restorations were done for almost half (51.7%) of the participants, composite only by 13.4%, artificial crown by 17.4%, while 20.7% of the molars presented without coronal restorations. Periapical status on X ray examination showed some variability with 37.4% demonstrating disappearance of radiolucency. Furthermore 82.8% (n=24) showed no tenderness on vertical percussion. Radiographically periapical status was not correlated to the length ($P=0.144$), density ($P=0.58$) or taperness ($P=0.40$). The type of coronal restoration was correlated to the periapical status ($P=0.04$). Pain on percussion was not correlated to periapical status ($P=0.30$).

Conclusions Quality of RC Fillings, types of coronal restoration were unable to predict success or failure of root canal treatment of 29 molars performed by undergraduate students on 2013 after 5 years follow up.



Case report or case series

GE133



Clinical Case of Treatment of a Tooth with Apical Periodontitis


Authors: Zh. Asyrbekova, D. Galieva, O. Khvorostenko, A. Baitokova, S. Vovk
Moscow State University of Medicine and Dentistry, Department of Carisology and Endodontics (Moscow, Russia)



Aim. To increase the effectiveness of endodontic treatment in teeth with odontogenic cyst.

Introduction.
Treatment of teeth with apical periodontitis is not a simple task for a dentist. The more implantology has been developing, the more teeth have been extracted year by year, as implant treatment, according to many, is more predictable. Despite treatment complexity and a long-term follow up period, preservation of such teeth is definitely of high priority for doctors as well as for patients.



Case presentation.
Patient D., 42 y.o., was referred to the university clinic with complaints of persistent pain and swelling in the left side of maxilla. In another clinic there had been an attempt of endodontic treatment (pulp cavity of tooth 2.2 was opened, chemo-mechanical treatment was performed, there was purulent exudate from the canals. After application of calcium hydroxide dressing the inflammation was got worse (there was an exacerbation of the inflammatory process and the patient addressed to the clinic again. X-ray revealed periapical bone tissue resorption, approximately 0.5x0.7 cm in diameter (Fig. 1).



(Fig. 1)

Diagnosis: Chronic apical periodontitis of tooth 2.2

Treatment: The 1st visit - chemomechanical treatment (ProtaperS1,S2,F1, then up to #45 (ISO), 5% NaOCl, 17% EDTA), temporary filling with calcium hydroxide paste for two weeks. The patient didn't complain of pain and swelling. The 2nd visit - chemo-mechanical treatment (NaOCl, 17% EDTA, 2% CHX, obturation with lateral condensation technique (sealer H26). Followups after 1 year (Fig. 2) and 2 years (Fig.3).



(Fig. 2) (Fig.3)

Discussion.
Endodontic treatment was succeeded to stabilize the process. Symptoms progressively vanished in the following 2 years.

Conclusion.
Following all steps of endodontic treatment, subsequent instrumentation and irrigation, calcium hydroxide paste application contribute to stabilization of the process and decrease of bone tissue lesion.

References.
Basrani B., Haapasalo M. Update on endodontic irrigating solutions. / Journal of Endodontics.-2012. Vol. 27. P.74-102.
Baumgartner J.C. Microbiologic aspects of endodontic infections // J. Calif. Dent. Assoc. - 2004. - Vol. 32. P. 459-468.
Behnen M., West L., Liewehr F., Buxton T., McPherson J. Antimicrobial Activity of Several Calcium Hydroxide Preparations in Root Canal Dentin // Journal of Endodontics.-2001.-Vol. 27.-P. 765-767.

Remineralization of early enamel caries lesions

K.JABRANE,S.DHOUM,M.JABRI

Department of odontology restorative endodontics, Faculty
of Dentistry, Hassan II University of Casablanca

Aim:

- Define the clinical management of early enamel caries lesions.

Introduction:

- Preventive concepts and treatments such as remineralization of early enamel lesions have been proposed to reduce the number of these lesions.

Case Presentation:

- 30-year-old woman suffering from early enamel caries lesions in the anterior sector (maxilla and mandible) (fig1), the diagnosis was post orthodontic white spot , the treatment was dental remineralization using fluorinated gel and trays (Fig2/ Fig3).



Fig 1



Fig 2



Fig 3

Discussion:

- The start of the carious process on the dental surface is often explained by a series of chemico-physical - phenomena involving a number of dissolution precipitation processes in which acids produced by the bacterial plaque induce demineralisation of calcified dental tissues following a drop of the medium pH.
- Diagnosis of initial carious lesions of the enamel is more or less difficult in function of the lesion location (anterior or posterior tooth, occlusal, cervical or approximal lesion).
- The challenge of clinicians is to achieve the best treatment of dental demineralization: this aim can be obtained with biomimetic biomaterials and innovative ways to carry them into the site of demineralization.
- The repair of early dental demineralization can be achieved by many methods , the most recent technique use peptides derived from milk caseins that associate with amorphous calcium phosphate (ACP).

Conclusion & Clinical Relevance:

- The carious process remains very complex because of its multiple etiological factors. This multifactorial aspect of caries involves management of the causes and effects of the disease.

References:

- Remineralization Strategies in Oral Hygiene: A Position Paper of Italian Society of Oral Hygiene Sciences-S.I.S.I.O. Working Group.Sanavia C, Tatullo M, Bassignani J, Cotellessa S, Fantozzi G, Acito G, Iommiello A, Chiavistelli L, Iommiello A, Sabatini S, Nardi GM. Open Dent J. 2017 Oct 24.



SELECTIVE DIAGNOSE OF UPPER SECOND PREMOLAR WITH VERTUCCI TYPE V (CBCT EVALUATION) AND ITS MANAGEMENT ; A CASE REPORT



Dewi Isroyati Sugiana¹, Kamizar²

^{*1,2} Conservative Department, Dentistry Faculty, Universitas Indonesia

Aim

Identifying vertucci type V on upper second premolar with cone beam computer tomography (CBCT) so that the endodontic treatment could be done properly

Introduction

Missed canal is one of the main problem of the unsucces endodontic treatment. Upper second premolar has variation of root canal anatomy and need another examination besides conventional radiograph to know it. Using CBCT could get the good visualisation of root canal variation anatomy

Case Presentation

A 35-years-old women came to Universitas Indonesia Hospital with dull pain. After examination the diagnose of this case is Symtomatic apical periodontitis. From the periapical radiograph, there is one root canal appeared. However, when initial file inserted to orifice, there was another canal in 1/3 mid root canal. We took CBCT to determine another canal.

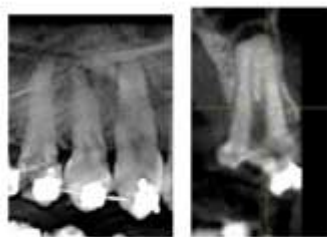


Figure 1

From the CBCT result, the canal separated into two canals in the middle of root canal and continously separated into two apical foramen, and it has vertucci type V variation anatomy. We continue the endodontic treatment using Protaper Next until X2. We used calcium hydroxide as endodontic medicament and obturation had been done with warm vertical compaction technique in the next week of treatment.

Discussion

Insidence of Vertuccy tipe V on Upper second premolar is 3%. Using CBCT, it could get the axial image so that the separated root canal could be seen and misslead canal could be prevent.



Figure 2

Conclusion & Clinical Relevance

The successfull of endodontic treatment could be get from elimination of all bacteria in all of root canal anatomy. From CBCT we could get the view of Vertucci type V and endodontic treatment could be done properly.

References

1. Almeida-Gomes, Fabio. Unusual Anatomy of Maxillary Second Premolar. European Journal of Dentistry, April 2009 Vol.3
2. Shrivastava, Nidhi. Endodontic Management of Maxillary Second Premolar; A Case report. Journal of Orofacial Science. January 2014

Outcome of Vital Pulp Therapy, Revascularization, and Apexification Procedures: A Retrospective Case Series

Amjad Al-Sulami, B.D.S, Waad Al-Harbi, B.D.S, Mey Al-Habib, B.D.S, CAGS, FRCD(C), DSCD
Department of Endodontics, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia

Aim

To report the outcome of vital pulp therapy, revascularization and apexification procedures treated in the endodontic department at King Abdulaziz University after at least a six month follow up period. A set of outcome criteria was established to describe clinical and radiographic success and failure.

Introduction

- ◆ **Vital pulp therapy** is a conservative endodontic treatment performed to encourage continued physiological development and formation of the root end in order to preserve the vitality and function of the coronal or remaining radicular pulp tissue in vital permanent teeth.
- ◆ **Revascularization** is a regenerative treatment that is biologically based to allow root maturation by continued deposition of dentin and a cementum like structure along the root walls.
- ◆ **Apexification** is a method to induce a calcified barrier in a root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp.

Case Presentation

- ◆ A total of 25 out of 34 necrotic immature teeth and vital teeth met the inclusion criteria. 35 vital roots were treated by vital pulp therapy, 8 necrotic immature roots were treated by revascularization and 7 necrotic immature roots were treated by apexification.
- ◆ Each case at follow-up was assigned to one of the following outcome criteria :
 1. **Complete healing:** The absence of clinical signs and symptoms, complete resolution of periradicular radiolucency, and an increase in the root dentin thickness/length and apical closure.
 2. **Incomplete healing:** The absence of clinical signs and symptoms, the periapical lesion completely healed without any signs of root maturation or thickening, the periapical lesion either reduced in size or unchanged with/without radiographic signs of increasing root dentin thickness/length, or apical closure.
 3. **Failure:** Persistent clinical signs and symptoms and/or increased size of the periradicular lesion.

Discussion

Sixty percent of the cases were healed completely, 28% presented with incomplete healing and 12% failed during the observation period and needed further treatment.

	Complete healing	Incomplete healing	Failure
Outcome Criteria	60%	28%	12%
Apical closure	84.6	13.5	1.9
Absence signs and symptoms	76.9	11.5	11.5
Healing of Radiolucency	71.2	26.9	1.9



Figure 1. Complete healing of vital pulp therapy procedure (MTA pulpotomy) of a lower left molar. Patient was asymptomatic 14 months after completing the treatment. (A) Preoperative radiograph. (B) Postoperative radiograph. (C) Follow-up radiograph at 2 months. (D) Follow-up radiograph at 14 months.



Figure 2. Complete healing of revascularization procedure of a lower right molar. Patient was asymptomatic 11 months after completing the treatment. (A) Preoperative radiograph (B) Follow-up radiograph at 2 months (C) Follow-up radiograph at 11 months.



Figure 3. Failure of revascularization procedure of a lower left molar. Patient was symptomatic with increased size of the periradicular lesion. (A) Preoperative radiograph (B) Postoperative radiograph (C) Follow-up radiograph at 9 months.

Conclusion & Clinical Relevance

- Within the limitation of this study, the outcome of vital pulp therapy, revascularization and apexification where in healing of periapical periodontitis, absence of signs and symptoms and maturation of roots occurs are fairly high.
- Studies with larger sample size and longer follow up periods are needed to evaluate the outcomes of vital pulp therapy, revascularization and apexification on a larger aspect.

References

1. Apsey/Brother, R. M., Traversetti, D. and Munksgaard, B. (2005) 'Apexification : a review', pp. 1-8.
2. Sulham, S., Kold, M. N. and Sævi, T. (2016) 'Outcome of Revascularization Procedure : A Retrospective Case Series', *Journal of Endodontics*. Elsevier Ltd, 42(12), pp. 1752-1758. doi: 10.1016/j.jend.2016.06.021.
3. Shilton, H., Keshik, M. and Sharma, R. (2015) 'Review Article Regenerative Endodontics — Creating new horizons', [November], pp. 1-10. doi: 10.1002/jbm.b.35587.
4. Jung, I., Lee, S. and Hwang, K. M. (2006) 'Biologically Based Treatment of Immature Permanent Tooth with Pulp Necrosis : A Case Series', 24(7). doi: 10.1018/j.jem.2006.01.023.





Endodontic treatment approach of a patient with dystrophic epidermolysis bullosa: a case report

Hancerliogullari D, Turkyilmaz A, Erdemir A
 Department of Endodontics, Faculty of Dentistry, Kırıkkale University



Aim: To notice the root canal treatment management of a case of a Dystrophic Epidermolysis Bullosa (DEB) which requires a special approach from the dental point of view.

Introduction: DEB is a rare genodermatosis characterized by skin and mucosal blistering after minimal trauma. Oral bullae, ulcers, erosions, oral pain, and gingival inflammation indices are the most common oral feature of DEB. Hypoplastic defects of enamel with hypomineralization may cause extensive caries, extraction of these teeth is one of the reason for oral and oesophageal tissue damage.

Case presentation: A 27 years old female patient with destructive effects such as; intensive hand disability (fig.1), cicatrization in the skin, lip tension (fig.2), shallow vestibular sulcus, extensive caries, gingival bleeding. Both electric and cold vitality pulp testing at maxillary right lateral incisor, mandibular left first and second premolar, maxiller left second premolar were negative. Because of microstomia rubber dam isolation was not operable. The access cavities were opened with pediatric size diamond burs. Isolation was performed by using lubricated cotton rolls with Vaseline®. Section tip leaned on tooth surface to avoid mucosal sloughing. For determining root canal working length electronic apex locator was used with size #15 K-file, 21 mm. K-files and H-files were used for mechanical instrumentation. Root canal irrigation applied slowly by using diluted sodium hypochlorite (2,5%) and EDTA (5%). The canals were dried with sterile paper points. Obturations of the root canals were performed with VDW2 seal paste® and gutta-percha using the cold lateral compaction technique. The access cavities were restored with Clearfil Majesty Esthetic® composite. Endodontic treatments were performed as short as possible and applied in 3 visits. Maxiller lateral's periapical X-ray was taken with the angle of occlusal film (fig.4), but could not get from mandibular premolars after the treatment because of shallow lingual sulcus. Six months follow-up evaluation revealed, all teeth are asymptomatic with healthy soft tissues (fig.6).




Fig.1

Fig.2



Fig.3




Fig.4

Fig.5



Fig.6

Discussion: Although limited mouth opening in DEB, endodontic treatment can be performed in all patient if practitioner can reach the tooth for an access cavity preparation. The patient who has severe microstomia, endodontic treatment might need to be modified such as vestibular access cavity for anterior teeth, use of pediatric size instruments and electronic apex locators.

Conclusion and Clinical Relevance: The hereditary blistering disorders may have a dramatic impact on the patient and their family, and severe economic consequences for their health services. Because of bullae, ulcers, mucosal sloughing after surgical extractions, limited mouth opening, limited posterior space couldn't be appropriate for implant rehabilitation or prosthesis so that preventive protocol is the most suitable approach of choice. Endodontic treatment should be the first choice with conservative approach for these patients. We can improve the quality of life by reducing oral and oesophageal tissue damage by preventing tooth extraction.

References: 1. Susanne M. Krämer et al. Oral Health Care for Patients with Epidermolysis Bullosa – Best Clinical Practice Guidelines

Use of cone beam computed tomography in the diagnosis, planning and nonsurgical endodontic treatment of type II Dens Invaginatus in a maxillary lateral incisor

Aim: To discuss the use of cone-beam computed tomography (CBCT) in the differential diagnosis of a case of type II dens invaginatus.

Introduction: Traditional radiographs has limitations in diagnosis and planning of teeth having complex anatomy.

Case presentation: This is a clinical report of a case of type II dens invagination in left maxillary lateral incisor. A 12-year-old female patient was referred to Dept. of conservative dentistry. She reported history of pain and swelling on left anterior maxilla. Due to the insufficient information from conventional radiography, cone-beam computed tomography (CBCT) was ordered. CBCT revealed large apical lucency and two separate canals with another invaginated canal. Conventional root canal treatment was done. The canals were obturated using iroot SP and single GP cone method. 3,6,12-month follow-up radiographies showed periapical repair and absence of symptoms.

Discussion: CBCT may aid the diagnosis, planning, treatment as well as follow-up of teeth with developmental anomaly.

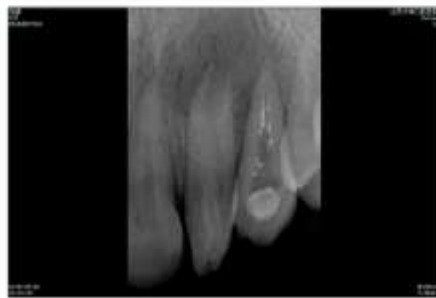


Fig.1



Fig.2



Fig.3



Fig.4

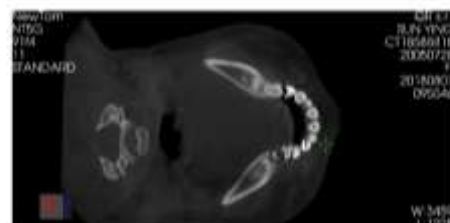


Fig.5

GE139

Case report or case series

Non-Surgical management of big apical lesion: 2 cases reports

*Lupu Sebastian LS

Department of Endodontics, Passionate Clinic, Iasi, Romania

Abstract

Periapical lesions of endodontic origin are caused by the imbalance between microbial factors and host's defenses at the interface between infected radicular pulp and periodontal ligament.

Periapical lesions are a controversial subject between the general practitioner who indicates in most cases surgical approach. Simply apply to judgment methods and rational decisions into endodontics show us that nonsurgical approach is a normal one. A surgical approach is recommended only after non-surgical techniques fail.

This 2 cases reports describe the non-surgical management of big apical lesion cyst-like on the mandibular frontal side without the obvious symptomatology diagnosed during the routine dental radiographic examination. The first case was decompressed by surgery drainage before come in our endodontic clinic. This fact has hampered further the healing and involved more visits. The second case is a similar case who was not decompressed surgical and the healing was faster. In this second case, all the teeth involved were treated in a single visit.

Indirect pulpal capping with Biodentine® of maxillary incisor coronary fracture: a case report

Nolas R^{1,2}, Paulo M¹, Cardoso M^{1,2}

¹Department of Endodontics – Universidade Católica Portuguesa, Vila Nova de Gaia, Portugal
²Department of Endodontics – Universidade Católica Portuguesa, Center for Interdisciplinary Research in Health (CIRH), Institute of Health Sciences – Vila Nova de Gaia, Portugal



AIM

To describe the use of Biodentine® in the indirect pulpal capping of a maxillary incisor coronary fracture.

INTRODUCTION

Dental trauma is considered by the World Health Organization as an obstacle to global public health, especially in anterior teeth, as it can be detrimental to function, self-esteem and personal success. Coronal fractures can be classified as complicated or uncomplicated, depending on whether or not there is pulp exposure. When the lesion involves only the enamel and dentine, an uncomplicated coronal fracture is defined, where bleeding of dental origin usually does not occur. This type of trauma is the most common, especially in central incisors (1,2,3).

CASE PRESENTATION

A 25-year-old male patient presented with history of recent trauma. Facial clinical examination revealed an upper lip laceration and an extended enamel-dentine tooth fracture without pulp exposure of the maxillary right and left central incisors. An indirect pulp capping with Biodentine and a composite provisional restoration was proposed. After the patient provided informed consent, anesthesia was performed and rubber dam was applied. A pink image could be seen in the center of the teeth, suggesting the pulp beneath. The teeth were restored with Biodentine in the center of fracture. Etching was performed only in the enamel and adhesive was applied at the entire surface. Provisional restoration was performed with composite. After 2 years, the tooth remained vital without radiographic anomalies.



Fig. 1 Initial rx Fig. 2 Coronary fracture (vestibular view) Fig. 3 Coronary fracture (palatal view) Fig. 4 Coronary fracture (incisal view) Fig. 5 Indirect pulp capping with Biodentine®



Fig. 6 Enamel etching Fig. 7 Adhesive application Fig. 8 Provisional restoration with composite

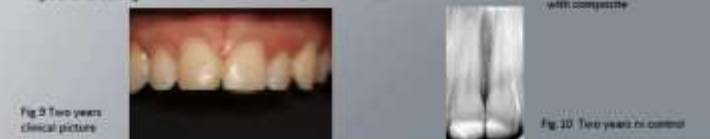


Fig. 9 Two years clinical picture Fig. 10 Two years rx control

DISCUSSION



As dental trauma is detrimental to the quality of life of patients and as their prevalence is high, the dentist should be meticulous and cautious in evaluating the damage of pulp and periodontal tissue. Biodentine® was used as a pulp capping material because of its property of inducing the formation of a dentin barrier (4,5).

CONCLUSION AND CLINICAL RELEVANCE

In this case a correct diagnosis and early treatment, increased the likelihood of maintaining pulp vitality, aesthetics and restoring function.

REFERENCES

1. Andreasen JO, Andreasen FM. Traumatismo Dentário. Serções Clínicas. São Paulo: Paranaense; 1995. 265 pg.
2. Andreasen JO, Andreasen FM, Bakland LK, Pines MT. Manual de Traumatismo Dental. Porto Alegre: Artes Médicas Sul; 2000. 90 pg.
3. Andreasen JO, Andreasen FM, Bakland LK, Pines MT. Manual de Traumatismo Dental. Porto Alegre: Artes Médicas Sul; 2000. 90 pg.
4. Andreasen JO, Andreasen FM, Bakland LK, Pines MT. Manual de Traumatismo Dental. Porto Alegre: Artes Médicas Sul; 2000. 90 pg.
5. Pines MT, et al. Guidelines for the management of dental traumatic injuries. A Journal of Pediatric Dentistry. Dental Traumatology. 2007; 23: 130-136 (JPM). Site of the International Association of Dental Traumatology. 2020.
6. Lacerda MS. Endodontia: tratamento canal radicular: princípios básicos e radiologia. 2 volumes em cadernos. São Paulo: Artes Médicas; 2000. Setembro de 2000. 240p.
7. Traumatismo Dentário. São Paulo: Artes Médicas - USP-APCD; 1996. 207 pg. <http://www.usp-dentist.org.br>
8. Mahamoudi Omer, Karampour Maryam and Karampour Feres. A review on Biodentine, a contemporary dentine replacement and repair material. Biomed Res Int. 2014; 2014.

MICROSURGICAL ENDODONTIC RETREATMENT IN RESOLUTION OF SEPARATED ENDODONTIC INSTRUMENT

Castano L.¹; Fernandes V.¹; Freitas V.¹; Moreira C.²; Sá A.³






¹ - Assistant of the Department of Conservative Dentistry - BCS-10204

INTRODUCTION






During the endodontic treatment, a fracture in instruments can occur in the root canal. A separated endodontic instrument hinders an efficient instrumentation and cleaning of the root canal system, thus having an impact on the final treatment result. In situations where bypass or removal using ultrasound becomes impossible to perform due to several factors, the option is to have it removed micro-surgically. In these cases literature tells us that mineral trioxide is the best material to use in this procedure. Nevertheless, surgical ultrasonic tips, dental operating microscopes, and biocompatible root end filling materials have contributed nowadays to a better outcome in endodontic surgery.

CASES PRESENTATIONS






Patient: 53 year old male
Diagnosis: Previously performed treatment with symptomatic apical periodontitis in 2.2.
Treatment Plan: Non surgical root canal retreatment. Attempted removal: Ultrasounds and IRS.
Irrigation: Hypochlorite 5.25% and EDTA 17%.
Performed treatment: Surgical root canal retreatment.
Obturation: MTA.

Patient: 41 year old female.
Diagnosis: Previously initiated therapy with symptomatic apical periodontitis in 1.2.
Treatment Plan: Non surgical root canal treatment. Attempted removal: Ultrasounds.
Irrigation: Hypochlorite 5.25% and EDTA 17%.
Performed treatment: Surgical root canal retreatment.
Obturation: MTA.

Patient: 68 year old female.
Diagnosis: Previously initiated therapy with symptomatic apical periodontitis in 1.2.
Treatment Plan: Non surgical root canal retreatment. Attempted removal: Ultrasounds and Stieglitz Roots Forceps.
Irrigation: Hypochlorite 5.25% and EDTA 17%.
Performed treatment: Surgical root canal retreatment.
Obturation: MTA.

DISCUSSION / CONCLUSION / CLINICAL RELEVANCE

In the cases presented, an attempt was made to remove fractured instruments, through various techniques, including the use of Stieglitz Roots Forceps, Ultrasounds and IRS. Due to factors such as apical curvatures, instruments attached to the apical constriction or instruments outside the root canal, where a non-surgical procedure was not viable, a surgical removal of the instruments was performed. After these procedures and correct apical sealing with MTA, a complete cure of the lesions was obtained and no signs or symptoms were observed.

We can assume that in cases of retreatment in which we are faced with fractured instruments and the compulsion and difficulty of this removal may lead us to consider resorting to surgical procedures. This tends have been shown to be effective in this type of cases.

REFERENCES

1. B. Küller. Microsurgical endodontic retreatment of a maxillary molar with a separated file: a case report. *Australian Dental Journal* 2011; 56: 76-81.
2. Ahmad A, Hader M, Dummer P. Management of Intracanal Separated Instruments. *JCE* – Volume 38, Number 5, May 2013.
3. Safheerthi SL, Steibel J, Devi L. Surgical Management of a Separated Endodontic Instrument using Second Generation Platelet Concentrate and Hydrargyric. *Journal of Clinical and Diagnostic Research*. 2017 Jun; Vol 11(6): 2001-2003.
4. Croom D, Manli C, Tami P. Periapical Microsurgery: A 4-dimensional Analysis of Healing Patterns. *JCE*. – 2018.
5. Wang Z, Zhang MM, Liang YH. Outcomes of Endodontic Microsurgery Using a Microscope and Mineral Trioxide Aggregate: A Prospective Cohort Study. *JCE*. – 2017.



ENDODONTIC RETREATMENT OF MAXILLARY CENTRAL INCISOR WITH INTERNAL RESORPTION: A CASE REPORT



Begüm CÖMERT*, Derya DENİZ SUNGUR*

*Hacettepe University Faculty of Dentistry, Department of Endodontics
Ankara, Turkey

Aim: The aim of this case report is treatment of a maxillary central incisor with internal root resorption (IRR) using tricalcium silicate based cement and gutta-percha.

Introduction: Tooth resorption is a common sequel which follows injuries or irritation to the periodontal ligament and/or tooth pulp. IRR are usually asymptomatic and they are discovered occasionally through periapical radiographs, which reveal very defined and regular outlines. CBCT is a detailed method for three dimensional examination of the lesion.

Case Presentation: An 18-year-old male patient was referred to Hacettepe University Faculty of Dentistry Department of Endodontics with a history of a dental trauma at 10 years old in maxillary right central incisor. The tooth had a great loss of coronal structure and was asymptomatic. An inadequate previous endodontic treatment but no periapical lesion was observed in the diagnostic radiograph (*Fig 1*). CBCT scan revealed an IRR without perforation in the middle third of the root (*Fig 2*). At first appointment, previous root canal filling was removed by hand files and chemomechanical instrumentation was performed up to size #45. Calcium hydroxide was placed for two weeks. At second appointment, the root canal was irrigated copiously with 2,5% sodium hypochlorite followed by %17 EDTA for 1 min and 5 mL of saline. After drying with paper points the apical third of root canal was obturated with #45 size gutta percha and excess materials was removed with a hot plugger, IRR area and the rest of the canal was filled with Biodentine (Septodont, St, Maur-des-Fosses, France) under operation microscope with 11X (Zeiss, Carl Zeiss, Germany) (*Fig 3*).



Fig 1: Diagnostic periapical radiograph



Fig 2: CBCT scans revealing the irregular canal form related to internal resorption.



Fig 3: Periapical radiograph after repair of the lesion with Biodentine and gutta-percha.

Discussion: Thermoplastized gutta-percha techniques or calcium silicate based cements are good alternatives for irregularities related to IRR. In this case a hybrid technique including single-cone for apical third and Biodentine for resorption area was successfully applied.

Conclusion: A combined obturation including gutta-percha and calcium silicate based cements provides an adequate and predictable obturation in cases with IRR.

References:

1. Yildiz F, Nallı T, İsmail A, Toffan R, Gupta S. Treatment of Internal Resorption With Mineral Trioxide Aggregate: A Case Report. *J Clin Diagn Res.* 2013 Oct; 7(10): 2400-2401.
2. Apolloni L, S. Mahesh LC, Calvetti RD, Verbeek RM. Biodentine™ material characteristics and clinical applications: a review of the literature. *Eur Arch Paediatr Dent.* 2014 Jun; 19(2):147-58.
3. Kizilkanal Eren S, Akceli H, Arslanbeyli Öm S, Serdar A, Kaya T, Çelik M, Çelik M. Obturation quality of calcium silicate-based cements placed with different techniques in teeth with perforating internal root resorption: a micro-computed tomographic study. *Clin Oral Investig.* 2019 Feb; 23(2): 505-513.



Endodontic Treatment of Teeth with Open Apices and Periapical Lesions: Two Case Reports

Esra İrem Yigit, Sevdâ Bilim, Cemre Güzel, Burhan Can Çanakçı.
Department of Endodontic, Trakya University, Edirne, Turkey

Aim

This case report aimed to present two successful root canal treatment with periapical lesions and open apices.

Introduction

Establishing an apical seal in root canals with open apices is challenging with traditional obturation techniques. Combination of Mineral Trioxide Aggregate (MTA) for apical plug and warm gutta-percha injection for coronal part is commonly chosen in such cases. These case reports describe the clinical and radiographic results of endodontic treatment of teeth with open apex using (MTA) as apical plug.

Case Presentation

Case 1

A 19-years-old female patient referred to our clinic with a complaint of a discoloration and esthetic problem of maxillary right central incisor. In clinical observation, large restoration and seconder caries was detected. The tooth was asymptomatic, not sensitive to percussion and palpation tests and gave negative respond to electric pulp test. Radiographical examination revealed that the development of the root had not yet been completed and periradicular lesion existed in teeth 11 (Fig. 1). Non-surgical root canal treatment was planned. Calcium hydroxide paste was used as intracanal medicament after chemo-mechanical preparation (Fig. 2). Root canal was obturated with MTA (Angelus Soluções Odontológicas, Londrina, Brazil) in apical third and gutta-percha with sealer (Adseal; Meta Biomed Co, Cheongju, Korea) using warm gutta-percha injection technique in coronal part (Fig. 3). The tooth was restored with composite resin. In 12 months follow-up, the tooth and periapical structures was clinically and radiographically healthy (Fig. 4).



Figure 1



Figure 2



Figure 3



Figure 4

Case 2

A 23-years-old male patient was referred our clinic for left maxillary lateral incisor with root canal treatment with no coronal restoration and root canal filling was associated with oral cavity. Intraoral examination revealed a sinus tract at the vestibul area. Radiographical examination revealed a periapical lesion (Fig. 5). Retreatment was performed (Fig. 6) and calcium hydroxide was used as intracanal medicament. Root canal was obturated with MTA (Angelus) in apical third and gutta-percha with sealer (Adseal) using warm gutta-percha injection technique (Fig. 7). After devital bleaching, the tooth was restored with composite resin. In 12 months follow-up, the tooth and periapical structures was clinically and radiographically healthy (Fig. 8).



Figure 5



Figure 6



Figure 7



Figure 8

Discussion

One of the important factor for the successful treatment of a tooth with open apex is disinfection of the root canal system and creating a synthetic apical barrier. Several materials and techniques were advised for this issue. Since its introduction by Torabinejad and Chivian (1), one of the goals of MTA was to create an apical plug: a hard barrier against which the root canal filling material can be condensed. Also MTA has a good sealing ability and biocompatibility (2). Several studies report healing of the periradicular tissues in the presence of MTA in such cases (3,4).

Conclusion & Clinical Relevance

Combination of MTA plug and warm gutta-percha injection techniques is effective in obturating the root canals with open apices.

References:

1. Torabinejad M, Hong C, Lee S, et al. Investigation of mineral trioxide aggregate for root-end filling in dogs. *J Endod.* 1995;21(12):605-8.
2. Moretton T, Brown C, Logan J, et al. Tissue reactions after subcutaneous and intraosseous implantation of mineral trioxide aggregate and ethoxybenzoic acid cement. *J Biomed Mater Res.* 2000;52:528-33.
3. Patil SA, Patil AA, Dodwad PK. Management of non-vital teeth with open apices using MTA as an apical plug: two case reports. *World J Dent.* 2011;2(1):45-8.
4. Root lengthening with apical closure in two maxillary immature permanent central incisors after placement of mineral trioxide aggregate (MTA) as an apical plug. Mesmoudi F, Bourmeche I, Sebati A, Baccouche Z, Mastouk F. *Eur Arch Paediatr Dent.* 2018 Feb;19(1):65-71. doi: 10.1007/s40368-017-0323-7. Epub 2018 Jan 15.



TREATMENT OF INTRAORAL-EXTRAORAL SINUS TRACT, two case reports



Gizem Ozdemir, Emel U. Ozyurek, M.Ozgur Uyanik

Hacettepe University Faculty of Dentistry Department of Endodontics

Aim: Our aim is to report the case of 2 different localized sinus tracts that cause chronic periapical tooth infection in our hospital recently.

Introduction: The extraoral sinus tract occurs at the end of an inflammatory process of the necrotic pulp tooth. Depending on the localization of the tooth forming the source can be intraoral or extraoral.

Case Presentation

Case 1: A 19 year old female patient was trauma 10 years ago, maxillary right central incisor tooth remained open apex. Therefore, apexification was performed with Biodentine. Pain and fistula path during treatment from the maxillary lateral incisor was formed. Retreatment to lateral tooth was made with apical plug with Biodentine (Septodont, USA). After the treatment, the fistula path was closed.



Case 2: A 43 years old female patient had a lesion under her chin. Mandibular right canin tooth was EPT negative. The canal treatment was completed. However, when the sinus tract was not closed at the 1st month, the root canal treatment was performed and the resection was decided. In this process, the patient applied leech therapy and resection was delayed as the fistula was recovered. Following the 5th month follow-up, the asymptomatic and fistula path was closed.



Discussion: It can be easily determined by the correct clinical and radiological examination for the dental origin of the sinus tract. This helps prevent unnecessary antibiotic therapy or surgical treatment of the infection. The effect of patient-administered leech therapy is currently unknown.

Conclusion: In cases, two different sinus tract consisting of odontogenic origin and odontogenic trauma is presented. In this case, improvement with canal treatment resulted in successful outcome.

References: Pasternak-Junior B¹, Teixeira CS, Silva-Sousa YF, Sousa-Neto MD. Diagnosis and treatment of odontogenic cutaneous sinus tracts of endodontic origin: three case studies. *International Endodontic Journal* 2009 Mar;42(3):271-6. doi: 10.1111/j.1365-2591.2008.01519.x.



Multi-rooted premolar, a case report



M.Özgür Uyanık, Gizem Özdemir

Hacettepe University Faculty of Dentistry, Department of Endodontics

Aim: In this case, three rooted and two rooted premolar teeth of the same patient will be treated.

Introduction: It is possible for the lower premolar teeth to be very rooted in the population, although they are rare. In radiological examination, it is important to carefully examine these channels and not to skip excess channels.

Case Presentation: A 27-year-old patient admitted to our clinic symptomatically on the right and left side. Pulpitis was diagnosed. In the radiological examination (Fig.1), left second premolar teeth had three roots and right second premolar teeth had 2 roots. Canal treatments were performed under local anesthesia and rubberdam isolation.



Left 2.premolar



Right 2.premolar



Discussion: With the advancement of endodontics, successful treatments of complex anatomy structures of root canals become more predictable. However, the fact that the treatment of teeth with complex anatomy is unique and needs more patience.

Conclusion: A good clinical-radiological examination and good illumination are a prerequisite for the success of endodontic treatments. In the presented case, the teeth are asymptomatic and they are still present in the mouth..

LARGE PERIAPICAL LESIONS, ENDO SURGICAL TREATMENT

Branka Mikica Sepic Matanovic, Marijana Molnar,
Boris Pazin, Albin Lumezi
Department of oral medicine, endodontics and
periodontology,
Dental clinic Zagreb, Zagreb, Croatia

Aim: large periapical lesions, endo or surgical treatment.

Introduction: Large periapical lesions still present as problems, we encounter in everyday practice. Initial root canal treatment is highly successful, appreciated by patients and cost-effective, but failures occur.

Should a tooth with large periapical lesion be endodontically treated, or treated by means of other mainly surgical methods, or be replaced by single-tooth implant? We present different cases, with different methods of treatment and outcome.

Case report 1:

Tooth 22, presented with a large periapical lesion and initial mobility. Initial endodontic therapy was done, symptoms disappeared, and stability was restored.



Case report 2:

Tooth 21 presented with large periapical lesion, initial endo therapy, was followed with surgical procedure, with good outcome.



Case report 3:

Tooth 12 presented with large periapical lesion and internal resorption. Endo surgical therapy was performed with a successful outcome.



Discussion: The first-line treatment option is initial nonsurgical treatment. Endodontic surgery should be considered before extraction and replacement by single-tooth implant.

Conclusion and clinical relevance: Comprehensive case assessments, evaluation of all endodontic options are necessary when choosing the optimal treatment for patient with large periapical lesions.

References:

Endodontics, Endodontic Retreatment, and Apical Surgery versus Tooth Extraction and Implant Placement: A Systematic Review; 43 Chercoles-Ruiz A, Sanchez-Torres A, Gay-Escoda, J Endod, 2017, May 43
Outcome of Endodontic Micro-resurgery: A Retrospective Study Based on Propensity Score-matched Survival Analysis. Kim D, Kim S, et al J Endod 2018.

Assessment of healing of periapical lesion after non-surgical root canal treatment

Fatma Kaplan*, Asiye Nur Dincer, Tugce Yuca Ozturk

Department of Endodontics, Bezmialem Vakif University, Faculty of Dentistry, Istanbul, Turkey

Aim: These case series presents, long-term clinical and radiographic success of nonsurgical endodontic treatment of two tooth associated with periradicular lesions

Introduction: Root canal treatment involves the removal of infective pulp, shaping, cleaning and decontamination with files and irrigating solutions, and obturation of the root canals.

Case Presentations

Case1: 10 years old male patient was referred to our clinic with swelling on the mandibular anterior region. The clinical and radiographic examination has been identified periapical lesion area into the root of the teeth 31,32,41 and 42. Teeth #41 gave negative response to electrical pulp test (EPT). Only tooth 41 starting root canal treatment. After application of calcium hydroxid, treatment completed and dental composite filling has been restored. Radiographic follow-up (1.year and 2.years) healing of the lesion was observed. Teeth number 41, 42 and 31 were determined to continue of vitality.

Case 2: 20 years old female patient was referred to our clinic with complaints of pain and swelling on the right mandibular region. The radiographic examination was detected radiolucent lesion, #46. Tooth 46 gave negative response to vitality test. Endodontic treatment initiated and calcium hydroxide placed to the canals. The canals were then filled and tooth was restored. The radiographic follow-up (6.month and 18.month).

Discussion: In this case series, the importance of long-term clinical and radiographic follow-up is indicated.

Conclusion & Clinical Relevance: In conclusion, the successful of root canal treatment are based on knowlwdgw of treatment procedure and accurate diagnosis.

References:

1. Goldman, Melvin, Lawrence B Goldman, Robert Cavaleri, John Bogis, and Peck Sun Lin. 1982. 'The efficacy of several endodontic irrigating solutions: a scanning electron microscopic study: part 2', *Journal of endodontics*, 8: 487-92.
2. Seltzer, Samuel, and IB Bender. 1965. 'Cognitive dissonance in endodontics', *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, 20: 505-16.

FRAGMENT REATTACHMENT OF FRACTURED INCISORS

S.DHOUM, J.DAKKAKI, R.SKALLI, M.JABRI

Department of restorative dentistry and endodontics, faculty of dentistry of Casablanca

Aim

to show, through two clinical cases, the pulpal response following a permanent traumatized permanent tooth: enamel-dentin fracture without pulpal involvement

Introduction

The pulp reactions of traumatized teeth have been the subject of many investigations, and have been for years nominal. The healing of the pulp is multifactorial and depends on what is done (intrinsic to the neurovascular bundle, pulpal immune potential) and severity and multiplicity of trauma, therapeutic management, bacterial contamination

Case presentation

20 years old female patient consulting after a dental trauma related to #11
The clinical and radiographic explorations didn't show any pulpal implication (Fig 1, 3 & 10)
The fragment of the injured tooth were brought (Fig 2) and the decision of the reattachment of the fragment were made (Fig 5, 6, 7 & 8).



1 week (fig 11), 3 months (fig 12) and 18 months Follow up (Fig 9 & 13) has showed no pulpal or peri-apical complications.

22 years old female patient consulting after a dental trauma related to #21
The clinical and radiographic explorations didn't show any pulpal implication (Fig b & c)
The fragment of the injured tooth were brought (Fig a) and the decision of the reattachment of the fragment were made (Fig d, e, f, g & h).



2 weeks follow up (fig i) showed severe pain related to the injured tooth and we proceeded to the endodontic treatment of the tooth, 24 months follow up (fig k) has showed no peri-apical complication.

Discussion

If the neurovascular bundle is intact or partially damaged and in case of bacterial infection, pulpal survival is possible. Within the pulp, regressive changes are nonetheless observable, notably with hyalinization and the deposition of diffuse and amorphous calcifications.

Canal obliteration, also known as PCO (pulp canal obliteration) or calcifying metaplasia, is a frequent consequence of trauma, autotransplantation or orthodontic treatment. It can be partial or total. In the retrospective study of Oginni et al on the exposed teeth of the canal obliterations, 56.9% of the traumatized teeth, on a partial obliteration and 43.1% a total obliteration. The etiology is currently unknown. Several hypotheses have been put forward. It could be related to an

alteration of the blood circulation caused by the uncontrolled formation of calcified tissue along the canal walls.

The pulp bleeding and blood clots were pathological mineralization zones. This must be considered as a response to severe damage to the vasculo-nervous bundle. According to Andreasen, this would be an uncontrollable response of the sympathetic nervous system in response to trauma, resulting in particular from the loss of inhibition of the parasympathetic nervous system. Finally, according to Torneck, pulp calcification would come from a simple stimulation of pre-existing odontoblasts increasing their secretion rate. Pulp necrosis can occur immediately when the trauma is responsible for the section of the vascular bundle without the possibility of pulpal revascularization.

References

1. Yilmaz Y., Zehir C., Eyuboğlu O., Belizir N. Evaluation of success in the reattachment of coronal fractures. *Dental Traumatology*. 2009;24(2):151-158.
2. J. De Munck, K. Van Landuyt, M. Peumans et al., "A critical review of the durability of adhesion to tooth tissue: methods and results," *Journal of Dental Research*, vol. 84, no. 2, pp. 118-132, 2005.
3. D. P. Lase, L. C. C. Vieira, E. Araujo, and G. C. Lopes, "Tooth fragment reattachment: the natural restoration," *Operative Dentistry*, vol. 37, no. 6, pp. 584-590, 2012.
4. Prevost A. F., Ghassan M., Mascini M., et al. Autogenous tooth fragment adhesive reattachment for a complicated crown root fracture: two interdisciplinary case reports. *Case Reports in Dentistry*. 2016;2016:7.
5. Ozel E., Karadag M. K., Soyman M., Bayraktar G. Two-year follow-up of fractured anterior teeth restored with direct composite resin: report of three cases. *Dental Traumatology*. 2008;24(5):589-592.

Periodontal trauma management : cases report.

EL ARROUF N., NECHAD S.

Conservatrice Dentistry and Endodontics Department , Dental Faculty, Mohammed 5 University at RABAT

Introduction


Les traumatismes dentaires constituent une urgence fréquente de notre pratique quotidienne. Un diagnostic précis de l'importance et de la sévérité du traumatisme, un suivi à long terme et une évaluation des possibles séquelles secondaires sont à la base d'une prise en charge adéquate.

Les réactions pulpaires externes sont des séquelles parodontales post-traumatiques fréquentes. Alors que la réaction de surface n'a aucune influence sur le pronostic de la dent atteinte, les réactions de remplacement et inflammatoires - si elles ne sont pas interceptées très rapidement - conduisent à la perte de la dent, notamment dans les cas d'extrusion et de luxation dentaire.

En s'appuyant sur des cas cliniques et la littérature, ce travail fera le point sur ces complications qui peuvent être évitées ou minimisées si le traitement d'urgence est correctement conduit et les soins réalisés au rythme adapté, en vue d'intercepter et de traiter précocement les complications avant qu'elles ne deviennent irréversibles.


Scénario clinique 1

Une patiente de 19 ans, consulte immédiatement après un traumatisme dentaire.




L'examen clinique met en évidence une luxation de la 11 et une fracture coronale de la 21. Le test au froid est négatif sur la 11.

A l'examen radiographique, le dent est associé à une luxation de la 11 et la partie apicale de l'axe est visible.



Le traitement immédiat consiste en un repositionnement optimal et une immobilisation (T) de la dent lésée.

Une immobilisation aux composites de la 22 est réalisée.




À 11 mois la sensibilité après 1 semaine.

Des séances de contrôle régulières (1, 2, 6 mois, 1, 2 ans) ne montrent aucune complication endodontique ou parodontale.

Scénario clinique 2


Un patient de 15 ans qui se présente 2 mois après un accident de la voie publique.



L'inspection clinique montre une extrusion de la 11 et la 31, une luxation latérale de la 21. Les tests de sensibilité pulpaires ne sont pas concluants pour les 11, 21 et 31. L'examen de l'occlusion dynamique montre une interférence entre la 21 et la 11 en RCM et en PRC et en position et des mobilités de degré 1 sur les mobilités sup. et inf.

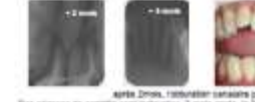
L'examen radiographique montre un élargissement parodontal de niveau apical de la 11 et une image radiopaque linéaire sur la 22.

On note également un élargissement parodontal du niveau apical de la 31 et une réaction apicale évidente.



Chez ce patient, on va réaliser la contention souple de la 11, uniquement dans le but de réduire la mobilité.

Avec respect de l'axe l'axe apical et la partie inférieure parodontale.




Après 2 mois, l'immobilisation souple par contention latérale de la gâche perdue suivie par l'ostéon de la 11 et de la 31.

Des séances de contrôle sont réalisées, à 6 mois, la 11 continue à répondre aux tests de sensibilité pulpaires, et l'examen radiographique montre l'absence de l'élargissement parodontal et aucune évolution de la réaction.

Scénario clinique 3

un patient de 18 ans se présente le lendemain d'une rixe, il rapporte l'extrusion des deux incisives centrales maxillaires (11 et 21) et un bled de réfraction immédiate (TEA = 5 mm).




L'inspection clinique montre une élévation gingivale au niveau de la 21, des incisives centrales maxillaires dans leurs axes.

Le test au froid est négatif sur la 11 et la 21. La position est normale et l'examen de l'occlusion ne montre aucune interférence entre les incisives sup. et inf.

L'examen radiographique montre des incisives maxillaires maxillaires dans leurs axes, avec un élargissement parodontal.

Aucune fracture radiopaque ou radiolucide n'est mise en évidence sur les deux incisives.




Le traitement chirurgical consiste à réaliser une contention souple coudée.

Une prescription est émise au patient.


(amoxicilline 2g) + arbutamine du patient + 4 can de bouche à la cholestérol, pendant 7 jours.

Chez ce patient la prévention est cruciale, et le développement des réactions pulpaires externes, et l'invasion bactérienne de la pulpe dentaire.



Un traitement endodontique est réalisé sur la 11 et la 21.

En passant par une période de révascularisation coronale à l'aide de la technique de l'oxyde de zinc (2 mois), pour prévenir les réactions inflammatoires externes. La contention est démontée après 10.




Deux mois après, une ostéon souple par contention latérale de la gâche perdue suivie par l'ostéon coronale de la 11 et de la 21. Des contrôles réguliers sont réalisés.

Durant cette période, la vitalité des dents adjacentes ainsi que les gingivales est vérifiée. C'est ainsi qu'à 12 mois on a mis en évidence la nécrose de la 21, qui a nécessité un traitement endodontique.


L'examen des dents remplacées montre un aspect physiologique et radiographiquement normale de toute complication avec guérison des incisives maxillaires. Les séances de contrôle doivent se continuer encore pour 3 ans.

Scénario clinique 4

Un patient de 10 ans se présente 48 H après un accident de la voie publique avec la 21 qu'il a pu récupérer et garder dans un mouchoir dans sa poche (TEA = 10 mm, milieu de conservation sec).




L'examen clinique met en évidence l'absence de la 21 et l'absence de toute autre lésion associée. La pulpe est restaurée et paramètre des lésions dentaires ne montre aucune fracture radiopaque associée. L'examen radiographique confirme la vitalité de l'incisive. Il met également en évidence une ancienne fracture radiopaque sur la 11 associée, probablement par la formation d'une cassure. La courbe coronale confirme l'absence de la fracture avérée. L'extrusion révèle un écart traumatique à l'âge de 11 ans.



Il s'agit d'une extrusion dentaire avec un temps extra-oral de 48 H.

Les incisives du ligament parodontal sont endommagées, et il y a une lésion à réparer. Le traitement endodontique peut se faire avec un traitement de l'urgence, à des traitements de l'urgence, à des traitements de l'urgence, à des traitements de l'urgence.


Par la suite, la dent est immédiatement restaurée des incisives maxillaires, puis remplacée dans une solution de doxycycline à 20 mg pendant 20 min, puis la dent est insérée avec du sérum physiologique pendant 20 min pour être réimplantée.



Une contention est réalisée en utilisant la dent remplacée en denture et en utilisant une aggrégation.

Pour cela le patient doit se soumettre à un traitement endodontique. Un examen radiographique nous permet de le vérifier sur la suite.

La doxycycline par voie systémique n'est la méthode de choix à raison de 100 mg, 2 x pendant 7 jours, une hygiène bucco-dentaire rigoureuse est importante. Il est conseillé au patient d'éviter toute alimentation excessive de la dent remplacée les 1ers jours.



La contention est démontée après 8 semaines et des séances de contrôle régulières sont réalisées.

DISCUSSION

Un diagnostic précis et une prise en charge immédiate adéquate sont des facteurs essentiels au pronostic du traumatisme. Plus le laps de temps écoulé entre le choc et la consultation est minime, plus le repositionnement est facile (1).

Les conséquences parodontales sont surtout des réactions pulpaires. Elles peuvent être de surface (autodentaire) ou de type inflammatoire ou encore de remplacement (2).

L'aggrégation d'une réaction radiolucide, peut être interceptée par des contrôles fréquents et par une thérapie adéquate. Dès qu'elle est diagnostiquée, le traitement endodontique doit être mis en place. L'hydroxyde de calcium est une médication de choix, son pH de 12,4 permettant une action anti-bactérienne et capable de traverser la zone de nécrose (2,3).

En cas de luxation, si une revascularisation pulpaire semble possible au moment de l'accident, des examens de contrôle fréquents sont nécessaires (Cas clinique 1). Si une réaction pulpaire apparaît, il faut immédiatement entreprendre une thérapie endodontique avec révascularisation transitoire à l'hydroxyde de calcium (Cas clinique 2). Les recommandations varient d'un traitement court (7 à 10 jours), si le traitement endodontique est réalisé dans les 10 jours suivant le traitement d'urgence, à des traitements de l'urgence (3).

La dent permanente extrudée est toujours réimplantable tant que l'axe est accessible. Les meilleurs résultats sont obtenus lorsque le temps entre la luxation et la réimplantation est inférieur à 5 minutes (4). Une réimplantation retardée (> 5 min) diminue la probabilité de régénération du ligament (5). Dans le cas des réimplantations différées, un traitement de surface sur la racine à la doxycycline est couramment recommandé pour réduire la réaction inflammatoire, et limiter l'apparition de la réaction de remplacement (6).

Si l'axe de la dent est fermé, la réaction et l'infection pulpaire précoce induisent souvent une ankylose avec une réaction de remplacement ou une réaction radiolucide inflammatoire progressive. Ce processus peut être arrêté si la pulpe est retirée dans les 7 à 10 jours suivant la réimplantation (cas clinique 3). (7-9) Si le temps extra-oral de la dent excède 60 minutes, ou si elle a été conservée en milieu sec, les cellules ligamentaires sont détruites et le traitement endodontique doit alors être réalisé avant la réimplantation (cas clinique 4) (7-9).

Le choix d'une contention souple permet de maintenir la dent dans sa position physiologique sans jamais interférer sur la réparation ou permettre une hygiène rigoureuse. Sa durée est de 7 à 10 jours ; si l'axe est fracturé, elle est maintenue 6 semaines, 6 semaines pour une dent avulsée mobile plus de 2 heures en milieu sec, (10,11) Le nombre de micro-organismes peut de plus être réduit par une antibiothérapie systémique et par des rinçages buccaux désinfectants. (1)

La compréhension des dommages liés aux traumatismes dentaires et leurs conséquences, des phénomènes inflammatoires et une meilleure connaissance des bases biologiques de la réparation ont conduit à plus d'efficacité et de conservation dans les thérapies.

REFERENCES BIBLIOGRAPHIQUES

1. Andreasen JO, Andreasen PM, Andreasen L. Textbook and Color Atlas of Traumatic Injuries to the Teeth. (4th ed.). Oxford: Blackwell; 2007.
2. Trippa M. Root Resorption due to Dental Trauma. Endodontic Topics 2002; 1: 79-100.
3. Andreasen JO, Baroni MK, Jacobson LM, Andreasen PM. Regeneration of 400 avulsed permanent incisors. Part 4. Factors related to periodontal ligament healing. Endod Dent Traumatol 1989; 1: 36-50.
4. Vestreim DG, Santos CL, Sposito CK, Pini WM, Pancherz SR, Sunavold M, Hegre MR. Delayed reimplantation of rat teeth after use of recombinant powdered milk as a storage medium. Dent Traumatol. 2009 Feb; 25(1): 51-7.
5. Barnett SJ, Kery D, Tenenbaum HC, Sigal MJ, Johnson DH. Replantation of permanent incisors in children using Endobag. Dent Traumatol. 2005; 21: 265-75.
6. Cvek M, Cleaton-Jones P, Austin J, King M, Loeferle J, Fatt P. Effect of topical application of doxycycline on pulp revascularization and periodontal healing in replanted monkey incisors. Endod Dent Traumatol 1990; 6: 170-176.
7. Hoshino SE, Maxwell LB. An evidence-based assessment of the clinical guidelines for replanted avulsed teeth. Part 1: Timing of pulp extirpation. Dent Traumatol. 2009; 25(1): 32-42.
8. Pohl T, Filippi A, Kinschler H. Results after replantation of avulsed permanent teeth. I. Endodontic considerations. Dent Traumatol. 2005 Apr; 21(2): 90-92.
9. Trippa M, Vellody C, Koren L, Moshelev J, Friedman S. Effect of different endodontic treatment protocols on periodontal repair and root resorption of replanted dog teeth. J Endod 1992; 18(13): 482-4.
10. Capogoglio D, Ronchin M, Cappa D. Splinting technique for traumatic luxation of anterior permanent teeth. Br J Oral Maxillofac Surg. 1990 Jul-Sep; 33(2): 11-16.
11. Van Am T, Filippi A, Buser D. Splinting of traumatized teeth with a new device. J Dent Traumatol. 2001 Aug; 17(4): 195-4.

Other

GE150

The incidence of root canal instrumentation with different rotary and hand files on apical cracks formation: an in vitro study

*Khromova LA Mitronon AV Vedmitskaya VV Sukhikh MO

Department of Cariesology and Endodontics, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russian Federation

Aim To conduct a comparative analysis of most commonly used among practitioners rotary and hand files for root canal instrumentation. To determine the causes of an apical crack formation.

Methodology 80 recently extracted teeth with one root were used in the research. Teeth with incompletely formed tips, caries, developmental anomalies, calcified and resorpted canals were excluded from the study. Teeth were stored in distilled water. They were divided into four groups. The teeth from the first group were instrumented with ProTaper Universal (Dentsply Maillefer) files, from the second group - with Mtwo (VDW dental), preparation of the teeth from the third group was performed by ProTaper Next (Dentsply Maillefer) instruments, and the teeth from the fourth group were instrumented with hand ProTaper files (Dentsply Maillefer). The apical part of the roots of all teeth was stained with methylene blue and studied under a digital microscope. Electron microscopy was also performed.

Results No cracks were observed after root canal instrumentation with ProTaper hand files (Dentsply Maillefer). As it can be seen on images made by digital and electronic microscopy, root canal instrumentation with rotary nickel-titanium files caused apical cracks formation. The probability and frequency of cracks occurrence depended on several factors, such as the cross-sectional shape of the instruments, their cutting ability, the effect of twisting, their flexibility, torsional resistance and cyclic fatigue, as well as the anatomical structure of the root canal: its width and length, curvature and apical opening position. The probability of the development of apical cracks during instrumentation

with selected rotary files on average was 30% higher than during the instrumentation with hand files.

Conclusions Nowadays, rotary files for root canal instrumentation are very popular due to their good cutting ability, flexibility and less time spend for the preparation compared with hand instruments. However, despite all the benefits, root canal treatment with rotary instruments can lead to the development of apical cracks formation, which can be a reason of a root fracture in the future.

GE151

Cone-beam computed tomography for diagnosis and treatment of endodontal-periodontal lesions

*Rotova AA, Mitronin AV, Aparina EA, Solopova AR

Department of Cariesology and Endodontics, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russian Federation

Aim Determination of the most accurate method of diagnosis in the endodontic treatment of molars and premolars of the upper jaw, the study of types and frequency of medical errors leading to the development of odontogenic sinusitis after endodontic treatment.

Methodology The analysis of 85 CBCT, orthopantomograms and intraoral radiographs was carried out. The patient complained of soreness of the tooth 1.6. when biting. The tooth previously endodontically treated. The CBCT shows heterogeneity of the root canal contents, MB-2 is not sealed, in the maxillary sinus on the right there is blackout with clear contours of 1.5 x 2 cm in size, communicating with the medial-buccal root. Treatment: canal filling, mechanical and medical treatment of MB-2. The channels were sealed with Calasept for a period of 1 week, then repeated mechanical and medical treatment and Metapex sealing for a month, then the channels were sealed with lateral condensation with AH+ and restored with a ceramic tab. On the CBCT after 6 months, there is a decrease in the size of the blackout in the maxillary sinus to 1x0.5 cm.

Results The most accurate method of diagnosis in the endodontic treatment of molars and premolars of the upper jaw is cone-beam computed tomography. Based on the results, it was found that 19.6% of the upper jaw molars and premolars subjected to endodontic treatment have errors in instrumental treatment and root canal obturation, which in most cases is due to the lack or lack of information about the anatomical and morphological features of their structure. Low-quality instrumental treatment of root canals of teeth was noted in 58.9%, incomplete and non-uniform root canal obturation-in 53.6%, insufficient depth of obturation - in 45.3%, removal of filling material behind the top – 12.7%, root perforation-in 7.6% of cases.

Conclusions The using of CBCT in clinical practice provides the most accurate diagnosis in the endodontic treatment of molars and premolars of the upper jaw, which reduces the probability of occurrence of odontogenic sinusitis.

GE152

The impact of cone beam computed tomography in the diagnosis of complex endodontic cases

*Alsereidi H, Sam Al-Salehi SK

Department of Endodontisc, HMBCDM, MBRU, Dubai, United Arab Emirates

Aim To assess the impact of CBCT upon diagnosis as part of endodontic management of posterior teeth. The null hypothesis that CBCT does not make a difference in endodontic diagnosis was tested.

Methodology The sample consisted of five patients referred to a specialist Endodontic unit in a teaching hospital. Three of these were complex retreatment cases one of which was also associated with sinus problems, a hyperplastic resorption case and a complex diagnostic case. This work was initially piloted by recruiting ten Endodontic specialists before doubling the number of assessors to twenty. A full clinical history, a colour photographic intraoral image, two periapical radiographs as well as limited volume CBCT examination were carried out for each patient. All these components, except the CBCT dataset, were combined into a Powerpoint presentation. Additionally, a questionnaire was

also designed for the 20 assessors. The case scenarios, for the 5 patients, were examined by each assessor individually on two dates three months apart. On one date, all the information including CBCT images was given to each assessor but, on the other date, the CBCT images were withheld.

Results The initial provisional diagnosis and that after 3 months were in close agreement with each other, as confirmed by Kappa values. Wilcoxon Signed Rank Test was used for data analysis. For final diagnosis, thirteen of the assessors changed their diagnosis in the resorption case with the availability of CBCT. There was also a significant improvement in their confidence level ($p=0.001$). The corresponding figures for the complex diagnostic case were 70% and $p=0.001$. For the retreatment case with associated sinus problems the figures were 60% and $p=0.001$. However, for the other two retreatment cases a smaller proportion of assessors changed their minds and the improvement in their confidence level was only statistically significant in one of the two cases. Similar trends were also recorded for helpfulness of the images in making a diagnosis and this was statistically significant ($p<0.05$).

Conclusions Clearly, the availability of CBCT images significantly increases clinician's confidence in reaching a final diagnosis. Radiographic reporting on CBCT images by Maxillofacial Radiologists in secondary referral centres is important as some clinicians could, on occasions, miss important pathology

GE153

Endodontic shaping of primary teeth: a systematic review of the literature

*Ajdidi I¹, Marty M², Vergnes JN³, Diemer F¹

Departments of ¹Endodontics, ²Paediatric Dentistry Department, ³Public Health and Epidemiology Department, Toulouse University, Toulouse, France

Aim The use of rotary instrumentation has become widespread in recent years. There is a large bibliography on the subject but this one depletes considerably when it comes to deciduous teeth.

The aim of this study is to compile systematically all the articles about the endodontic shaping of primary teeth using a key words research.

Methodology A systematically key words research was done on pubmed, database and google scholar in 2017. 86 articles corresponded to our informatic research criteria. After analysis and exclusion, 49 articles were selected. We obtained 36 ex-vivo studies, 2 in-vivo clinical studies, 7 randomized controlled trials and 4 case reports or case series. No study was excluded under the criteria of quality. The articles obtained have too many protocols' variability to make possible to study the results in a quantitative way.

Results Afterwards, we compared the results in a non-quantitative way in every field of interest with the aim of revealing a tendency favorable for a specific endodontic system. These articles reviewed cleaning efficacy, instrumentation time, shaping quality, shaping incidents, bacteria removal, success rate and post-operative pain.

Conclusions The few numbers of articles available and the protocols' variability encourage us to discuss the validity of the results obtained. Anyway, we can confirm that the different endodontic systems reviewed are able to treat primary teeth with a significant time saving when a rotary instrumentation is employed.



DIFFERENT TREATMENT PROTOCOLS IN IMMATURE TEETH:

Two Case Reports

Sıla Nur USTA, Ayhan EYMIRLI

Department of Endodontics, Faculty of Dentistry, Hacettepe University
Ankara, TURKEY

AIM: The aim of this poster is to demonstrate the applicability of apexification and revascularization treatment as two accepted treatment protocols in immature teeth with Biodentine.

INTRODUCTION: Apexification treatment is the most widely used treatment method in immature teeth. Due to the fact that it has some disadvantages, regenerative treatment which is a new approach, can be used as an alternative in appropriate cases. Unlike apexification therapy, regenerative endodontic treatments provide revascularization of the pulp and continuation of root development.

CASE 1: 13 year-old boy referred to Department of Endodontics complained to pain of maxillary central incisor that had been previously applied the endodontic therapy.

CASE 2: 14 year-old girl referred to Department of Endodontics for a routine dental care.



After radiographic examination, radiolucency was observed at central and lateral incisors' apex both. Central incisor had an open apex.

After radiographic examination, a large size radiolucent area was seen at maxillary lateral incisors apex and tooth didn't complete the root development.



Biodentine as an apical plug was prepared and placed into the canal nearby 3 mm.



Canals were obturated with gutta-percha. Restorations were done with bonded composite.



Canal irrigated with 5.25 NaOCl (20ml) and saline respectively. Ca(OH)_2 placed into the canal.



Ca(OH)_2 removed and canal irrigated with 5.25 EDTA(20ml) and saline. Induction of apical bleeding and 3 mm Biodentine was placed over the blood clot.



8-MONTH FOLLOW-UP



DISCUSSION: The desirable clinical and radiographic results in these two case studies indicated that two treatment options can be applied depending on the suitability of the case. Despite the fact that case studies show successful results, it is recommended that long term follow-up has been continued.

CONCLUSION: The decrease in the radiolucent areas after 8 months of follow-up indicates that these two treatment protocols yield successful results.

REFERENCES: Hargreaves, K. M., Berman, L. H. (2016). Cohen's Pathways of the Pulp.

/ PLATINUM SPONSOR



/ GOLD SPONSORS



/ SILVER SPONSORS



/ BRONZE SPONSORS



EXHIBITORS

/ Acadental, Inc.
/ Alltion (Wuzhou) Co., Ltd
/ American Dental Systems GmbH
/ Aquarius Health & Wellness
/ B&L Biotech, Inc.
/ Bio Composants Médicaux
/ CJ-Optik GmbH & Co. KG
/ COXO Medical Instrument Co., Ltd
/ DEMED Dental Medizin Technik
/ DHM-dental BV
/ DRSK Group AB
/ ENDOSTAR
/ Forumtec
/ FragRemover GbR
/ Global Surgical
/ Innovative material and devices, Inc
/ J. MORITA EUROPE GMBH
/ JADENT GmbH
/ Karl Kaps GmbH & Co. KG
/ Kohdent Roland Kohler Medizintechnik GmbH & Co. KG
/ Komet Dental Gebr. Brasseler GmbH & Co. KG
/ Laschal
/ MANI, INC.

/ Maruchi
/ Medcem GmbH
/ Medident Italia
/ Meta Biomed Europe GmbH
/ NEOLIX SAS
/ ORODEKA SRL
/ P.P.H. CERKAMED WOJCIECH PAWŁOWSKI
/ Produits Dentaires SA
/ Quality Endodontic Distributors Limited (Q.E.D Ltd)
/ Quintessence Publishing Co. Ltd
/ S.C. Doctor Tools SRL
/ Sanctuary Health Sdn Bhd
/ Sendoline AB
/ SHENZHEN SUPERLINE TECHNOLOGY CO., LTD.
/ SHENZHEN PERFECT MEDICAL INSTRUMENTS CO., LTD
/ SICAT GmbH & Co. KG
/ SS White Dental
/ Stoma / Storz am Mark
/ Swiss Endo Academy
/ Tri Hawk S.A.
/ United Dental Changzhou
/ VELA-Medical
/ ZEISS
/ Zumax Medical Co.,Ltd.