General Endodontic Abstracts

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### General Endodontic Posters

#### General Endodontic posters 13:30–14:30 Grand Hall 1

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GE1

Evaluation of the ability of panoramic radiographs to detect the relationship between the root apex and the maxillary sinus using cone-beam computed tomography imaging

*Kalyoncuoğlu E¹, Keskin C¹, Güler DH¹, Acar L²
Departments of ¹Endodontics, ²Maxillofacial Surgery, Ondokuz Mayıs University, Samsun, Turkey

Aim Given the limitations of the panoramic radiography for assessing topographic relationship of the apices of maxillary teeth with sinus floor, the purpose of this study was to assess reliability of panoramic radiography to predict the relationship between root apices and the inferior border of the maxillary sinus using cone-beam computed tomography (CBCT) images.

Methodology Matching panoramic radiographs and CBCT images from 34 subjects were analysed. The analysis included 240 maxillary teeth, which was classified according to their relationship to the maxillary sinus floor on panoramic radiographs and CBCT images by three independent observers using the criteria described by Shahbazian et al. Agreements between the two imaging techniques were examined statistically.

Results The agreement between panoramic radiography and CBCT to assess the relationship between the root apices of premolar teeth and maxillary sinus was 84.49%, while the corresponding values for the apices of the first molar and second molar teeth were 63.94% and 58.74% respectively. The root apices of maxillary teeth that were distinctly separated from the sinus floor showed the same type 1 classification in 100% of the cases using both of the techniques. The corresponding percentage for such roots showing type 2, 3 and 4 relationships significantly lower (P<0.05).

Conclusions A high level of agreement was observed when roots are below the maxillary sinus floor. The results of the study suggest that CBCT is a useful tool for the accurate diagnosis of the roots showing close contact with or projecting into the maxillary sinus.

GE2

Evaluation of the relationship between the maxillary sinus floor and the root apices of maxillary premolar and molar teeth using cone beam computed tomography

*Güler DH¹, Keskin C¹, Acar L², Kalyoncuoğlu E¹
Departments of ¹Endodontics, ²Maxillofacial Surgery, Ondokuz Mayıs University, Samsun, Turkey

Aim This study was conducted to assess the vertical relationship between the maxillary sinus floor and root apices of maxillary posterior teeth using CBCT.
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Methodology In this cross-sectional study, 40 CBCT images of the patients applied to Oral Radiology department of Ondokuz Mayis University were used. Two-hundred and eighty-three maxillary premolar and molar teeth were evaluated. The vertical relationship between the root apices of premolar and molar teeth and the maxillary sinus floor was evaluated according to the criteria established by Shahbazian et al. The mean distance of each roots to the sinus floor were calculated.

Results The shortest distances between maxillary sinus floor and the root apices were observed in the mesiobuccal root of the second molar (0.58 ± 1.16 mm) and the widest in the palatal roots of the first premolars (10.05 ± 8.04 mm). Significant differences were observed between the distance of maxillary sinus floor to the root apices of single-rooted first and second premolars. (P < 0.05). No significant differences were detected among the distances between the root apices of molars and maxillary sinus floor (P > 0.05).

Conclusions The roots of maxillary molar teeth showed greater proximity to the maxillary sinus floor. The clinician should be aware of the anatomical and morphological details of these roots.

GE3

The prevalence of maxillary premolars with a complex endodontic system in a private clinic, years 2014-2017

Rosu AO¹, Andrei CG², Pangica AM², *Manea S²

Departments of ¹Prosthodontics, ²Endodontics, Faculty Of Dental Medicine, University of Medicine and Pharmacy "Titu Maiorescu", Bucharest, Romania

Aim To present the anatomy of the upper and lower premolars. Even if they are presented in the literature to have mostly just one or two root canals, for a large percentage, the anatomy of the upper premolars is more complex.

Summary We all studied the Weine’s classification and the more complex, Vertucci’s classification of root canal morphology and there is no surprise if we find a different morphology that the expected one. The literature tells us that the majority of first upper premolars have a percentage of 85% for the two separated canals with two separated foramen, a 9% variety of premolars have just one root canal and a small percentage (6%) are 3 root canals premolar type. For the second premolar we have the percentage of 48% for the single root canal with one foramen, 27% for the typology of two root canals joining in one apical foramen, 24% for two root canals with two separated foramen and also a 1% typology with 3 root canals. In the everyday current practice every clinician deals with all sort of difficult cases and all of us have to be aware of the complexity of the endodontic system and also to treat and manage it by the method that suits best every case. The presentation shows you some particular cases of premolars and the treatment applied on each case. From almost 200 cases of
upper premolars, treated in our clinic in the past 2 years, 43 cases (more than 20%) were premolars with a complex endodontic system, premolars that we managed to treat by different techniques of preparation. As a conclusion, we can say that for this upper premolars which present a complex anatomy, with a careful approach and special technique, we can do an accurate root canal treatment.

**Key Learning Points**

- To make the clinicians aware of the various and complex anatomy of the upper and lower premolars considered in most of the cases by many dentists, easy to treat.
- To present more than one technique/approach in treating this complex upper premolars, performed by different clinicians.

**Imaging**

GE4

An evaluation of root canal anatomy and use of different diagnostic imaging modalities in root canal treatment of molar teeth

*Patel R, Mannocci F, Patel S*

*Endodontic Postgraduate Unit, King's College London, London, United Kingdom*

**Aim** To investigate the impact of periapical radiographs, cone beam computed tomography (CBCT) and a dedicated endodontic diagnostic software (3DEndo, DentsplySirona, Baillaigues, Switzerland) to assess root canal anatomy and the use of each modality for the practitioners completing treatment.

**Methodology** 60 patients requiring primary molar endodontic treatment were allocated randomly into three groups according to the diagnostic imaging modality the clinician had available to them: • Group 1 (n=20) conventional radiographs only, • Group 2 (n=20) conventional radiographs and CBCT, • Group 3 (n=20) conventional radiographs, CBCT and 3DEndo. Ethical approval was sought and gained for this study. Imaging modalities were used under optimal conditions prior to root canal treatment which was completed over two visits using a standardised protocol. Immediately after endodontic treatment a questionnaire was completed by the clinician to assess the usefulness of the imaging modality.

**Results** There were statistically significant (P<0.01) lower stress levels detected in group 3 (CBCT and 3DEndo), followed by group 2 (CBCT), and then group 1 (conventional radiography). For assessing root canal anatomy, including number of canals and provisional working lengths, there was a statistically significant (P<0.01) benefit with group 3, followed by group 2 and then group 1.
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The use of both CBCT alone, or in conjunction with 3DEndo improved the confidence of the clinician and were found to equally easy to use. 3DEndo software was found to be more desirable for use in endodontic treatment, enhanced radiographic interpretation and provided a level of 3D evaluation of anatomy which positively improved how radiographic interpretation was learnt in comparison to the other two modalities.

**Conclusions** 3DEndo software allowed for a better understanding and visualisation of complex root canal anatomy and improved radiographic interpretation compared to CBCT when carrying out molar endodontic treatment. Both CBCT and 3DEndo were found to be more helpful than radiographs alone for assessment and appreciation of root canal anatomy. Three dimensional imaging would be beneficial for assessment of molar teeth prior to root canal treatment.

GE5

**Comparison of 3-d reconstructions of micro-ct and cone-beam ct in the measurement of root canal volumes**

*Eren H¹, Eren I², Yilmaz F², Ocak M³

¹Department of Dentomaxillofacial Radiology, Faculty of Dentistry, Ankara University, ²Department of Endodontics, Faculty of Dentistry, Ankara University, ³Department of Anatomy, Hacettepe University, Faculty of Medicine, Basic Sciences Division, Ankara, Turkey

**Aim** The aim of this study is to evaluate and compare the volume measurement of 3D reconstruction images of lower first molar’s mesial root-canal produced by Micro-CT and CBCT devices.

**Summary** Canal preparation is one of the major factors in determining the success of root canal therapy. Several approaches have been used to assess the shaping ability of different NiTi rotary systems, including histological sections, plastic models, serial sectioning, scanning electron microscopy, radiographic comparisons, silicone impressions of instrumented canals, and micro-computed tomography The micro-Computed Tomography has been considered as the gold standard for laboratory studies in endodontics. However, using Micro-CT scanning in studies such as determining root-canal morphology or performance of instrumentation systems is very expensive and time consuming. Alternatively, Cone-beam CT (CBCT) has been used to evaluate root canal morphology or instrumentation performance of files or rotary systems. Instead, CBCT can be used in patients and in vivo studies despite its lower resolution due to the lower radiation level of exposure compared with Micro-CT. Also, CBCT is a fast and inexpensive scanning method. 27 first lower molars were used to evaluate the volumetric measurement of root canals. Periapical radiographs were taken to preliminary examination of root canals and mesial root canals were cutted to better scanning of Micro-CT and CBCT devices. 3D reconstructions of mesial root-canals produced by Micro-
CT and CBCT devices were compared volumetrically. Results showed that there was an acceptable consistency between volumetric measurements of images produced by Micro-CT and CBCT devices.

**Key Learning Points**

- CBCT can be used as an alternative imaging tool instead of Micro-CT to evaluate the root-canal morphology and volumetric changes.
- The most important factor in the volumetric measurement consistency of root canal is voxel size within 3D scanning devices.
- A threshold voxel size value must be defined to accurately measure the root canal volume to the nearest real volume size.

**GE6**

**Comparison of digital periapical radiography and cone-beam computed tomography in detecting Manual, ProTaper Rotary and Reciproc fractured files**

*Verner FS¹, Junqueira RB², Queiroz PM², Freitas DQ², Oliveira-Santos C³

¹Department of Dentistry, Federal University of Juiz de Fora - Campus GV, Governador Valadares, Brazil
²Department of Oral Diagnosis, Piracicaba Dental School - State University of Campinas, Piracicaba, Brazil
³Department of Stomatology, Ribeirão Preto Dental School - University of São Paulo, Ribeirão Preto, Brazil

**Aim** To evaluate the ability of digital periapical radiography (DPR) and cone-beam computed tomography (CBCT) to detect Manual, ProTaper Rotary and Reciproc fractured files in the presence and absence of root filling.

**Methodology** Thirty-one human molars (80 canals) were used. Root canals were randomly divided into the following groups: G1 - no fractured instruments and without root filling (WORF); G2 - no fractured instruments and with root filling (WRF); G3 - fractured conventional hand files (Flexofile #10, Dentsply Maillefer) and WORF; G4 - fractured conventional hand files and WRF; G5 - fractured Reciproc files (R25, Reciproc, VDW) and WORF; G6 - fractured Reciproc files and WRF; G7 - fractured ProTaper rotary files (ProTaper #F1, Dentsply Maillefer) and WORF; G8 - fractured ProTaper rotary files and WRF. DPR in ortho-, mesio-, and distoradial directions were performed in a direct system (SnapShot [Instrumentarium Imaging]). CBCT images were acquired in the OP300 scanner (Instrumentarium Imaging) with limited field of view (6 x 4 cm) and 0.085-mm voxel size. All images were assessed and reassessed by 4 observers for the presence or absence of fractured files on a 5-point scale. The sensitivity, specificity, and accuracy were calculated.

**Results** Low sensitivity values were observed for detection by CBCT in the presence of root filling and fractured files (G4: 0.20; G6: 0.27 and G8: 0.45) and for detection by DPR in the presence of root
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filling and fractured files (G4: 0.35). The accuracy of DPR was significant higher than CBCT in the presence of root filling and fractured files (G6: p<0.001 and G8: p=0.002).

Conclusions DPR should be the exam of choice when investigating Manual, ProTaper Rotary and Reciproc fractured files, irrespective of the presence of root filling.

GE7
Effects of moisture content of root canal dentine on detection of microcracks with micro-computed tomography

*Rödig T1, Müller C1, Hoch M1, Wiegand A1, Schulz X2, Lungova M1

1Department for Preventive Dentistry, Periodontology and Cariology, University Medical Center Goettingen, 2Centre for Statistics, University of Goettingen, Goettingen, Germany

Aim To evaluate the effect of moisture content of root canal dentine on detection of microcracks using micro-CT.

Methodology Roots with single canals were inspected by stereomicroscopy under 25x magnification to select ten specimens with and without craze lines or cracks (each n = 5). After standardization of root length, each specimen was scanned six times with different moisture conditions of root dentine using a micro-CT scanner (SkyScan 1272; Bruker-microCT, Kontich, Belgium) at high resolution (80 kV, 125 µA, 10.5 µm). Scanning conditions were as follows: 1. after 30 d wet storage, 2. after 2 h dry time, 3. after 48 h wet storage, 4. after 24 h dry time, 5. after 48 h wet storage, 6. after 2 h dry time. Between each scanning procedure, the roots were stored wet for 48 h. A total of 708 horizontal micro-CT images of the same root levels were blindly evaluated for the presence of dentinal microcracks twice by 5 calibrated observers at 4-week intervals. Statistical analysis was performed by using nonparametric analysis of variance (P = 0.05).

Results Intra-rater percentage agreement ranged between 92% and 98%, whereas inter-rater percentage agreement was 81% and 83%. There were no significant differences between all wet groups as well as between both groups with 2 h dry time (P > 0.05). Almost no cracks were observed after wet storage of the specimens with a significant increase of detectable cracks after 2 h dry time (P < 0.05). Significantly more microcracks were identified after 24 h dry time than after 2 h dry time (P < 0.05).

Conclusions Moisture content of root canal dentine influences the detection of microcracks. Micro-CT scanning should be performed on dried specimens to allow reliable identification of dentinal defects. Formation of new cracks during dry periods up to 24 h was disproved.
GE8

Evaluation of an ex vivo CBCT root canal segmentation for experimental endodontology

*Michetti J¹, Basarab A¹, Diemer F², Kouame D¹

¹Institut de Recherche Informatique de Toulouse, ²Institut Clément Ader, Toulouse, France

Aim To test on extracted teeth a segmentation procedure based on an adaptive local thresholding method, and to compare it with equivalent segmented microCT (µCT) data.

Summary Methodology Twelve intact freshly extracted teeth with closed apices were scanned with a CS 8100 3D® CBCT (75µm) and with a Micro-CT Quantum FX (40µm). First, an automated rigid registration and a resampling to 75µm in the axial plan was performed on the µCT data, in order to align the reconstructed slices on CBCT data. An automated segmentation procedure using an adaptive local thresholding method, was carried out on CBCT and µCT data. Furthermore, an apical closure and a root canal extraction were automatically performed on the binary volume of the teeth. The canal area and the Feret’s diameter were measured for all the radicular axial reconstructions.

The comparison of these measurements was done using the Pearson correlation analysis (r) and with the method of Bland and Altman. Results From the 2181 canal sections compared, a strong correlation coefficient was found between CBCT and µCT for both the area (r=0.99) and the diameter (r=0.97) estimation. Concerning the bias (CBCT-µCT), the means of differences were -14558µm² ±76412 for the area and -37µm ±124 for the diameter. Conclusions The comparison with µCT shows that CBCT endodontic segmentation using an adaptive local thresholding method appears to be an interesting root canal assessment tool due to its reproducibility (automated and adaptive according to the type of tooth), accuracy (a bias for the diameter of 1 to 3 CBCT pixels), and computational effectiveness (a few minutes for both acquisition and image processing). For a resolution of 75µm, this image processing technique might enable the use of CBCT not only for experimental endodontology but also for teaching the different steps of the root canal treatment.

Key Learning Points

• Our research validates the use of a 75µm-resolution CBCT with dedicated image processing CBCT for experimental endodontology

GE9

Clinical decision making of various specialists for endodontically challenging cases

*Oturgan O, Candaner Y, Basturk FB, Turkaydin D, Sazak Ovecoglu H, Gunday M

Department of Endodontics, Marmara University, Istanbul, Turkey
Aim To assess variations in treatment planning and decision making of different specialists for endodontically challenging cases.

Methodology A questionnaire was distributed to 50 dental specialists from Maxillofacial surgery, Endodontics, Periodontology, Prosthodontics and Oral Radiology. Each questionnaire included 5 different clinical scenarios presented with pre-operative periapical x-rays; 1. A 34-year-old woman was administered to the clinic with acute pain on her upper second molar. The diagnosis was acute irreversible pulpitis. 2. A periapical radiograph of a 26-year-old woman, with no symptoms, showed a periapical lesion on her upper central incisor. 3. A periapical lesion with an improper root canal treatment was detected on a 56-year-old man’s radiograph. He had pain on his lower first molar for a month. 4. A 14-year-old patient’s upper central incisor was avulsed and replanted after a traumatic injury 2 years prior to his administration to the university hospital. The radiograph showed an external resorption. 5. A 33-year-old woman’s x-ray revealed a lower first molar with an inadequate canal filling and two posts. A periapical lesion was also detected. The participants were asked to make a treatment plan for each case; RCT/ RCT combined with surgery/ extraction. Also, they were asked to rank the difficulty of each case and the difficulty of their decision-making. The treatments of all cases were completed in the university hospital with a 1 year follow-up.

Results There were significant differences in treatment planning amongst various specialists. Extraction was the most predominant choice of treatment for oral surgeons (44%) whereas root canal treatment was chosen by 80% of endodontists.

Conclusions Considering the fact that a root canal treatment was performed for all cases and that all teeth were functional without any symptoms at 1 year follow-ups, tooth-conserving should be a treatment of first choice. However, dental specialty status play an important role on the clinician’s decision-making.
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comprising 200 endodontists and 800 general dentists. Descriptive statistics were given as frequencies (n) and percent (%) using SPSS 21.0 (IBM-SPSS Inc, Chicago, IL) software.

Results The overall response rate was 82.5%. Rotary NiTi instruments were used by 81.5% of the entire respondents. The two main reasons for not using rotary NiTi were “time consuming” and “fracture concern”. Almost half of the respondents (43.6%) had attended to continuing education courses. Instrument fracture had been experienced by 70.2% of respondents, and the respondents stated the “root canal anatomy” and “over-usage” for two main reasons for NiTi fracture. Almost half of the respondents (49.8%) faced the instrument fractured in molar teeth. It is learned from the survey that the 25.8% of respondents obturate the root canals and follow up the patient when they faced with instrument fracture. Only 3.6% of respondents refer the patient to an endodontics for retrieval.

Conclusions The results indicated that high percent of dentist in Turkey use NiTi rotary instruments in root canal treatment. The dentists usually face with NiTi instrument fracture and they likely to obturate the canals that include fractured file and follow up the patient.

GE11

Survey on attitudes, materials, and methods preferred in endodontics practice by dentist in Turkey
*Tokkara C1, Özyürek T1, Özsezer Demiryürek E1, Bursalı T2, Özler M3

1Department of Endodontics, Ondokuz Mayıs University, Samsun, 2Artvin Health Care Center, Artvin, 3 Ağrı Doğubeyazıt Public Hospital, Ağrı, Turkey

Aim To obtain information about root canal treatment approaches, materials, and methods used by endodontists and general dentists in Turkey.

Methodology A questionnaire survey comprising 14 questions was developed by first creating questions. The final series of questions covered demographics, diagnosis and treatment planning issues, preference of type of irrigation solution, and preparation instruments. Questionnaires were directed to a group of 275 persons who were restricted by taking into consideration the distribution of the institutions they worked in Turkey. Descriptive statistics were given as frequencies (n) and percent (%) by using SPSS 21.0 software.

Results When the pre-operative vitality conditions of the teeth are taken as criteria for single-visit or multi-visit treatment planning, the proportion of physicians who performed single sessions in vital teeth was 73.1% while the rate of single sessions in devital teeth was 21.1%. 12% of participations do not use pre-operative radiography. The present also showed that 95.6% of the participants use sodium hypochlorite as an irrigation solution. 85.8% of the participants do not use any type of magnification device. 62.2% of respondents indicated that they performed root canal retreatment in
their practice. It was learned that 16.7% of the dentists prefer tooth extraction in cases where retreatment is necessary. However 20% of the responders prefer to refer the patient who needs retreatment to the endodontist.

**Conclusions** This survey shows the importance of establishing higher specialist training or continuing dental education for general dentists to update their knowledge.

**GE12**

**Treatment Planning for a Compromised tooth: Clinician’s point of view vs Patient’s**

*Fumei G, Re D, Taschieri S*

*Department of Biomedical, Surgical and Dental Sciences, Division of Oral Rehabilitation, Istituto Stomatologico Italiano, University of Milan, Milan, Italy*

**Aim** Summarize the different options for the treatment of a compromised tooth, pointing the clinician’s choice and the patient’s. A bibliographic analysis is intended to reveal which either clinicians or patients may deem most appropriate in a given clinical condition

**Summary** The treatment of a severely compromised tooth in daily practice puts the clinician and the patient in a very difficult situation on which the best choice might be. Scientific literature provides information on the prognosis of the most common approaches: endodontic or root canal therapy and crown positioning or tooth extraction, implant insertion and crown positioning. On such basis a rationale decision should be made. On the other hand the clinician processes them through his competences and expertise. Besides that, the patient, properly informed, is more involved in the decision making process and may find eligible a treatment on the basis of different parameters than the clinician’s. He/her can cooperate with the health professional in order to achieve the most satisfactory treatment decision creating a balance between the preferences of the former and the expertise of the latter. The Central position of the patients in the decision making introduces the evaluation of the Willingness to Pay for the specific treatment they have chosen.

**Apex locators/working length**

**GE13**

**Apex locator in the Dental practice treatment**

Zhekova AA, *Mitronin AV, Galieva DT, Ostanina DA*

*Cariology and Endodontology, Moscow State University of Medicine and Dentistry, Moscow, Russian Federation*

**Aim** Improvement of the effectiveness of endodontic treatment and determination of working length using different apex locators.
**Methodology** We have measured working length of 42 extracted teeth on medical indications (a periodontal disease, orthodontic treatment). All teeth were divided into 3 groups. In the I group for determination of working length we used NSK-IPEX apex locator. In the II group for determination of working length was used an apex locator of Dentsply Propex pixi. In the III group for determination of working length was used Morita apex locator. Have orginesed the hemomechanical processing of the root channel including hand, machine and ultrasonic instruments, with irrigation 3% of hypochlorite 40°C and greasing each instrument with EDTA gel. With nickel - titanium K-f files measured working length. Finally conducted the X-ray extracted teeth in a side projection. Also has been leaded questioning for studying of apex locator efficiency in endodontic practice.

**Results** By comparison the results of apex locator Nsk Ipex, 32 teeth (77%) the instrument was in the range of an apical constriction, and 10 teeth (23%) we observe instrument’s exit for an apical constriction We can confirm with a X-ray. In tooth 3.3. the instrument’s exit to 0,4 mm is observed., And tooth 3.1. - on 1,1 mm. By using Propex Pixi in 37 (89%) extracted teeth the instrument was in the range of an apical costriction, and in 5 (11%) teeth – went beyond the limits. In the tooth 2.1. – on 0,5 mm the instrument exit out, in the tooth 3.5 – on 1 mm. During the work with apex locator Morita is seen success 100% that proves to be true and X-ray too.

**Conclusions**
1. Have proved need of immersion of the file in the range of an apical constriction.
2. Reliable values have shown in statistics of an apex locator Morita - in 100% of cases, Dentsply – in 89% of cases, NSK – in 77% of cases. 3. Apex locator Morita with nickel - titanium dental rotary instruments showed high efficiency, responsibility and safety. 4. Statistics of apex locator confirm X-ray length. 5. Questioning has confirmed various opinions of determination working length of the root channel, using in an endodontic treatment.
CLINICAL ACCURACY OF ELECTRONIC APEX LOCATER IN TEETH WITH PERIAPICAL LESIONS

Gülşen Cansu Öztürk, Merve Çakın, Burak Ergüler
Department of Endodontics, and Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Yenimahalle University, Istanbul, Turkey

Aim
To evaluate in vivo the accuracy of an electronic apex locator (EAL) in determining the working length of teeth with periapical lesions during apex surgery.

Introduction
Determining the ideal working length of root canal treatment in teeth with periapical lesions can be challenging. The clinician can experience difficulties when locating the cervical-dental junction due to apical resorption and exudation. Besides reference to radiographic apex technique, EALs are commonly used in daily practice. Woodpeck I (Guilin Woodpecker Medical Instrument Co. Ltd., Guilin, China) is a multi-frequency based apex locator (1). The purpose of this study was to evaluate the accuracy of Woodpeck I and compare it to radiographically and visually established working length of mandibular incisor teeth with persistent intracanal exudate.

Methodology
A 57-year-old patient admitted to the clinic with intraoral swelling and pain due to a periapical lesion located around the apices of fewer central incisors (Image 1). Root canal treatment was commenced in order to resolve the symptoms. The root canal lengths were measured by advancing a size 10 hand file until the EAL screen showed 00 (Image 2, 3). Digital periapical radiographs were used to control the working lengths (Image 4, 5). Canals were instrumented using step-back technique under copious irrigation with sodium hypochlorite. Following repeated drainage sessions that carried out every 2-3 days for 3 weeks, an apical surgery was planned. Access to the apical region of the teeth was achieved by a semilunar incision and a full thickness flap. Size 30 K-files were introduced in the root canals until the tips became visible and then positioned at the most coronal level of the major foramen under 3x magnifying loupé (Image 6). The working lengths were measured using the same reference points. The working lengths measured using EAL and digital periapical radiography during the root canal treatments were in accordance with the lengths measured under direct vision during the apical surgery; 21 mm for the right and 22 mm for the left central incisor.

Discussion
Although radiographic working length determination is an easy and accustomed technique, it has some limitations due to the superpositions, difficulty of locating the precise apical constriction and insufficient resolution and magnification (2). Also, teeth with necrotic pulps and periapical lesions are usually present with inflammatory apical root resorption, resulting in altered or even absent apical constriction that is difficult to determine radiographically (3). Previous studies showed that EALs have high accuracy in teeth with periapical lesions, exudation and root resorption (4, 5). Woodpeck I was evaluated in one study and reported to be reliable in determining the working length (1). Similarly in this case the working lengths measured with Woodpeck I, digital periapical radiography and under direct vision during the apical surgery did not differ.

Conclusion: & Clinical Reference
Woodpeck I is able to determine the position of the major apical foramen with high accuracy. Within the limitations of this in vivo study, Woodpeck I can be considered reliable in working length determination of teeth with periapical lesions, and persistent intracanal exudate.

References
Effect of the simultaneous working length control during root canal preparation on postoperative pain

*Arslan H, Güven Y, Karataş E, Doğanay E

Department of Endodontics, Ataturk University, Erzurum, Turkey

Aim To evaluate the effect of simultaneous length control during root canal preparation on postoperative pain compared to separate working-length determination and root canal preparation. (Design: a parallel-group, randomised, controlled trial with two arms)

Methodology P = patients having a first or second molar tooth with preoperative pain or percussion (VAS > 50), I = simultaneous length control during root canal preparation, C = separate length determination and root canal preparation, O = postoperative pain. Forty-four molar teeth were randomly divided into two groups (n = 22): control group (separate length determination and root canal preparation) and simultaneous length control during root canal preparation. The following variables were recorded: age, gender, tooth number, preoperative pain on the VAS, pain level on the first, third, fifth, and seventh days, analgesic intake after the procedure, and initial/final percussion pain. The data were analysed with the chi-square test, independent samples t-test, and Mann-Whitney U test.

Results The group for simultaneous length control during root canal preparation resulted in lower postoperative pain levels on the first day than did the control group (P < 0.05). Despite two patients’ intake of postoperative analgesics in the control group, no patient needed to use postoperative analgesics in the group for simultaneous length control during root canal preparation (P > 0.05).

Conclusions It seems that simultaneous length control during root canal preparation as a non-pharmacologic strategy for reducing postoperative pain is a beneficial technique for preventing postoperative pain.

Evaluation of the accuracy of 3 electronic apex locators under 2 different circumstance

Çinar Firdevs, *Üstün Yakup

Department of Endodontics, Erciyes University, Faculty of Dentistry, Kayseri, Turkey

Aim The purpose of this in vivo study is to evaluate and compare the accuracy of 3 different electronic apex locators under different circumstances.

Methodology Twenty five human single-rooted teeth scheduled for extractions because of orthodontic or periodontal reasons were used in this study. Working length measurements were performed with the Root ZX mini, Raypex 5 and Propex Pixi electronic apex locators in the presence
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of pulp blood or remnants and 2.5 % sodium hypochlorite solution in the root canal space. After the teeth were extracted, a 8-K file was used to determine the reference working length, which was established at 0.5 mm short of the major foramen under a surgical microscope at 25 × magnification. Data were analysed using the Kolmogrov-Smirnov, Student T, Chi-squared tests. Significance was set at p<0.05.

Results There were statistical significant differences between the results of the mini Root ZX (96 %) and Raypex 5 (68 %) within ± 0.5 mm, and between the results of the Raypex 5 (68 %) and Propex Pixi (92 %), within ± 0.5 mm in presence of blood and pulp remnants. Also, there were statistical significant difference between the results of the mini Root ZX (92 %) and Raypex 5 (68 %) within ± 0.5 mm, in presence of sodium hypochlorite solution.

Conclusions In presence of blood – pulp remnants or NaOCl solution in the root canal space; the clinician should be more careful during root canal length measurement procedures with EALs.

Epidemiology

GE17

Association of the TNF polymorphism 308 G/A gene in patients with acute apical abscess

Menchaca-Tapia P1, Palafox-Sánchez CA1, Muñoz-Valle JF1, Salazar-Camarena DC1, Tello-Martínez GJ2

1Research Institute of Biomedical Sciences, 2Department of Endodontic Postgraduate Program, University of Guadalajara CUCS, Guadalajara, Mexico

Aim Indentify the genotype and allele frequency of the TNF polymorphism 308 G/A in patients with acute apical abscess and healthy controls. Identify of the TNF-α cytokine soluble levels in patients with acute apical abscess and healthy controls. Associate the TNF polymorphism 308 G/A in patients with acute apical abscess.

Methodology 31 patients with AAA diagnose without any previous medication for their condition as cases group, and 100 healthy patients as control group. Patients presenting either diabetes, hepatitsis, HIV+ or immunocompromised were not considered for the study. With a Vacutainer™ system 2 4.0 mL blood samples without anticoagulant and separating gel, and 2 4.0 mL with EDTA were obtained on each patient. The polymorphisms were evaluated with PCR technique with amplification and digestion. The TNF-α cytokine soluble levels were quantified in a MAGPIX system. Furthermore the cases group patients received root canal treatment in two appointments. In the control group X2 was used for the Hardy-Weinberg balance. The differences between the cases group and the control group were analysed with Students test (P<.05).

Results In the cases group the G allele frecuency was 95.2% and 4.8% for the allele A. In the control group the G allele frequency was 95% whereas the A allele was 5%. The genotypes frequency
between the groups did not show significant difference $x^2=0.0047$. P=0.9453. The allele data showed $x^2=0.0026$. P=0.9592. The TNF-α levels showed statistical difference $P=0.0007$. In the control group the mean was 9.03 + 5.16 ng/mL, for the AAA group was 84.62 + 179.89.

**Conclusions** The TNF gene polymorphism -308 G/A does not predisposes to acute apical abscess. Patients with acute apical abscess present higher TNF-α levels compared to healthy patients. TNF-α could work as biological marker of acute apical abscess.

GE18

**Prevalence and associated factors of root resorption in an endodontics clinic**

*Carvalho ES1, Pereira LIC1, Neves Fs1, Bittencourt MLF2, Mendonça GR1*

1*Dental Clinic, Federal University of Bahia, 2Private Practice, Bahia, Brazil*

**Aim** To evaluate the prevalence of root resorption and its correlated factors in patients aged between 10 and 78 years attended in the Federal University of Bahia.

**Methodology** It was accomplished a cross-sectional study with a representative sample of 120 teeth indicated for endodontic treatment and without history of orthodontic therapy. All patients were submitted to clinical and radiographic evaluation, and was detected the presence of root resorption, type of the resorption, etiology, presence of caries, dental trauma and periapical lesion. Also, some data of the patients were analyzed and collected: gender, age, resorption type and affected teeth.

**Results** Data were analyzed by chi-squared test, Fisher’s exact test, and multiple logistic regression ($P < 0.05$). It was found 53 teeth with root resorption and it was more frequent in females between 30 and 50 years-old. Also, the maxillary incisors were the most affected teeth with root resorption. Inflammatory root resorption was the most prevalent resorption type ($p=0.0013$) and the apical third was the most affected ($p=0.001$). With regard to the etiology, it was observed factors like dental trauma and caries.

**Conclusions** There was a high occurrence of external inflammatory root resorption in the apical third of the root. It’s necessary a large follow-up of these patients for preventing undesirable tooth loss.
Immediate reconstruction of tooth 12 after root canal treatment. A case report.

Kryszyna Pietrzycka, Halina Pawlicka, Katarzyna Olczak
Department of Endodontics, Medical University of Lodz, Poland

Aim: Description of the course of treatment of asymptomatic tooth 12 with immediate prosthodontic reconstruction.

Introduction: One of the conditions of successful root canal treatment is overall tightness of the apical and coronal parts of the root canal, which prevents bacterial leakage. Numerous scientific studies have shown that inadequate post preparation results in a root canal treatment failure. Reconstruction of the root crown can lead to the development of lesions in the periodontal tissues, or lack of healing of existing lesions.

Case report: A 34-year-old patient came to the dental practice to improve the aesthetics of tooth 12. Medical history was irrelevant. The tooth was pre-restored endodontically 10 years ago appeared to be asymptomatic. A photodocumentation and RVC of the root canal were taken (Fig. 1-3). An extensive filling on the palatal surface and the reconstruction of the labial surface with a composite material were observed. The radiograph showed the root canal filled correctly without lesions in periodontal tissues. A reconstruction of the tooth with a glass fiber post and a cast porcelain fused to metal crown was planned. After the access to the root canal in apicectomized condition, using a dental surgical microscope, it was found that the material in the coronal portion of the root canal was soft. It could be removed by using a probe (Fig. 3). In such a situation, it was decided to perform re-treatment of the root canal before prosthetic reconstruction. The material in the coronal portion of the root canal was removed with Gates-Glidden # 1.3 (DENTSPLY Maillefer) burs, while the rest of the root canal was removed with a Hedstrom file # 25 and the ultrasonic # 24. Fr mounted on the Endo-Chuck to. After determination of the working length using the apex locator, the canal was prepared mechanico-chemically with MTAfill instruments to the size 40 (vDW) (Fig. 4). During the preparation the following irrigants were used: 5.25% NaOCl solution activated by ultrasound, 15% EDTA to remove smear layer, and Hurricane Plus for final rinsing. A gutta-percha cone with a suitable taper was matched, the root canal was filled with gutta percha by a continuous wave condensation with SuperEndo (2) and SuperEndo B (B & L Biotech) and AH Plus sealer (DENTSPLY DeTrey) leaving a free space for a glass fiber post (Fig. 5). The root MRA was performed (Fig. 5). The root canal was prepared with a FibreOne Post Tapered 1.25mm but a FibreOne Tapered Post of a suitable size was cemented using the Build-I™ FR Core material (Pentro) (Fig. 6). Tooth 12 was prepared for a porcelain fused to metal crown. A double-stage impression was taken using Express STO Putty and Light Body (3M ESPE) mass. The tooth was secured with temporary crown made of Sturcut 2 EC (voco) material. On the next visit the PFM crown was cemented with Fuji Plus (GC) (Fig. 7). The follow-up visit showed a good state of periodontal tissue and satisfactory aesthetic reconstruction (Fig. 8).

Discussion: Numerous scientific studies have shown that the success of root canal treatment is affected by the state of periradicular tissues prior to the treatment, a homogeneous root canal filling extending to 2 mm within the radiographic apex and a satisfactory coronal restoration of the tooth [1-3]. In the case described by the author the last condition of the tight sealing of the tooth was not fulfilled, which caused the initial bacterial leakage in the crown portion. The clinical state was thus an indication for root canal re-treatment and immediate prosthodontic reconstruction of the tooth. Many researchers draw attention to the fact that a well-prepared, filled and asymptomatic tooth after root canal treatment should be secured as soon as possible with tight final reconstruction [4,5]. Such a procedure was carried out in the presented case.

Conclusions: Good quality permanent crown restoration after properly performed root canal treatment prevents the root canal system against bacterial leakage.

References:
Management of an Iatrogenic Root Perforation

Ece ALTINOVA HEPDURGUN, Ilgin AKÇAY

Ege University, School of Dentistry, Dept. of Endodontics, Izmir, Turkey

Aim: This case report summarizes the management of an iatrogenic perforation under the bucco-cervical region of the root surface.

Introduction: Canal treatment involves the removal of infective pulp, the subsequent shaping, clearing, and decontamination of the hollows with small files and irrigating solutions, and the obturation of the decontaminated canals. Filling of the canals is done with an inert filling such as gutta-percha. Today endodontic mishaps still occur despite the advancements in the field of instrumentation and materials during treatment. Iatrogenic perforation is a procedural accident that occurs during root canal treatment.

Case presentation: A 55-year-old female patient was referred to department of endodontics with a complaint of a sensibility on the buccal mucosa of right maxillary lateral incisor. Radiological examinations revealed a perforation in the middle-third of root canal and the presence of gutta-percha outside the root canal under the cementoenamel junction (Fig. 1). Gutta-percha was removed in one-piece after the access cavity preparation (Fig. 2). The root canal was negotiated, biomechanical preparation completed, calcium hydroxide paste was used as the intra canal medicament in between appointments and the root canal obturated. Following obturation the patient was scheduled for surgery. The perforation site was subsequently sealed using mineral trioxide aggregate (Fig. 3). The flap was then repositioned. Sutures removed after 10 days.

Discussion: The success of the treatment of an iatrogenic root perforation depends on meticulous diagnosis and expeditious multidisciplinary treatment.

Conclusions and Clinical Relevance: A 9-month follow-up revealed that patient was asymptomatic; tooth was functional and the periodontal probing depths were within normal limits (Fig. 4).

References: Gl Cons Yıldırım, Kerem Deli Treatment of lateral root perforation with MTA: a case report oral surgery, oral medicine, oral pathology, oral radiology and endodontology e55-e58 2006
MANAGEMENT OF IATROGENIC ROOT PERFORATIONS - CASE SERIES

AIM
This case series aims to present a nonsurgical approach to manage root perforations, located in the pulp chamber.

INTRODUCTION
Root perforation is a mechanical, iatrogenic, or pathologic communication between the root canal system and the external tooth surface. Iatrogenic perforations are reported to occur in approximately 2-15% of endodontically treated teeth.

Treatment options may vary according to several factors, mainly the location, size, and depth of the perforation. Treatment may include local anesthesia, removal of the necrotic tissue, and the use of antibiotics.

In this case series, all teeth were diagnosed with a perforation located within the pulp chamber and treated nonsurgically.

DISCUSSION
Iatrogenic perforation can occur during different steps of the endodontic treatment. At an early stage, during the access to the pulp chamber, while locating the canals, orifice, or at the time of obturation.

Conclusions & Clinical Relevance
The nonsurgical treatment option for root perforations localized in the pulp chamber is a favorable prognosis as shown in this case series.

REFERENCES
The aim of this study was to present a case report about a diagnosis and treatment in mandibular second molar with single root and single canal.

Introduction-A successful endodontic therapy depends upon complete knowledge of the anatomy and the variations present in the human dentition. The mandibular second molar contains two roots and three canals.

Case Presentation- A 26 years male patient reported to the Department of Endodontics and Dental Pathology with complain of sharp pain in right mandibular second molar for 5-6 months, whose medical history was non-contributory. In orthopamographic imaging (Owandy, France) revealed a deep restorative filling. The root canal morphology confirmed the presence of a single root with a linear canal, constricting towards the apex.

Initially 47 was treated. Access cavity opened after anaesthesia under rubber dam. Only a single round orifice was located in the middle portion of the floor of the pulp chamber. Working length was determined and cleaning and shaping completed by crown down method with this protocol of irrigation; NaOCl 2.5% (Sigma Aldrich-Germany), EDTA 17% (Chez Republic), and NaCl 0.9% (B-Braun, Germany). A snugly fitting master cone was selected. Obturation of the canal was done with warm gutta-percha – Thermafill (Dentsply, Australia).

Discussion. Anatomical variation such as fusion, germination, or anomalies in the roots may often be diagnosed based on preoperative radiographs. Conventional intraoral periapical radiographs are in important diagnostic tool in endodontics for assessing the root morphology and canal configuration. Our research partially corresponds with Fava et al., since he has encountered four second molars of both upper and lower jaws with single root and single canal, compared to our study where this feature was found only on the right mandibular second molar and bilateral maxillary second molar.

It is concluded that the diagnosing of these unusual cases is of high importance for successful endodontic treatment of these teeth.


MINERAL TRIOXIDE AGGREGATE AS APICAL PLUG IN TEETH WITH NECROTIC PULP AND IMMATURE APICES: A REPORT OF 3 CASES

Aim: To present short-term follow-up results in three cases with necrotic pulp and immature apices which were treated by a mineral trioxide aggregate (MTA) apical plug technique.

Introduction: In case of absence of natural apical constriction as a result of incomplete root development, conventional root canal filling technique is a challenge. One of the most reliable treatment approaches for these teeth is apexification procedure with MTA. MTA offers an artificial apical barrier that prevents overfillings and promotes to form hard tissue barrier. In comparison with calcium hydroxide that has been used as the material of choice for apexification for many years, MTA does not require multiple scheduled visits and weaken the root structure.

Case Presentation: The following three cases that had trauma histories at the age of 7-8 years of age, were referred to our clinic. In case 1, the diagnosis was chronic periapical periodontitis with an abscess associated with infected root canals. In clinical examination, fluctuant abscess on the labial mucosa was observed. In case 2 and case 3, the diagnosis was chronic periapical periodontitis. Radiographic examinations revealed radiolucent areas and immature teeth with open apices. At the first visit, for each case, access cavity was prepared and root canal lightly mechanically cleaned under irrigation with 2.5% NaOCl. Only for case 1, pus from the abscess was also drained through the root canal. The root canal was dried with paper points and dressed with calcium hydroxide for 2 weeks. In case 1, calcium hydroxide was refreshed every two weeks for twice until the patient was asymptomatic. But in the case 2 and 3, the patients were asymptomatic at the second visit. Calcium hydroxide dressings were removed by irrigation with 2.5% NaOCl and dried with paper points. Apical 3-4 mm portion of root canals were filled with MTA (MTA Angelus, Londrina, PR, Brazil), moist cotton pellets were placed into the root canals and access cavities were closed with temporary filling material. After 1 day, the remaining portion of the root canals were filled with gutta-percha by using lateral condensation technique.

Discussion: MTA apexification technique has been proposed as an alternative to calcium hydroxide apexification for treatment of immature necrotic teeth. Main advantages of this technique are reduction of treatment time, number of appointments and radiographs.

Conclusion: The present clinical cases confirm that MTA can be considered as an effective material to create an apical barrier. After 3 months follow-up, the cases were asymptomatic.

References:
Multidisciplinary approach in an apical resection case

Hatice Miray Uyan1, Demet Şahin2
1 Medipol University Hospital, Department of Endodontics, Istanbul, Turkey
2 Medipol University Hospital, Department of Periodontology, Istanbul, Turkey

Introduction
Apical resection is considered as the last treatment option to surgically maintain a tooth with a periapical lesion that cannot be preserved with conventional endodontic approaches. The aim of apical resection is to prevent bacterial leakage from the root-canal system into the periapical tissues by placing a tight root-end filling following root-end resection.

Case Description
11-year-old male patient applied to our endodontics clinics with swelling and pain complaints. The patient had no medical condition. Patient history revealed tooth trauma in the 2.1 region. Clinical and radiologic examinations revealed a large periapical lesion with some amount of periodontal involvement. Root-canal treatment procedures with apical surgery was chosen as the treatment plan (figure 1). Extirpation of the necrotic pulp was performed and Ca(OH)2 (Metapex) was placed (figure 2). Since patient had significant dental anxiety, all remaining dental procedures were planned to perform under general anesthesia. Root canal was prepared, disinfected (Wizard), irrigated and filled with MTA. Following root canal treatment, a sulcular incision was performed and a full-thickness flap was elevated. Granulation tissues were removed, and 1/3 apical of the root was resected. Bony defect was filled with allogenic particulated bone graft (MinerGss) and a collagen membrane (Mem-Lok) was placed. Primary closure was obtained. Healing was uneventful (figures 3-4).

Discussion/Conclusion
Multidisciplinary approach is often the key factor for success in challenging clinical situations. In case of large periodontal involvement, sulcular incision could be an option in the treatment plan even in the anterior esthetic area.

References
Multidisciplinary treatment approach to traumatized maxillary right incisors with severe lateral luxation: A case report

*Bayram ZC¹, Uyanik MO¹, Karaca C3, Nagas E¹

Departments of ¹Endodontics, ²Oral Maxillofacial Surgery, Hacettepe University Faculty of Dentistry, Ankara, Turkey

Aim To represent immediate treatment approach to severe lateral luxation.

Summary 16-year-old male patient was referred to Endodontics Clinic of Hacettepe University several hours after a dental trauma with a severe lateral luxation of maxillary right central and lateral incisors with a mild alveolar bone fracture. Under local anesthesia the teeth and alveolar bone reposed and splinted semi-rigidly and diagnosed radiographically. The next day, endodontic treatment initiated and calcium hydroxide placed to the canals. After 4 weeks, calcium hydroxide removed and root canal treatment completed. On the 12th week splint has removed. At the end of 19 months; the teeth were asymptomatic, functional, alveolar bone was healed and no root resorption, ankylosis or lesion was observed radiographically.

Key Learning Points

• In dental traumatic injuries, early intervention is one of the most important factor effecting the success of treatment. Also for the teeth with lateral luxation; repositioning and initiating root canal treatment as soon as possible, and physiologic splinting decrease the root resorption and ancylosis.
Orthograde retreatment after failed apical surgery using an MTA apical plug: Case report

Kui Pereira da Costa, Célia Marinho, Joana C. Martins, Sergio A. Quaresma, António Giraldo

Faculdade de Medicina Dentária, Universidade de Lisboa
Dpt. Endodontics

Aim
To present a successful case of an orthograde retreatment after failed apical surgery using an MTA apical plug.

Introduction
Previously treated teeth with persistent periapical lesions might be preserved with nonsurgical retreatment or endodontic surgery, assuming the tooth is restorable, predictably wound, and the patient intends to retain the tooth (1). Orthograde retreatment should always be considered first instead of surgical surgery (2), and although the success rates are high (3), it may be that a surgical approach is necessary. When this too is unsuccessful, a dental disease may arise. Acting as a conservative approach and considering the lower success rate of a second apical surgery (3), an orthograde retreatment presents as a viable treatment option in an attempt to preserve the tooth.

Case Presentation
A 25-year-old female patient was referred by a general practitioner after a diagnosis of chronic apical abscess on tooth 21. The patient presented a dental history of complex crown fracture, at age 12, which was treated by non-surgical endodontic treatment. Nine years later, at age 21, the patient developed an acute apical abscess indicating failure of the initial treatment. Subsequently, apical surgery was performed and seven years later, at age 28, a sinus tract was noticeable. At the time of this finding, the patient was asymptomatic. Radiographies, exams revealed periapical pathology, appearance of previous apical surgery without re-filling and the presence of a separated instrument.

Technique
Anesthesia was achieved and rubber dam placed after which orthograde retreatment was performed under radiographic control over three visits. After endodontic access, the removal of obstruction material with rotary instruments (i.e. access files, Dentsply Maillefer Gates) and working length determination with electronic apex locator (tree ZX J Morita, Japan) during the canal filling removed a separated fragment present in the canal was inadvertently pushed towards the apical region and then removed with Moler System. Irrigation was made with 2.5% NaOCl during the treatment. 10% citric acid and 3.25% NaOCl were used as final irrigation protocol.

Discussion
In contrast to the traditional apical surgery technique, contemporary apical surgery introduces a new armamentarium making the technique easier to perform safer and more predictable. His new armamentarium encompasses magnesium, ultrasonic tips and new biocompatible root-end filling materials, such as the MTA (4).

In case of apical surgery failure, the option of orthograde retreatment presented as a viable alternative to extraction of the tooth. According to the study by Mente et al. 2015 (5), 87% of the teeth that had already undergone primary treatment and subsequent coronal section before presenting posttreatment disease, were classified as successful after performing the orthograde retreatment with an MTA plug.

Conclusions and Clinical Relevance
In the presented case, orthograde retreatment with an MTA plug after a failed apical surgery showed a successful outcome after 10 years.

Orthograde retreatment after an unsuccessful apical surgery might be a viable option to consider as an alternative to a new surgical approach.

References
Regenerative endodontic procedures with biodentine in immature permanent teeth after a dental trauma: A case report
Garrido, Mauricio 1,2; Farias, Javier 2.
1. Assistant Professor, Department of Conservative Dentistry, Faculty of Dentistry, University of Chile
2. Endodontist, University of Chile

Aim: To discuss the clinical protocol in a case of dental trauma (DT) in immature permanent teeth (IPT) with apical lesions treated with Endodontic Regenerative Procedure (REPs).

Introduction: DT is a highly prevalent lesion in child and juvenile population over the world. REPs are an alternative to treat IPT with pulpal necrosis due to DT since it resolves the infectious condition and allows to continue the root development using the stem cells of the apical papilla (SCAP).

Case Presentation: A 10-year-old male patient referred with history of DT 2 years ago of teeth 1.1 and 2.1. Clinically, both teeth presented asymptomatic and crown fractures involving both enamel and dentin of the incisal edges. The sensitivity and percussion tests were negative. Radiographically, they were observed with incomplete root formation and periapical radiolucent areas (fig. 1). It was decided to perform Endodontic Regenerative Procedure (REPs) on both teeth in two sessions.

First session, canal disinfection took place with 2.5% hypochlorite and canal medication was left with calcium hydroxide (Ultracal®) and left double sealed. In the second session, canal medication was removed with 2.5% hypochlorite irrigation, canals were dried and the canal dentine etched with 15% EDTA Largil Ultra (Septodont, Saint-Maur-des-Fossés, France) for 2 minutes, for then proceeding the formation of the clot (fig. 2) and subsequent placement of Biodentine (Septodont, Saint-Maur-des-Fossés, France) until sealing the access cavity (fig. 3). The case was controlled at 6, 12 and 24 months. The patient was asymptomatic, the lesions were in regression and there was formation of dentinal bridge in the periapical zone of the root of teeth 1.1 and 1.2 (fig. 4).

Discussion: REPs are a new technique which is in constant study and development, changes are proposed in order to achieve successful results, focused mainly on disinfection but achieving the survival of SCAP and its subsequent differentiation. In order to preserve viability and to promote the differentiation of SCAPs we must used low RaOCl concentrations, the use of EDTA for the release of growth factors and medicating with hydroxyl of calcium between sessions.

Conclusions and Clinical relevance: For the case presented, a greater clinical and radiographic control is required in the long term, however the protocol used should be considered as a reproducible treatment option in cases of immature tooth with necrosis.

References:
REGENERATIVE ENDODONTIC THERAPY of A ROOT-FILLED INCISOR: 15 MONTH FOLLOW-UP

Gülcen Esentürk, Zafir C. Çehreli
Department of Paediatric Dentistry, Faculty of Dentistry, Hacettepe University, Ankara, TURKEY

Aim: This case report presents 15-month clinical and radiographic outcome of regenerative endodontic therapy in a previously root-filled, traumatized immature incisor.

Introduction: Apexification and apical plug backfilled with warm gutta-percha are endodontic procedures that are traditionally performed in the treatment of traumatized, non-vital immature permanent teeth. More recently, biologically-based treatment procedures such as revitalization has been proposed as an alternative treatment option to enable continuation of root maturation.

Case Presentation: A 10-year-old boy was referred to Paediatric Dentistry Department for management of spontaneous pain and retreatment of a maxillary central incisor that had experienced traumatic injury four months earlier. Radiographic examination revealed root canal filling of unacceptable quality along with post. The post was removed with ultrasonics and the root filling was removed with minimal debridement. Calcium hydroxide paste was placed into the canal after irrigation with 2.5% NaOCl. 3 weeks later, the calcium hydroxide was removed with copious saline irrigation, and regenerative endodontic treatment involving induction of apical bleeding and placement of coronal barrier using Biodentine was performed. The tooth was restored with acid-etch resin-based composite. Clinical and radiographic examinations were performed at 3, 6, 12 and 15 months. Radiographic evidence of continued root development and apical closure was observed during the follow-up.

Discussion: In this case, 2.5 sodium hypochlorite was used as irrigant and Calcium hydroxide paste was placed in to the root canals as medicament. Biodentine was used as a coronal barrier so as to prevent discoloration. The revitalization procedure provided radiographic evidence of apical closure, and to a lesser extent, increase in root wall thickness.

Conclusion & Clinical Relevance: During the 15-month follow-up, the regenerative endodontic treatment, employed as retreatment provided continued root development in the absence of clinical and radiographic symptoms.

Retreatment and Bicuspidisation of Endodontics Failure

Endang Suprasthi1, Anggias Ergit Pratih2
1Lecturer Departemen Conservative Dentistry, Faculty of Dentistry, Universitas Indonesia.
2Resident Departemen Conservative Dentistry, Faculty of Dentistry, Universitas Indonesia

AIM:
Retreatment and bicuspidisation an effort to sustain the failure of endodontic

Introduction
Endodontic failure due to
• endodontic inadequate such as ledge, perforation, and broke instrument.
• Signs: periodontitis. Swelling and the incidence of fistula.
• Treatment: retreatment, surgery or a combination.
This failure dealt by endodontic retreatment and bicuspidisation.

Case
Female 49 years complaints of rear tooth left mandibular pain and had been treated two years ago. Clinical examination #36 with a crown restoration and sensitive of percussion. Radiological examination Radiolucent on bifurcation and root apical mesial and distal. The filling of the root canal was not hermetic.

Treatment
Unloading crown seemed perforation of the bifurcation, gutapercha disposal patchwork and custom made metal post
• Remove of the gutapercha filling and metal post.
• Root canal preparation using Pro Taper Hand Use
• Irrigation solution using NaOCl 2.5% dan CHX 2%,
• Intracanal medication Ca(OH)2
• Bicuspidisation of roots mesial and distal
• Root canal filling using endomethasone sealer and gutapercha

Restoration
Fiber posts, composite resin core and porcelain fused metal

Discussion
Endodontic failure in this case due to filling does not reach the apical. This is consistent with the statement of Ingle et al at 60% in obturation not reach 0-2 mm.1
Bicuspidisation done because perforation of the bifurcation with the consideration of the stability and availability of supporting bone is still good, no fluting between both roots and to create embrasure to maintain oral hygiene.5
Fiber posts have since had a sexual properties resembling dentin so as to reduce the risk of fractures. Restoration with fiber posts, composite resin core and porcelain fuse metal crown adapted to the rest of the tooth structure, anatomical position and load occlusion.

Conclusion
In this case retreatment and bicuspidisation shows the successful treatment after 1 month but periodic still needs to be done.

References
Retreatment of a Two-Rooted Mandibular First Premolar

Fatma Canbolat
Department of Endodontics, Faculty of Dentistry, Ankara University, Ankara, Turkey

Aim
To present management of a mandibular first premolar with two roots

Introduction
One of the most important prerequisites for successful endodontic treatment is adequate knowledge and understanding of root canal anatomy. Mandibular premolars typically present with a single root and a single canal. Root canal configurations may vary significantly with respect to ethnicity, race, and sex [1].

Case Presentation
A 35 year old male with a non-contributory medical history was referred to our clinic with sensitivity in the right first premolar, i.e. tooth #44 (Fig. 1). The patient reported that the tooth #44 had been root treated 5 years ago. Clinical examination revealed amalgam restoration. Tooth was tender on percussion. On radiographic examination periapical radiolucency and incomplete obturation was observed. A diagnosis of secondary apical periodontitis was made. Therefore, endodontic retreatment was indicated. Root filling materials were removed from the root canals with Gates Glidden drills and H-files. After determination of the working length with an apex locator (Mini RootZ, Morita) and its radiographic confirmation, the canals were cleaned and shaped with EDTA gel and ProTaper files (Dentsply Maillefer, Ballaigues, Switzerland) supplemented with alternate 2.5% sodium hypochlorite irrigation. Afterwards, the root canals were dressed with calcium hydroxide paste and coronally sealed with a temporary filling material. At the next appointment (after 10 days), the tooth was asymptomatic. After completion of the chemomechanical preparation, the root canals were dried with paper points and obturated with laterally compacted gutta-percha and AHPlus sealer (Fig. 2). At the 6 month (Fig. 3a) and 1 year (Fig. 3b) follow up examination, tooth was functional with no clinical signs. Radiography revealed healing of the periapical radiolucency around the root. Further follow up examinations were recommended for evaluation of treatment outcomes.

Discussion
When exploring the floor of the pulp chamber anatomical variations in root canal system should be considered. According to Ingle the most significant cause for endodontic failures was incomplete canal instrumentation and poor canal obturation [2]. Angled preoperative radiographies using parallel technique, are essential in providing clues such as the number of existing roots [3].

Conclusion
Successful root canal treatment requires adequate knowledge regarding morphologic variations in root canal system of teeth. The possibility of atypical morphology and additional canals should never be overlooked.

References
Root Perforations Associated with the Use of Miniplates and Fixation Screws for Orthognathic Surgery: A Case Report

Dr. Tuğrul ASLAN*, Dr. Yakup ÜSTÜN*
* Erciyes University, Faculty of Dentistry, Department of Endodontics, Kayseri, TURKEY

**Aim:** To highlight a possible complication associated with the inter-radicular placement of fixation screws.

**Introduction:** Miniplates and fixation screws are used for fixation of two bone segments together. The main concern has been the potential for damage to teeth roots. The root injury can result in loss of tooth root, substance, loss of response to pulp sensibility testing, root fracture, local infection and fistula (1,2,3). This is a case report about a young woman who had undergone an orthognathic surgery with two proven root damages.

**Case Presentation:** A 33-year-old female patient was referred to our clinic for examination of an accidentally inter-radicular placed screws within 2 roots of her teeth. She had undergone an orthognathic surgery (genioplasty) approximately 3 months before the application to our clinic. Radiographic examination presented a strong evidence of inter-radicular placed screws in teeth 43 and 32; besides, CBCT imaging confirmed the complication (Fig.1 and Fig.2). In clinical examination, there was no response to vitality in mandibular incisors and canines; thus, root canal therapies were performed with the agreement of oral surgeons. In teeth 43 and 32, root canal therapies were performed up to the level of screws (Fig.3). 3 months later, apical resections were done in teeth 43 and 32 (Fig.4). Patient was asymptomatic at the end of 1 year follow-up (Fig.5).

**Fig.1.** After the genioplasty surgery.

**Fig.2. a) CBCT image of affected region. b) CBCT sections of teeth 32 and 43, respectively.**

**Fig.3.** Panoramic view after the root canal treatments.

**Fig.4.** Apical resections and removal of fixation screws.

**Discussion:** In this case report, a young woman had undergone an orthognathic surgery 3 months prior to this visit. No visible symptoms found in our clinical examination; however, CBCT imaging indicated two perforated roots. CBCT is a useful tool for correct diagnosis in this type of damages. Root canal treatments were performed, apical resections were done and screws were removed. There were no symptoms in the last visit.

**Fig.5.** 1 year follow-up.

**Conclusion & Clinical Reference:** Root perforation is a possible complication of screw placement in orthognathic surgery and can be successfully treated. However, it may require apical surgery. Every effort must be made to prevent root perforation during orthognathic surgery.

**References:**

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Orçan Caliskan E., Yegen H. C., Sunay H.
1 Assist. Prof. Istanbul Kemerburgaz University Faculty of Dentistry, Department of Endodontics,
2 Assoc. Prof. Istanbul Kemerburgaz University Faculty of Dentistry, Department of Endodontics

AIM:
This artical case report presents the periapical surgical retreatment of maxillary canine with extruded root canal filling into the periapical lesion.

INTRODUCTION: Endodontic therapy is considered a series of important steps and failure of any of these steps may compromise the treatment outcome. Retreatment of endodontically treated teeth is a challenge that requires complete removal of the previous root canal filling material. External root resorption is a pathologic condition caused by several etiologic factors including failed root canal treatment.

CASE PRESENTATION:
A 24 yr-old female, with no general health problems was referred for the root canal treatment of the right maxillary canine, 2 years ago. Root-filled maxillary canine associated with painful swelling on the mucosa over the tooth and hypersensitivity to percussion. There was a large composite filling on the palatal surface.

Radiographic examination revealed that the right upper canine has a large radioluculent lesion and external root resorption. The root canal treatment was insufficient to remediate the condition, and there were extruded gutta-percha points (over 10 mm) in the lesion.

At first, extruded gutta-percha points were removed through root canal. Retreatment procedure was performed with ProTaper retreatment files (Dentsply,Maillefer,Ballagues, Switzerland) with a sequence of D1(30/0.09), D2(25/0.08) and D3(20/0.07) files respectively.

The canals were irrigated with 1% NaOCl. After completion of preparation, the smear layer was removed with 5 mL of 17% EDTA and 5 mL of 1% NaOCl as the final rinses, dried with paper points. The root canals were obturated with gutta-percha cones covered with AH-Plus sealer (Dentsply,De Trey, Konstanz, Germany) using cold lateral compaction technique. After root canal treatment, in the same session, mucoperiosteal flap was elevated, the granulomatous tissue was curetted carefully. A deep and wide root-end cavity was prepared, filled with mineral trioxide aggregate (MTA-Pro Root, Dentsply, Tulsa Dental Company).

CONCLUSION
In the case described, 6, 12, 18 month and 2 years clinical recall showed no symptoms, and 2 years radiographic recall showed osseous repair of periapical pathosis.

The present report indicates that the tooth which has large periapical lesion and failed canal treatment can be treated in the same session, association with endodontic retreatment and periapical surgery and retrofilling. MTA retrofilling can be used successfully in the surgical retreatment of cases in which the external root resorption apically.
One-Year Clinical Outcome To Direct Pulp Capping With Calcium Hydroxide, MTA And Biodentine In Permanent Young Teeth With Caries: A Randomized Clinical Trial.

Brizuela Claudia 1, Cabrera Carolina 1, Inostroza Carolina 1, Mercade Montserrat 2.

1 Faculty of Dentistry, University of los Andes, Santiago Chile.
2 Faculty of Dentistry, University International of Catalunya, Barcelona España.

AIM: The present study aimed to compare clinical efficacy of MTA, Biodentine and Calcium Hydroxide as a direct pulp capping dressing materials in permanent young teeth.

METHODOLOGY: The study is a controlled clinical trial with random assignment of three parallel groups, including 169 patients with at least one permanent molar with deep dentin caries and diagnosis of normal pulp or reversible pulpitis. The direct pulp capping was performed with a follow-up of one year. Data were analyzed by Fisher's exact test in Stata 14.

RESULTS: A total of 169 patients were included (82 men, 87 women) with a mean age at the time of the treatment of 11.3 years (SD 2.44) and a median age of 11 years. A total of 169 teeth were treated, 53 molar teeth had a direct pulp capping with Calcium Hydroxide, 56 with MTA and 50 with Biodentine. The type of teeth were as follows: 44 maxillary first molars, 2 maxillary second molars, 104 mandibular first molars and 19 mandibular second molars. At one week follow-up were 100% of clinical success. At three months, there was one failure in the Calcium Hydroxide group. At six months' follow-up, there were four new failures (one in the Calcium Hydroxide group and three in the MTA group). At one-year follow-up, there was another failure in the Calcium Hydroxide group. According to Fisher exact test, at six-months there were no statistically significant differences among the studied materials (p=0.221) neither at one-year follow up (p=0.127).

CONCLUSIONS: The success rates of direct pulp capping at one year is 100% for Biodentine™ and 86.4% for MTA and Calcium Hydroxide. However, these differences are not statistically significant.

FUNDING SOURCE: Research with state funding through the chilean National Fund for Research and Development in Health (FONIS SA13I20175).
General Endodontic Posters

GE34

Removal Efficiency of Calcium Hydroxide Intracanal Dressing with Er:YAG Laser: A Scanning Electron Microscopic Study

*Kourti E, Pantelidou O

Department of Endodontics, Dental School, Aristotle University of Thessaloniki, Greece,

Aim This ex-vivo study compared the efficiency of Er:YAG laser to remove calcium hydroxide from root canal walls, especially from the apical third, with manual and ultrasonic irrigation technique by using a SEM.

Methodology 64 single-rooted teeth were divided into 3 groups of 20 teeth each. The rest 4 teeth were used as control groups (2 positive and 2 negative control group). After coronal access, all teeth were instrumented by Protaper Next rotary files (Dentsply-Maillefer, Ballaigues, Switzerland) up to size F3, followed an irrigation protocol and filled with pure calcium hydroxide powder mixed with saline. Teeth were stored in an incubator for 7 days and then calcium hydroxide was removed using 3 techniques: manually (Group 1), by ultrasonic irrigation (Group 2), by laser Er:YAG and x-pulse tip (Group 3). The teeth of control groups were instrumented as the experimental groups; no removal technique was applied in positive group, whereas in negative one, the root canals were left empty. Teeth were sectioned longitudinally and observed under SEM. Results were statistically analyzed with the Kruskal-Wallis Test and Mann-Whitney Test.

Results The results showed significant difference between Laser and the other two groups in coronal and middle root third, but no statistic difference in apical third

Conclusions Laser improved the removal of calcium hydroxide in comparison with conventional techniques
The Surgical Management of A Large Peri-apical Lesion with Platelet-Rich Fibrin As An Alternative For Bone Grafts

Peter de Bruyckere, Evelien Van Hecke, Mathieu Vanendaela, Prof. Peter Bottenberg

Introduction

Platelet-rich fibrin (PRF), developed by Choukroun et al (2001), is a second generation platelet concentrate widely used to accelerate soft and hard tissue healing. The PRF production attempts to accumulate platelets and released cytokines in a fibrin clot. It is a rich source of growth factors which possesses many advantages in bone regeneration.

Aim

The aim of this case is to present and evaluate the healing potential of platelet-rich fibrin as an alternative to using bone grafts.

Case Presentation

A 33-year-old female patient was referred to the Department of Endodontics of the VUB with pain and swelling in the upper left front teeth region. Introral periapical radiograph revealed a large periapical radiolucency in relation to upper left lateral incisor. Tooth 22 was non vital and tender on percussion. First conventional endodontic treatment of tooth 22 was performed. After 6 months-recall a fistula was noticed and periapical root-end surgery was indicated.

Figure 1: Radiographical follow-up

(a) CBCT pre-op; (b) PA pre-op; (c) PA post-op;
(d) PA follow-up 6 months.

CHOUKROUN’s protocol was followed for the preparation of PRF. Blood was drawn into 10ml tubes without an anticoagulant and centrifuged immediately, using a tabletop centrifuge for 12min at 2700rpm. The absence of anticoagulant allows activation of the majority of platelets contained in the sample to trigger a coagulation cascade. The result product is a fibrin clot containing the platelets located in the middle of the tube between a layer of red blood cells at the bottom and acellular plasma at top (3). A full thickness mucoperiosteal flap was reflected under local anesthesia by a sulcular incision starting from distal of tooth 11 to the distal side of tooth 23. A through-and-through lesion was seen. Thorough tissue curettage was done at the defect site followed by irrigation using sterile saline solution. Putty ceramic (TotalFill, FKG, La Chaux-de-Fonds, Switzerland) was used as the root end filling material up to 3 mm.

Discussion

The PRF is produced without adding an anticoagulant; bovine thrombin, or calcium chloride is not needed for platelet activation and fibrin polymerization (4). The use of local growth factors has been studied to enhance the healing and regeneration potential of periodontal/ endodontic surgery. PRF contains and releases different growth factors. PDGF and TGF-β are two main growth factors, which have a positive impact on the healing of bone and soft tissue. These growth factors help to enhance the key stages of regenerative processes including angiogenesis, cell-differentiation and -proliferation, chemotaxis, extracellular matrix deposition, and remodeling (1,2,5,6). Autologous platelet storage via PRF is an easy, cost-effective way to obtain high concentrations of growth factors for tissue healing (6). Currently available clinical evidence suggests that the healing rate of surgical sites enhanced with PRF is up to two to three times higher than normal surgical sites (3).

Conclusion

Based on the results obtained in our case, we conclude that PRF can be a valid alternative to using bone grafts. Although the term enhanced healing rate is not applicable in this case since radiographically only partial per- api-cal healing can be seen. But since the patient is clinically complaint-free, we consider this case as successful.
Clinical trials

GE36

Comparison of two methods of treatment of extensive proximal carious decays: indirect pulp capping vs. Biodentine pulpotomy.

*Hrynyshyn OB

Department of Pediatric Dentistry, Lviv National Medical University named after Danylo Halytsky, Lviv, Ukraine

Aim
To assess the outcome of two methods (indirect pulp capping and complete vital pulpotomy) of extensive proximal carious lesions management

Methodology
Ninety deciduous molars with extensive carious lesions approaching the pulp on proximal surfaces in 81 children from 5 to 7 years old were included; children were randomly allocated to the groups with preliminary informed consent from the parents. Forty-six molars were treated with partial removal of dentin and indirect pulp capping (IPC). Forty-four molars were treated with complete dentin excavation and procedure of Biodentine pulpotomy. After local anesthesia, each tooth was isolated with rubber dam and disinfected with 5% sodium hypochlorite before caries excavation. Subsequently, partial dentin removal and indirect pulp capping with calcium hydroxide in group A or complete excavation of dentin and Biodentine complete pulpotomy in group B was performed. Clinical and radiographic evaluation was completed at 6, 12 and 24 months

Results
Eighty cases in 77 children were available for recall, 41 teeth in group of indirect pulp capping and 39 teeth in pulpotomy group. Clinical and radiographic success rate in group A ranged from 90,24% and 85,37 % at 12 months to 80,48 % and 75,62 % at 24 months. Four teeth presented symptomatic irreversible pulpitis, one and five teeth were associated with symptomatic and asymptomatic apical periodontitis. Clinical and radiographic success rate in group B ranged from 100% and 97,44% at 12 months to 97,44% and 92,32% at 24 months. Three cases of internal root resorption occurred during two-year follow up in group B. Overall radiographic appearance of normal alveolar bone structure in 24 months was seen in 92,32% of the cases in Biodentine pulpotomy group and 75,62% in the indirect pulp capping group (p<0,05)

Conclusions
Biodentine pulpotomy demonstrated higher successful rate in comparison with IPC for the management of extensive carious lesions located on proximal surface of deciduous teeth

GE37

Effect of Vent Position of Irrigation Needle on Post-endodontic Pain: A Preliminary, Randomized, Participant-Blind, Clinical Trial
Aim to compare the incidence and intensity of postoperative pain after irrigant delivery using a side-vented needle (Max-i-Probe®, Dentsply, Rinn, Elgin, IL, USA) and an end-vented needle (NaviTip, Ultradent Products Inc., South Jordan, UT, USA) after one-visit root canal therapy.

Methodology In a parallel, two-arm, participant-blind randomized clinical trial, thirty participants, each with a mandibular posterior tooth with symptomatic irreversible pulpitis, were included. Instrumentation of the canals was performed using ProTaper Universal rotary system (Dentsply, Tulsa, Johnson City, TN) with 2.5% sodium hypochlorite (NaOCl) as the routine irrigant. Teeth were randomly assigned into two equal groups (n=15) according to the needle used: MP Group, Max-i-Probe® and NT Group, NaviTip. Pain incidence and intensity, as assessed using an 11-point numerical rating scale (NRS), was recorded preoperatively then 4, 12, 24 and 48h postoperatively. Data was statistically analyzed using Mann-Whitney U-test, Friedman's test, Wilcoxon's rank test, and Chi-square test. The significance level was set to p<0.05.

Results MP group showed significantly lower pain score than NT group at the 24h-time point (p<0.05) as well as a higher incidence of participants with no pain (p<0.05). A significant decrease in the pain scores occurred over time within each group (p<0.05). For the MP group, a significant drop in pain score, compared to preoperative pain, occurred after 4h (p<0.05) with another significant drop between 4h and 12h postoperatively (p<0.05), followed by a gradual decrease in pain reaching its lowest level after 48h. For the NT group, a significant drop in pain score, compared to preoperative pain, occurred after 12h (p<0.05), followed by a gradual decrease in pain reaching its lowest level after 48h.

Conclusions Using side-vented needles may predispose to more and faster pain relief than end-vented ones within the first 24h after one-visit endodontic therapy for patients with irreversible pulpitis.

GE38
Evaluation of Post-operative Pain after Irrigation using End-Vented NaviTip versus Side-Vented NaviTip in Teeth with Irreversible Pulpitis (A Randomized Clinical Trial)
Bashar MA, Galal AG, *Bedier MM

Aim To compare the degree of Post-operative pain after the use of End-Vented and Side-Vented NaviTip needles (NaviTip® Ultradent Products Inc., South Jordan, UT, USA) in patients with irreversible pulpitis in mandibular posterior teeth after single-visit root canal treatment.
**Methodology** Patients were carefully diagnosed and checked for the eligibility criteria through careful medical, dental history and clinical examination. Patients who were eligible to the trial criteria and accepted to enter the trial were asked to record the pre-operative pain level on the Numerical Rating Scale (NRS) in the pain diary (n=38). Access cavities were prepared, then root canals were instrumented and one of the two needles was used for irrigation; 2mm short from the working length using 2.5% NaOCl then 17% EDTA followed by distilled water as a final. Root canals were obturated, then every patient was asked to mark the NRS scores at 0, 4, 12, 24, 48, 72-hrs and 7 days post-operatively. Statistical analysis was performed using the Kruskal-Wallis test followed by Mann-Whitney test for pair-wise comparisons and over time comparison were done by Friedman test followed by Wilcoxon rank test.

**Results** The End-Vented and Side-Vented NaviTip needles showed observable drop in the pain level, until it disappeared (p< 0.05). There was a significant increase in the pain level with the End-Vented needles at 4, 12, 24 and 48-hrs compared to the immediate post-operative (p< 0.05), and at 12, 24 and 48-hrs with the Side-Vented needles (p< 0.05). Pain was significantly higher with the End-Vented needles at 4 and 12-hrs post-operatively.

**Conclusions** There was similarity in the post-operative pain when using the End-Vented and Side-Vented NaviTip needles, yet the End-Vented needles caused more pain at 4 and 12-hrs in patients with irreversible pulpitis in mandibular posterior molars in single-visit root canal treatment.

**GE39**

**Post-Obluration Pain Following the Use of the AH Plus and iRoot SP Sealers**

*Atav Ateş A, Dumani A, Ünal İ, Yılmaz S, Yoldaş O*

*Department of Endodontics, Cukurova University, Faculty of Dentistry, Adana, Turkey*

**Aim** To evaluate and compare postoperative pain and overextension of root canal filling after root canal treatment using a carrier-based obturation system and two different sealers.

**Methodology** In this prospective randomized clinical trial, 160 mandibular premolars and molars in 160 patients were treated. Patients with vital and devital teeth were assigned to four groups using a randomized block design with block sizes of 10 patients each. The groups were composed of devital teeth with periapical lesions treated with iRoot SP sealer, vital teeth treated with iRoot SP sealer, devital teeth with periapical lesions treated with AH Plus sealer, and vital teeth treated with AH Plus sealer. In single visits, a single operator prepared root canals and filled them with sealer using the carrier-based obturation technique. Radiographs were taken and obturation length was recorded. Patients recorded pain scores use of Visual Analogue Scale and frequency of analgesic intake at baseline and 0–6, 6–12, 12–24, and 24–72 h.
Results The incidence of postoperative pain during the 72 h study period did not differ among groups. Analgesic intake was significantly greater in the vital teeth treated with AH Plus sealer group than the other groups at 0–6 and 6–12 h (P<0.05). The extrusion rate of root canal material was not statistically significant.

Conclusions Although the use of different sealers did not significantly affect pain levels following root canal obturation, the iRoot SP sealer was associated with less analgesic intake than was the AH Plus sealer.

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GE40
Pulp Revascularization of a Necrotic Immature Permanent Tooth in a 24 years old patient
*Hassan SJ
Department of Endodontics, Ibn Sina National College for Medical Studies, Jeddah, Saudi Arabia
Aim To observe the effect of pulp revascularization for treatment of immature teeth with apical periodontitis in a 24-year-old patient.

Methodology A healthy 24-years-old male patient was referred to the dental clinic of ibn sina national college to restore his broken anterior tooth. The patient had a history of trauma due to traffic accident 13 years ago. Clinical examination revealed enamel-dentin crown fracture on the discolored maxillary left central incisor. Radiographic examination revealed periapical radiolucency with an incomplete root development and a wide open apex. A diagnosis of pulpal necrosis with asymptomatic apical periodontitis was established. Pulp revascularization procedures were selected. Under local anesthesia and rubber dam isolation, an access cavity was prepared. The root canal was irrigated with 1.3% NAOCL with minimal filing followed by final irrigation with normal saline. The apical tissue was irritated using a K-file to induce bleeding into the canal space. After blood clot formation, mineral trioxide aggregates (MTA) was placed in the coronal third followed by cement and final restoration.

Results The patient was recalled at 7, 10 weeks and 10 months after treatment. In clinical examinations, the tooth was asymptomatic, without sensitivity to percussion and palpation or presence of swelling, with normal periodontal condition. There was slight pain on cold testing. Radiographic examination showed increased root wall thickness and root length.
**General Endodontic Posters**

**Conclusions** Pulp revascularization could be an effective treatment for immature permanent teeth with apical periodontitis in 24 years old patients, and root elongation and thickening of root wall were observed.

GE41

The clinical comparative evaluation of postoperative pain in single-visit and multiple-visit retreatment cases: a prospective randomized clinical trial

Uyan HM, *Olcay K

Department of Endodontics, Istanbul Medipol University/ Faculty of Dentistry, Istanbul, Turkey

**Aim** The purpose of this randomized clinical trial was to evaluate the incidence of postoperative pain after retreatment.

**Methodology** Patients whom need retreatment were included. Eighty asymptomatic teeth were randomly participated into four treatment groups (n=20) in terms of intracanal medicament applied: Group I: single-visit retreatment group (control), group II: Ledermix paste, group III: a mixture of metronidazole, ciprofloxacin and minocycline (triple antibiotic paste) and group IV: calcium hydroxide powder mixed with distilled water. Postoperative pain was recorded by each patient by using visual analogue pain scale in well-defined categories at 5 time intervals as 1, 6, 12, 24 and 48 hrs. after retreatment. The data was statistically evaluated using Kruskal Wallis and Mann-Whitney U test.

**Results** Two patients from the Group I had flare-ups. Mild pain occurred in 67.5%, moderate in 30% and flare-up in 2.5%. There was a significant difference between the groups (p<0.01). In 1, 6, 12 and 24 hrs. intervals, there was no significant difference in the pain levels between the group II and the control group (p>0.05). The pain levels in the group III and the group IV was significantly lower than the control group (p<0.05). In 48 hrs. interval, the pain incidence in control group was found significantly higher than the other groups (p<0.01).

**Conclusions** When considering the results it can be concluded that multiple-visit retreatment still safer than single-visit retreatment in terms of postoperative pain reduction after asymptomatic retreatment cases. TAP and CaOH2 is effective on reducing postoperative pain after retreatment.

**Acknowledgements** The authors thank Dr Cemal Atakan for statistical analysis and Hakan Olcay for final editing.
Outcome studies

GE42

A study on the radiographic quality of root canal fillings performed by undergraduate students as a means of assessment of the educational program in Endodontics

*Diamantopoulou V, Protogerou E, Khabbaz M

Department of Endodontics, National and Kapodistrian University of Athens, Athens, Greece

Aim To evaluate the radiographic quality of root fillings as well as the incidence of iatrogenic errors in root canal treatments provided by undergraduate students and investigate whether the changes, introduced to the preclinical education of students in Endodontics, after the results of a previous similar survey in the Dental School of Athens between the years 2004-6, had a positive effect on their performance.

Methodology Periapical radiographs of 570 teeth and their 976 root filled canals, performed by undergraduate students of the 4th and 5th year during the academic years 2012-15, were randomly selected. The sample was digitalized and assessed, by two independent investigators, as acceptable or non-acceptable according to two variables: the length and density of the root filling. Iatrogenic errors including ledges, perforations (root and apical foramen) and fractured instruments were also recorded. Root canal was the unit of assessment. Chi-square tests and multivariable random effects logistic regression models were used for statistical analysis.

Results Acceptable root fillings were found in 62.7% of canals, with similar percentages between the 4th and the 5th year students. Iatrogenic errors were noted in 19.4% of all cases, with the presence of ledges significantly reduced in the root canal treatments of the 5th year students (P < 0.05). Molars exhibited the majority of problems concerning quality and iatrogenic errors.

Conclusions The quality of the root fillings was improved (62.7% vs 54.8%) and the incidence of iatrogenic errors was decreased (19.4% vs 31.6%) in comparison with the previous research in Dental School of Athens. Significant attention must be given to the root canal treatment on molars through additional improvements on the educational system.

GE43

Evaluation of cardiovascular parameters after healing of apical periodontitis

*Sarigu SA1, Flore FG2, Madeddu MC2, Ideo IF1, Mercuro MG2, Cotti CE1

Departments of 1Conservative Dentistry and Endodontics, 2Cardiology, University of Cagliari, Cagliari, Italy
**General Endodontic Posters**

**Aim** To assess if there was a variation in the concentration of the markers of endothelial damage, in young patients which had received endodontic treatment in teeth with apical periodontitis (AP) and were considered healed.

**Methodology** Population: seven healthy women (36±4 years) and men (42±4 years) who had received conventional endodontic treatment and were judged healed, after a minimum of 6 months, were enrolled in the study. Patients belonged to the cohort from a previous study, who had AP and showed altered levels of endothelial reserve flow (EFR), asymmetrical dimethylarginine (ADMA) (only men), and high concentration of interleukin (IL)-2, IL-6, reactive oxygen species (ROS). Patients underwent dental examination, complete cardiovascular assessment, measurement of EFR, and blood examination for the evaluation of ADMA, IL-2, IL-6 and ROS. Data were analysed using the 2-tailed Student t test and the Pearson t test (P ≤ 0.05).

**Results** Women exhibited an improvement of the values of EFR and a decrease of the concentration of IL-2, IL-6 and ROS, but the results were not significant (P > 0.05). Men revealed a decrease in the concentration of IL-6 and ADMA (P > 0.05), but the other parameters observed in this study showed no variations following healing of AP.

**Conclusions** Based on this preliminary report in a small sample healing of AP does not seem to affect the concentration of the markers of endothelial damage. Future randomized clinical trials are necessary.

**GE44**

**Intra-operative Rapid Bacterial detection for the prediction of the outcome of root canal treatments: a Cone Beam Computer Tomography study**

*Knight A1, Blewitt I1, Patel S1, Foschi F1, Herzog D2, Al-Obaidi B1, Mannocci F1*

Departments of 1Endodontology, 2Tissue Engineering and Biophotonics, Kings College Dental Institute, Guys Hospital, London, United Kingdom

**Aim** To assess the correlation between pre-obturation bacterial detection using fluorescence amplification and outcome of endodontic treatments.

**Methodology** Pre-obturation root canal samples were taken using paper points from patients undergoing primary root treatments. The samples were analysed using a fluorescent spectrometer and a molecular fluorescent vital dye (Calcein AM).

Pre-operative and 1-year post-operative Periapical radiographs and Cone Beam Computer tomography (CBCT) scans were assessed by two calibrated expert examiners to evaluate the outcome of the root canal treatments.
Results This research is ongoing. 130 root canal treatments in 102 patients have been completed and 23 teeth have been reviewed. Three root canal treatments failed, two of which had a high level of bacterial detection at the time of obturation, updated results of a group of approximately 50 patients will be presented at the meeting.

Conclusions Rapid bacterial detection in endodontics could help the clinician in predicting the outcome of root canal treatments.

GE45

Reasons for loss of endodontically treated teeth: clinical and statistical study

*Kondylidou V, Oikonomou I, Georgopoulou M

Department of Endodontics, Dental School, National and Kapodistrian University, Athens, Greece

Aim To determine the reasons for loss of endodontically treated teeth and potential aggravating factors. This study was performed in terms of MSc Thesis during post-graduate program in Endodontics.

Methodology A sample of endodontically treated teeth of patients attending the Dental School of Athens, Greece was gathered from September 2013 to July 2015. Patients’ clinical and radiographic examination took place initially in Diagnostic Clinic and re-examinations were conducted subsequently by dental students under supervision in relevant clinics. After thorough examination by a group of clinicians specialized in all areas of dentistry, information about the status of every endodontically treated tooth, which was decided to be extracted, were recorded on a special form designed for the purposes of this study. Additional examined correlative factors to the reasons of loss were patients’ medical history, sex and age, type of tooth, smoking and parafunctional habits, financial reasons and patient’s preference regarding the proposed treatment plan.

Results 785 endodontically treated teeth were examined. Extraction was decided for the 41% of them (N=322). The main extraction reason was non-restorability (52.2%) followed by compromised periodontal condition (17.7%), vertical root fractures (10.6%), patient’s desire (9.3%), endodontic reasons (6.8%) and reasons relating to the overall treatment plan (3.1%). Aggravating factors were considered the absence of permanent restoration (P< .01), extensive caries (P< .001), non-restorable coronal fractures (P< .01) and periodontal disease (P< .01). Poor oral hygiene was proved aggravating regarding periodontal reasons (P= 0.024). Quantitative variables were expressed via measures of mean and standard deviation. Qualitative variables were expressed in absolute and percentage value. The relationships between qualitative variables were examined using Chi-squared test.
**Conclusions** Non-restorability was the main reason of loss. The low frequency of endodontic reasons indicates that the failure of endodontic treatment may not be the only reason of extraction before all possible treatment options are exhausted.

GE46

**Success of regenerative endodontic procedures in mature teeth**

Arslan H1, *Khalilov R1, Guven Y1, Gundogdu E1, Sahin Y2, Karatas E1

1Department of Endodontics, Ataturk University Faculty Of Dentistry, Erzurum, 2Department of molecular medicine, Yeditepe University Institute Of Health Science, Istanbul, Turkey

**Aim** The aim of the present study was to compare the regenerative endodontic procedures and nonsurgical endodontic treatment on the clinical and radiographic healing of mature teeth with periapical lesion.

**Methodology** Eighty mature teeth with periapical lesion were randomly distributed into two treatment groups; nonsurgical endodontic treatment, and regenerative endodontic treatment (n = 40). Patients were followed up for 12 months for clinical and radiographically assessments. The data were statistically analyzed with independent-samples t test and chi-square tests at 95% confidence level (P = 0.05).

**Results** 80% of teeth in the nonsurgical endodontic treatment group and 92.3% teeth in the regenerative endodontic procedures group were treated successfully (P > 0.05). 50% of teeth in the regenerative endodontic procedures group respond positive to electrical vitality test. 38.5% of teeth in the regenerative endodontic procedures group was visibly discolored. After bleaching procedure, all of the patients, who wanted to bleach the discolored tooth, were pleased to the color of the teeth.

**Conclusions** Within the limitations of the present study, regenerative endodontic procedures have similar success rate to the nonsurgical endodontic treatment. In certain cases, vitality responses were also observed with regenerative endodontic procedures. Mature teeth with periapical lesion can be treated with regenerative endodontic procedures. Although discoloration in teeth treated with regenerative endodontic procedures was solved with bleaching procedures, the discoloration is a considerable problem for regenerative endodontic procedures.

GE47

**The effect of tobacco smoking on the success of the endodontic treatment**

*Cankar K1, Nemeth L2, Groselj M2*
Aim The aim of the present study was to assess the effect of cigarette smoking on the success of endodontic treatment.

Methodology The success of endodontic treatment of teeth with apical periodontitis was compared between smokers (N=50) and non-smokers (N=50). Patients in both groups were gender and age matched (mean age 41.74 ± 11.1 vs. 41.93 ± 10.7). The teeth with apical periodontitis were tooth type matched and treated at the Centre of dental diseases and endodontics. Periapical index (PAI) was assessed from the periapical radiographs before the start of endodontic treatment and one year after the final root canal obturation. In addition, the number of visits needed to complete the treatment was also recorded.

Results At the beginning of the study there were no differences between PAI index values for teeth of smokers and non-smokers (3.37 ± 1.8 vs. 3.25 ± 1.9). Number of visits needed to complete the endodontic treatment was statistically significantly higher in smokers (3.95 ± 1.7) compared to non-smokers (3.05 ± 0.7) (p<0.05, Mann-Whitney Rank Sum Test). In non-smoking group the PAI index at one year control (1.12 ± 1.4) was statistically significantly lower than at the beginning of the treatment (3.25 ± 1.9) (p<0.05, Wilcoxon test), while in smoking group the differences before the treatment (3.37 ± 1.8) and at one year control (2.54 ± 2.1) were not statistically significant. In addition, in smoking group more teeth were extracted compared to the non-smoking group.

Conclusions The tobacco smoking affects the course of treatment and the final outcome of endodontic treatment.

GE48

The impact of tooth type, length, and root curvature on the outcome of re-root canal treatments – a CBCT study

*A Bakhsh A, Al-Nuaimi N, Davies A, Mannocci F, Patel S

Department of Endodontics, King’s College London, London, United Kingdom

Aim To assess the tooth type (anterior, premolar, molar), tooth length and root curvature and prognostic factors on the outcome of root canal retreatment using Cone Beam Computed Tomography (CBCT)

Methodology In total, 232 teeth in 203 consecutive patients were consented for root canal retreatment of failing primary treatment at the Endodontic Postgraduate Department King’s College London Dental Institute. Ethical approval was obtained prior to the commencement of this study.
Radiographs and small field of view CBCT scans were taken pre-operatively and at a 1-year follow up appointment. Tooth length and root curvature were assessed from the CBCT scans by an Endodontic Post-graduate not involved in the treatment of the patients. The outcome of the treatment was evaluated and categorised as per a radiographic/CBCT outcome (Patel, Wilson et al. 2012)

**Results** Of the 232 teeth treated, 183 (78.9%) teeth had a favourable outcome 1 year post treatment, whereas 49 (21.1%) of the teeth had an unfavourable outcome when assessed with CBCT. The molar tooth group showed the highest percentage of the unfavourable outcome when compared to premolars and anterior teeth.

**Conclusions** Due to the complex anatomy and the root curvature, molars tend to have a higher unfavourable outcome when compared with the premolars and anterior teeth.
Dental students in Slovenia and their first clinical experiences with endodontic treatment

*Grošelj M

Department of Dental Diseases and Normal Dental Morphology, Faculty of Medicine, University of Ljubljana, Ljubljana, Slovenia

Aim The aim of the present study was to analyse dental students' first clinical endodontic treatment cases.

Methodology One hundred randomly chosen clinical endodontic treatment cases performed by two generations of fifth grade dental students at Faculty of Medicine, University of Ljubljana, were analysed. The data were obtained from the students’ endodontic case presentation protocols, patients’ dental charts, and specially designed questionnaires about diagnosis, treatment, complications, and number of visits needed till final root canal obturation. Data were analysed using ANOVA.

Results Among 100 clinical cases analysed, 17 were incisor, 18 canine, 21 premolar, and 44 molar cases; 44 were single, 14 two, 30 three, and 12 four root canal cases; and 31 were vital, 32 non vital, and 37 retreatment cases. In 53 cases, where students started the endodontic treatment with diagnosis and access cavity preparation, the treatment was completed on average in 3.7±2.1 (range 1-11) visits. More specifically, the treatment was completed on average in 2.6±1.4 (range 1-6) visits in vital, 4.0±1.1 (range 3-6) visits in non vital, and 4.9±2.4 (range 2-11) visits in retreatment cases (p=0.001). Single root canal cases were completed on average in 2.7±1.1 (range 1-5) visits, two in 4.0±1.7 (range 2-6) visits, three in 5.1±1.4 (range 3-8) visits, and four in 7.4±2.5 (range 5-11) visits (p<0.001). In 48 cases treatment was completed without complications. In remaining 52 cases, most common complications were problems with crown build up and rubber dam placement (15), root canal transportations and root perforations (13), blocked root canals (11), flare ups (8), and unsatisfactory root canal obturations (5). Operating microscope had to be used in 23 cases and MTA as perforation repair material in 4 cases. 5 cases were referred for surgical retreatment or extraction.

Conclusions Inexperienced fifth grade dental students need numerous visits to complete endodontic treatment. Numerous visits increase the risk of treatment complications, especially in retreatment cases and multiple root canal cases.
Endodontic Confidence: Foundation Dentists in the UK

Introduction and Aims

Endodontics is one of the most challenging clinical procedures to carry out, particularly so for newly qualified dentists with little experience. Demand for endodontic treatment may increase with the aging population retaining teeth for longer. Students must leave dental school with confidence at an appropriate level to diagnose, create treatment plans and treat endodontic cases. The aim of this survey was to gather information on the perception of difficulty and confidence levels in Endodontics amongst newly qualified dentists.

Method

Survey forms were distributed to 39 Dental Foundation Trainees (DFTs) with a 100% response rate:

- Trainees were asked how many root canal treatments they had completed as an undergraduate.
- Confidence levels in the following areas: assessing the difficulty of proposed RCTs, placing a rubber dam, access, initial navigation, canal preparation and obturation.
- The scoring system was 1 Not confident, 2 Need advice/help, 3 Fairly confident, 4 Not at all confident.

Further questions determined what equipment they had been using for their practice and their interest in the specialty.

Discussion

The DFTs were alumni of 11 UK universities; 74% had done 10 or fewer RCTs as a student. 28% of DFTs had done 11-20 RCTs at university; all of these students were split between just two Universities. One DFT had done 21-30 RCTs and rather unsurprisingly, they were more confident across the board than most. Gilmour et al. found that undergraduates also felt less confident with more complex procedures and in particular those least practised.

90% of DFTs had a rotary machine available to them in their practice.

31% needed help in assessing difficulty of an RCT.

69% were confident to place a rubber dam alone.

31% were taught warm vertical condensation, 100% were taught cold lateral condensation.

Initial navigation of canals was found to be most difficult, with over a third of DFTs requiring significant help and advice from their trainer and only 16% being confident. Access and canal preparation, in comparison, were similarly viewed and evenly spread between requiring help and working alone. All DFTs were at least ‘fairly confident’ in the obturation stage. The hardest tooth to root treat was thought to be an upper molar, found also to be the case by Tenhunen et al.

54% would not attempt a simple re-RCT.

75% would like more training in Endodontics in their DFT year.

I’m practising with hand files until my confidence increases before moving on to rotary.

Conclusion

Confidence levels seemed appropriate for level of experience, with guidance understandably required in many situations. The questionnaire has showed this group as being appropriately confident in a skill which takes years to master, but they are keen for further formal teaching. In order to see true links between confidence and number of RCTs carried out at different schools a much larger sample size would be needed.

References


"Yes 72%  "No 28%  "Would you consider further formal education in Endodontics?"
"54% would not attempt a simple re-RCT"
"75% would like more training in Endodontics in their DFT year"
"I’m practising with hand files until my confidence increases before moving on to rotary"

Number of students: 4

What method was taught for canal preparation at university?

- Hand files: 18
- Hand NiTi: 25
- Machines: 9
- All: 54
General Endodontic Posters

GE51
Exploring current and alternative approaches for postgraduate development to demonstrate competency during Endodontic Specialist Training at University of Liverpool
*Alansari A1, Dawson L2, Jarad F1, Buckley C3
1Department of Restorative Dentistry, University of Liverpool Dental Hospital, 2 Department of Oral Surgery, University of Liverpool Dental Hospital, 3Educational Development Division, University of Liverpool, Liverpool, United Kingdom

Aim The aim of this qualitative study was to explore both traditional and novel approaches, for postgraduate development, that are used to demonstrate competency during Endodontic Specialist Training at the University of Liverpool - informing beneficial change to the delivery of endodontic postgraduate training.

Methodology Ethical approval was sought for semi-structured interviews. A schedule was constructed with six main focused questions, each question had numerous related prompts. The schedule was constructed based on the three main areas of interest; the Endodontic specialist training thus far in relation to governing bodies set syllabus, the process of work based assessments (WBA’s), the use of a novel approach to longitudinally monitor clinical training. Postgraduates in Endodontics program at the University of Liverpool were recruited (n=7). Written and verbal consent was obtained. A pilot interview was initially undertaken with an independent subject to help inform the interview structure. All interviews were audio-recorded and transcribed verbatim, then read and checked for accuracy by primary researcher. Data was analysed using thematic analysis (Braun & Clarke method). Text was read, and re-read before identifying initial codes and noting common themes. Insights and unforeseen topics were documented. The themes were examined in relation to the central topics of concern. Initial codes were refined to final codes.

Results Four main themes emerged with relevant codes: Trainee’s perception of a structured syllabus for endodontic specialty training; The Reality of Specialist Endodontic Training; Influence of WBA’s and ISCP sage in relation to Endodontic Specialty Training; The Inadvertent ‘Role Reversal’.

Conclusions There are administrative burdens and inefficiencies with both approaches to Specialist training in Endodontics. There is a need for an alternative, time efficient, streamlined approach to postgraduate Endodontic training, away from traditional competency based development.
Radiographic evaluation of the technical quality of endodontic treatment using manual versus Reciproc preparation in a preclinical student setting

*Claeys M, De Bruyne M, De Moor R, Meire M

Department of Endodontology, University of Ghent, Ghent, Belgium

Aim To compare radiographically the technical quality of endodontic treatment performed by dental students on extracted teeth, after either manual (crown-down/step-back using stainless steel files) or machine-assisted (Reciproc, VDW, München, Germany) preparation in a preclinical teaching setting.

Methodology Two groups of undergraduate students, in their primary endodontic training, divided over 2 academic years, were the subject of the study. In a preclinical setting, the first group (n=45) was taught manual preparation with the crown-down/step-back technique using stainless steel K-files (Dentsply, Ballaigues, Switzerland). The other group (n= 27) was taught machine-assisted root canal preparation with Reciproc files and dedicated motor (VDW, München, Germany). All teeth were filled with gutta-percha and epoxy resin sealer according to the cold lateral condensation technique.

Post-obturation radiographs were obtained from all premolar and molar teeth, yielding 777 canals (481 canals manually prepared, 296 prepared with Reciproc). These images were scored by two blinded examiners on working length, density and taper of the root filling, and preparation errors. Besides these scores, the degree of curvature, the tooth type, canal, and whether the tooth was an exam case or not, were also entered in a database, which was subjected to descriptive and analytical statistics.

Results Compared to the manual preparation group, working length was scored significantly more frequently as acceptable in the Reciproc group (P<0.05). No significant differences between both groups were observed in terms of density and taper of the root filling, and occurrence of preparation errors. Most preparation errors occurred in the mesial canals of lower molars and in the mesiobuccal canals of upper molars, regardless of the preparation method.

Conclusions Preclinical canal preparation of (pre)molars by undergraduate dental students with Reciproc resulted in better working length control compared to manual preparation with handfiles.
Recommendations for Tackling Operative Endodontic Pain

Mohamed Sami Shihabi, Mohammed Mashayk, Prof. Gianluca Gambarini

University of Rome (Sapienza)

**Aim**

1. To provide information about the incidence of post-endodontic pain.
2. To provide recommendations for the treatment of post-operative endodontic pain.

**Introduction**

Prevention and management of post-endodontic pain (PEP) is an integral part of endodontic treatment. Informing patients about expected post-endodontic pain (PEP) and prescribing medications to manage it can increase patient confidence in their dentists, increase patients’ pain thresholds, and improve their attitude toward future dental treatment.

**Incidence**

According to Pak and White: Systematic review Pain prevalence: Pre-op 81%, 24 hr 40%, 1 wk < 10%. Pain severity (10-point scale): Pre-op 54, 24 hr 24, 1 wk 3. Pain dropped substantially after 2 days and continued to decrease to day 7.

**Pulpinjury**: maximal pain relief in first 24-48 hours.

**Polypharmacy**: 12% long-term pain (10 mm pain 8.0x, pre-op pain 7.8, pericoronitis 7.8, interalp pain 3.9).

**Recommendations**

1. **Mild/no pain**: no drug need to be prescribed
2. **Mild/moderate/severe pain**: NSAID analgesics, "non steroid anti-inflammatory drugs"
   - Ibuprofen (Motrin, Advil): a common regimen is 200 to 400 mg orally every 4 to 6 hours as needed for pain relief or Acetaminophen. (Tylenol).
   - A common regimen is 365 to 625 mg every 4 to 6 hours.
3. **Flare up**: If the patient’s pain can’t be controlled by one of the above drugs, a narcotic analgesic (prescription pain relieve) may be required. It’s sometimes given in combination of NSAID and antibiotic e.g. Amoxicillin (600mg) every 8 hours.

**Iatrogenic errors**

**Case presentation of Sodium hypochlorite**

A 38-year-old female was referred to the Emergency Department of endodontist with a complaint of abrupt swelling of the left cheek following root canal therapy in the lower first premolar done the day before. Analgesics, corticoids and intravenous antibiotics were immediately administered.

And the reason is to prevent the patient from having a neurological complications such as nerve damage and tissue toxicity in the lower jaw also in case if it occurs in the upper jaw it could lead to obstruct the pathway of the air.

**Other recommendations for sodium hypochlorite accident**:

- **Gluconate**- long acting LA. Irrigation with saline to dilute, Aninos, analgesics, steroids, cold compresses/recalls.
- **Kleiner**- diplomate survey did not affect prognosis; women > men, necrotic with PARL more common.
- **Sabala**: 1) reassure pt, 2) pain control-LA b&k and analgesics, 3) saline irrigation, 4) ABO, 5)

**CONCLUSION AND CLINICAL RELEVANCE**

Previous researches have showed that the post-operative pain can be related to many factors, including initial infection, iatrogenic errors and periapical inflammation. Since (PEP) is a common finding dentists should develop a strategy to communicate with patients informing them about this possible occurrence and one of them is to give the patients a small Explanatory leaflets that describes in a very simple way all the possible complications and the treatment related to their therapy.

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Microbiology
GE54

Bacterial degradation of gutta-percha cones in medium containing Enterococcus faecalis: An in vitro study

Souza LR¹, Andrade Feitosa J¹, *Gurgel-Filho ED³

¹Organic and Inorganic Chemistry Department, Federal University of Ceará, ²Department of Endodontics, University of Fortaleza, Fortaleza, Brazil

Aim Gutta-percha cones used in endodontic therapy were meant to last a lifetime in root canals, after root canal filling. However, these materials may suffer degradation when in contact with persistent microorganisms. Enterococcus faecalis is one of those microorganisms commonly associated with persistent periapical infections and its prevalence range among 29% to 79%.

The aim of the present study was to evaluate the bacterial degradation of gutta-percha in medium containing E. faecalis.

Methodology Two brands of gutta-percha cones Odous and Tanari and polyisoprene in nature were immersed in BHI and Ágar Muller-Hinton inoculated with 5.4 x 10⁵ CFU/mL for periods of 10 or 100 days. In the control group the brands of gutta-percha and the pure gutta-percha (polyisoprene) were immersed in BHI and agar Muller-hinton with no contamination. At each time-point, cones were removed from medium, weighed and the organic fraction (polyisoprene) of gutta-percha points was separated from the inorganic fraction (ZnO and BaSO₄) by dissolution in chloroform. Gutta-percha polymer was precipitated with acetone. After this process the polyisoprene removed from the cones were characterized by thermo-gravimetric analysis (TGA), gel permeation chromatography (GPC), Fourier transform infrared spectroscopy (FT-IR), Proton nuclear magnetic Resonance (1H-NMR) and scanning electron

Results The results show that in all three samples there were small and gradual loss of the molar mass of the polyisoprene constituents of the cones. The degradation was more evident in polyisoprene in nature. Infrared spectra show that degradation also occurs with structural modifications of the polymer, especially in the occurrence of deformation bands of C=O and OH/OOH, and variations in the pattern of cristalinity of the bands of C=C-H. The SEM images show that changes may occur in the surface morphology of the cones biodegraded, resulting in the organic component selected attack. The 1H-NMR spectra of polyisoprene fresh show that the material has undergone minor structural changes in the molecules of polyisoprene during bioassay. All bioassays monitoring indicated that the inoculums grows continuously during the period of contact with the cones or polyisoprene in nature.
**Conclusions** Bacteria degrade the organic matter of the cones using them as a source of substrate and thereby causing voids cones.

**GE55**

**Infection of Porphyromonas endodontalis serum levels of soluble adhesion molecules of asymptomatic apical periodontitis**

*Garrido M¹, Huamán P², Valdés M³, Castillo C¹, García-Sesnich J², Bravo D⁴, Quinlan F²,⁵, Barstow L², Hernández M²,⁶,⁵*

¹Conservative Dentistry and Periodontal Laboratory, Faculty of Dentistry, University of Chile, ²Periodontal Laboratory, Faculty of Dentistry, University of Chile, ³Public Health, Faculty of Medicine, University of Chile, ⁴Pathology (Microbiology), Faculty of Dentistry, University of Chile, ⁵Dentistry Unit, Faculty of Health Sciences, Universidad Autónoma de Chile, Santiago, Chile

**Aim** Endodontic infection and soluble adhesion molecules associate with endothelial dysfunction. We aimed to assess serum levels of soluble (s) adhesion molecules ICAM-1, VCAM-1, and E-Selectin in patients with asymptomatic apical periodontitis (AAP) according to the presence of endodontic infection with Porphyromonas endodontalis (Pe).

**Methodology** Patients having at least one tooth with AAP and otherwise healthy (n = 23) were included and assessed for classic cardiovascular risk factors. Serum samples from all the participants were obtained in order to determine sICAM-1, sVCAM-1 and sE-Selectin levels by multiplex assay. Endodontic bacteriological samples were obtained with sterile paper points and Pe was identified by bacteriological culture and PCR. According to distribution, data were compared using impaired T Student’s or Mann Withney test. Statistical significance was set at p < 0.05.

**Results** Pe was identified in 5 of the 23 patients with AAP, representing 21.74%. sVCAM-1 levels were significantly higher (p = 0.02) in AAP patients infected with Pe compared to non-infected ones.

**Conclusions** Patients with AAP infected with Pe might course with higher levels of serum soluble adhesion molecules. Consecutively, Pe may associate with endothelial dysfunction.

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**GE56**

**Presence of Enterococcus faecalis and their antimicrobial susceptibility in root canals of teeth submitted to endodontic retreatment due to technical reasons**

*Bicego-Pereira EC, Barbosa-Ribeiro M, Arruda-Vasconcelos R, Zaia AA, Gomes BPFA*

Department of Endodontics, Piracicaba Dental School, University of Campinas, Piracicaba, Brazil
Aim To evaluate the presence of Enterococcus spp. from teeth submitted to endodontic retreatment due to technical reasons, to identify E. faecalis using PCR with primer-specific and partial sequencing 16S rRNA gene and their antimicrobial susceptibility.

Methodology Twenty teeth indicated for endodontic retreatment due to technical reasons were included in this study. Microbial samples collected from root canals were plated on m-Enterococcus selective medium. Detection of E. faecalis was performed by PCR with primer-specific and partial sequencing of the 16S rRNA gene of the isolated strains. The strains identified as E. faecalis were tested for their antimicrobial susceptibility by the disc diffusion method against 18 most commonly used antibiotics.

Results Seven root canals (35%) showed microbial growth in the selective medium. Out of the 43 microorganisms grown on m-Enterococcus, 41 strains were identified as E. faecalis by PCR primer-specific and sequencing. Amoxicillin was effective against all strains, followed by amoxicillin with clavulanic acid (38/41), ampicillin (38/41), doxycycline (33/41), fosfomycin (33/41) and tetracycline (30/41). Among the strains, there was resistance against clindamycin (38/41), gentamicin (35/41), rifampicin (20/41) and vancomycin (17/41).

Conclusions The selective medium m-Enterococcus showed high specificity for E. faecalis, with similar results of the molecular methods. E. faecalis strains presented varying degrees of resistance to antimicrobial agents, being more susceptible to amoxicillin, amoxicillin + clavulanic acid and ampicillin.

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UVB irradiation has a greater efficacy than photodynamic therapy on Enterococcus faecalis

*Markvart M, Agyraki A, Petersen PM, Bjarnsholt T, Bjørndal L

1 Cariology and Endodontics, Department of Odontology, University of Copenhagen, Copenhagen, 2 Diode Lasers and LED Systems, Department of Photonics Engineering, Technical University of Denmark, Roskilde, 3 Costerton biofilm Center, Department of International Health, Immunology and Microbiology, University of Copenhagen, Copenhagen, Denmark

Aim Within endodontics photodynamic therapy (PDT) has been suggested as a disinfectant procedure during root canal treatment (RTC). A photoactive dye (photosensitizer), methylene blue or toluidine blue, are activated by a light source, usually lasers or light emitting diodes (LEDs), thereby forming free oxygen radicals supposing to kill the bacteria. New ultraviolet (UV) LEDs may be used without a photosensitizer. The aim of the present study was to compare the efficacy of UVB irradiation with an existing PDT on Enterococcus faecalis biofilm.
**Methodology** UV irradiation was provided using an LED in the UVB region (296nm), with a fixed dose J/m². The PDT was applied using the commercial product Fotosan®. The biofilms were grown on AB-trace glucose medium and incubated for 24 hours (h) at 37°C. Three biological replicas were irradiated together with 2 or 3 technical replica. Controls were taken every h. Serial dilutions were made and plated onto lysogenic broth medium and the treatment effect was registered using total number of colony forming units (CFUs) after overnight incubation at 37°C. Statistical analyses were carried out using Two Way Anova with a significant level P=0.05.

**Results** No significant variation among the technical replica was noticed (P=0.082), but both the biological replica and the treatments had significant variation (P<0.0001). Both the UVB treatment and the PDT significantly reduced the growth of the E. faecalis biofilm (P<0.0001), and in addition, the UVB treatment was significantly more effective than PDT (P= 0.0017).

**Conclusions** UVB irradiation and the PDT significantly reduced the growth of the E. faecalis biofilm; however the UVB treatment was more efficient than PDT to reduce the total number of viable cells. UV LEDs may improve disinfection procedures during root canal treatments.

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**Irrigants/disinfection: Antimicrobial activity**

GE58

**Antimicrobial effect of cold atmospheric plasma produced by dielectric barrier discharge against Enterococcus faecalis**

*Pavelić B¹, Prebeg D², Šegović S¹, Katunarić M¹, Budimir A³, Anić I¹

¹Department of Endodontics and Restorative Dentistry, School of Dental Medicine University of Zagreb, ²Postgraduate Doctoral Study of Dental Medicine, School of Dental Medicine University of Zagreb, ³Department of Clinical and Molecular Microbiology, Clinical Hospital Center Zagreb, Zagreb, Croatia

**Aim** To evaluate the antibacterial effect of the atmospheric-pressure dielectric barrier discharge cold atmospheric plasma on suspension of Enterococcus faecalis in planktonic form inoculated in prepared canals of extracted human teeth.

**Methodology** Cold atmospheric plasma field was produced by CR glass probe of high frequency ozone generator Ozonytron X (Biozonix GmbH, Munich, Germany) by dielectric barrier discharge through the ambient air at atmospheric pressure. Thirty extracted human single rooted teeth stored in sterile isotonic saline solution were selected according to size and shape similarities. All teeth were then resected 13 mm from the apex using a diamond bur TR-11 ISO199/016 (Mani,
Utsunomiya, Tochigi, Japan) and embedded in acrylic Palavit G resin (Heraeus Kulzer GmbH, Wehrheim, Germany). Their canals were instrumented using the ProTaper rotary instrumentation technique using conventional sequence (S1, SX, S1, S2, F1, F2, F3) according to the manufacturer’s instruction (Maillefer, Ballaigues, Switzerland). Teeth were divided in one experimental group (20 teeth) and two control groups (positive and negative, five teeth each). Before starting each of the experiment cycles, the sterility of the samples was determined. The microorganism used was Enterococcus faecalis ATCC 29212 (LGC-ATCC, Wesel, Germany). Suspension was prepared in Brain-Heart (BH) infusion broth with concentration of 10^9 CFU (Colony Forming Units) and 0.02 ml of mixture of bacterial suspension was inserted into root canals by syringe. The active part of floating CR glass probe was placed at a distance of 1mm from orifice to the prepared root canal and activated at the highest level (5) for 20 and 60 seconds distance. After treatment, root canals have been refilled with 0.02 ml of sterile BH.

**Results** Significant reduction in the range of 10^8 CFU of Enterococcus faecalis after 20/60 seconds was estimated. Data were analyzed using Wilcoxon paired samples test, a non-parametric test for paired data. Although it has been determined, the difference antimicrobial effect after 20 and 60 seconds was not statistically significant.

**Conclusions** The use of the atmospheric-pressure dielectric barrier discharge cold atmospheric plasma showed pronounced antimicrobial effect against Enterococcus faecalis in planktonic form.

**GE59**

**Bionanoparticles containing antimicrobial peptides and their potential use in infected root canals.**

Nuñez A\(^1\), Cadena MA\(^2\), Nuñez F\(^2\), *Hernandez A\(^2\), Rojo B\(^2\), Cadena R\(^1\), Carrillo AG\(^2\)

\(^1\)Centro de Nanociencias y Nanotecnología, \(^2\)Department of endodontic, Universidad Autonoma de Baja California, Tijuana Baja California, Mexico

**Aim** The main objective of the study was to demonstrate at the laboratory level that the Plant-derived Virus Like Particles-Antimicrobial Peptides (VLP-AMPs) could be used in the future as a novel antimicrobial agent to treat root canal infections.

**Methodology** Cowpea chlorotic mottle virus (CCSM) is a plant pathogen easy to use, stable, non-toxic to cells mammal. It has been proposed as a candidate for use in various gene therapies. This investigation from the virus were built CCSM type virus particles (VLPs) with the DCD-1L peptide. These nanoparticles VLP DCD-1L were able to inhibit in manner prolonged the growth of pathogens in dental organs. Test Synthesis of VLPs- (DCD-1L) Analysis of the antimicrobial effect of VLPs- (DCD-1L) with SEM, confocal .Characterization of VLPs by means of Transmission Electron Microscopy. Cell culture / Biocompatibility assays of VLPs- (DCD-1L) and calcium hydroxide.
General Endodontic Posters

Results According to the results obtained, the antimicrobial peptides was not affected when it was encapsidated with CCMV capsid protein (CP). The antimicrobial tests results showed that the VLPs-AMPs exhibit better bacterial inhibition than the naked Peptides and Ampicillin; that could be due to the protection and controlled release of the peptides. Clinical trials would be necessary to determine its usefulness.

Conclusions Based on this information, there is potential for the use of antimicrobial peptides as a medicament in the treatment of infected root canals. Also, the encapsidation of the peptides in a viral capsid “in vitro” showed to be very promising.

GE60

Effect of photodynamic therapy towards phenotype character at cps genotype of Enterococcus faecalis isolated from persistent intra radicular infection

*Dewa Ayu NPA

Department of Conservative Dentistry, Faculty of Dentistry Universitas Indonesia, Jakarta, Indonesia

Aim Eliminating all bacteria, especially E. faecalis in the root canal remains a problem in root canal management due to its irregular shape at one third of apical area. The repeating endodontic visits also seem to be less practical. Utilization of laser photodynamic therapy is an attempt in finding the suitable technique and materials for eliminating this issue. Knowledge of specific character of bacteria such as the various genotypes and phenotype character, which is its behaviour toward environmental changes, is expected to be helpful in finding the best technique and medicament for root canal sterilization. The aim of this study are analyse genitpe characters difference of E. faecalis in the root canal affected with persistent intra radicular infection and analyse phenotype character changes after application of photodynamic therapy

Methodology E. faecalis was isolated from root canal and its cps genotype was determined. Phenotype character changes were onserved with sensitivity, protein profile and polysaccharide capsule profile after getting photodynamic therapy

Results E. farcalis sensitivity toward photodynamuc treatment for 60 seconds aquired from persistent intraradicular infection was effective in root canal sterilization

Conclusions Photodynamic therapy can change the sensitivity, protein profile and polysaccharide capsule profile of cps 1, 2 and 5 genotype E. faecalis in persistent intra radicular infection

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Evaluation of root canal disinfection following off-centred file preparation

*Albaaj F, Walmsley AD, Sammons RL, Tomson PL

School of Dentistry, College of Medical and Dental Sciences, Birmingham, United Kingdom

Aim To evaluate root canal disinfection following cleaning with off-centred files using a new root canal model

Methodology A root canal model with a continuous isthmus was developed as a replica of the mesial root of an extracted lower molar after scanning with microCT. Forty transparent root canal samples were created by the stereolithography three dimensional printing technology to 16 micron layer resolution. A single species biofilm of E. Faecalis was developed for 7 days on the sample surfaces. Three groups (n=10) were prepared with Protaper universal (PTU), Protaper Next (PTN), or Revo-S (RS) rotary file system, whereas one group was left as a negative control. A total of 5ml of chlorhexidine digluconate (2%) was delivered to the root canals by the standard hand syringe irrigation technique at 0.1ml/s flow rate. The remained biofilm was labelled with Fluorescent in situ hybridization (FISH) method and estimated using the laser scanning confocal microscopy (LSCM)

Results The root canal preparation methods have significantly reduced the amount of the biofilm in comparison to the control group (p < 0.05). However, significant percentages, 27 %, 25 %, and 15 %, of biofilm were left in the canal isthmus in all thirds (cervical, middle, and apical) following preparation with PTN, PTU, and RS respectively. The RS file system has significantly reduced the biofilm compared to PTN and PTU systems. After instrumentation, the LSCM images showed a low density biofilm accumulated mainly in the isthmus area with small patches of complete biofilm removal

Conclusions Based on the research limitation herein, the new model has simplified the procedure of biofilm evaluation through direct visualisation without the need for sample sectioning. The cleaning of the root canal samples by the off-centred files, PTN and RS, or symmetric PTU file does not completely remove biofilm especially in the isthmus area

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GE62


*Zhekova AA, Mitronin AA, Belyaeva TS, Ostanina DA

Cariology and Endodontology, Moscow State University of Medicine and Dentistry, Moscow, Russian Federation

Aim To evaluate strength of diode laser and photodynamic therapy in the endodontic treatment of infected root canals.

Methodology In our determination 42 patients in age of 35-57 were involved, all having apical periodontitis. All the patients were divided into 3 groups. In the Group I disinfection of root canals was performed in one visit by laser irradiation. In the Group II - two visits using the Calasept during 2 weeks. In the Group III - one visit by photodynamic therapy. Treatment efficacy was evaluated clinically and X-ray after 14 days, 6 and 12 months. Also bacteriological examination was led for assessing the remaining channel bacterial stocks culture.

Results Indices of clinical well-being treatment of chronic periodontitis on all stages of monitoring revealed high efficiency of the diode laser (97.7%) and photodynamic therapy (97.9%).

Number of remaining in the channel microrganisms in the Group I: Neisseria - 2 × 105, Bacteroides - 2 × 108; in the II: Streptococcus mutans - 1,5 × 105, Fuzobacteriums - 1 ×103; in the III: Bacteroides - 1×108.

Conclusions Using the laser radiation methods, photoactivated endodontic disinfection in the endodontic treatment of chronic apical periodontitis helped to reduce the number of complications and led to more effective bone regeneration as compared with the traditional method in the therapy in combination with calcium hydroxide.
The importance of root canal disinfection protocols in the treatment of large periapical lesions

Yegin H. C., Ozcan Caliskan E., Sunay H.

1 Assist. Prof. Istanbul Kemerburgaz University Faculty of Dentistry, Department of Endodontics, 2Assoc. Prof. Istanbul Kemerburgaz University Faculty of Dentistry, Department of Endodontics

AIM:
Bacterial elimination is very important for healing of treatment results of large apical lesions. This case report to emphasize the importance of root canal disinfection protocols in the treatment of large periapical lesions.

SUMMARY:
A 40 years old male patient referred to our clinic with pain and swelling in the mandibular anterior region. There was large lesions at apexes of teeth 33, 32, 31, 41 on the OTPG (orthopantomography). In the clinical examination, swelling was found in the apical region of the involved teeth and in the labial portion of the sulcus. In the pulp test it was determined that teeth were devital. Root canal preparation was finished with K-File No: 15# - 60# respectively. Each tooth was irrigated with 2cc saline and 2cc chlorhexidine, the cavities were temporarily closed. The same procedures were applied at 2 session. 33 and 41 were irrigated with rifamycin-SV (ampoule-2cc), aspiration of the tooth no 41 was performed to allow the rifosin to circulate throughout the lesion, at 3th session. At 4th session drainage was found to decrease to a minimum level and each tooth was irrigated with 2cc saline followed by laser disinfection. At 5th session it was observed that drainage was cut off in all teeth. Root canals were irrigated with 2cc saline and disinfected by laser. For each tooth, root canal filling was made using the AH Plus canal sealer and lateral condensation technique.

KEY LEARNING POINTS:
As a result of 6 months clinical and radiographic follow-up, it is observed that the healing process starts, and the radiolucency in the lesion area decreases on the OTPG. After 2 years of clinical and radiographic follow-up, complete healing of the lesion is observed.

Irrigation solutions used in canal disinfection and high-power diode laser are important for the elimination of bacteria.

Root canal irrigation protocols are very important in the treatment of large periapical lesions.
General Endodontic Posters

Irrigants/disinfection: Canal cleaning
GE64

An Assessment of The Penetration Ability of a Prepared Nanosilver Based Irritant Into Dentinal Tubules
Faculty of Oral and Dental Medicine
Cairo University

Aim of the study
The purpose of the current study is to evaluate the horizontal depth of penetration of various irrigation solutions into the dentinal tubules using prepared nanosilver and CHX loaded nanosilver based irrigation solutions compared to other commonly used irrigation solutions as chlorhexidine (2%), Sodium Hypochlorite (2.5%) and EDTA (17%).

Introduction
Although mechanical preparation aim to complete eradication of microorganisms. This seems to be impossible as bacteria can invade deeply in dentinal tubules. That’s why the role of irrigation mandatory. New irrigants as nanosilver has been introduced lately inorder to reach bacteria that harbor dentinal tubules.

Methodology
Twenty five freshly extracted mandibular premolars were decapitated at cemento-enamel junction and roots of 13 mm length were mechanically prepared. Initial irrigation by NaOCl (2.5%) was used between instruments followed the by EDTA (17%) at the end of the preparation. Samples were randomly distributed into five groups (n=5) according to the irrigating solution used as a final rinse. Group I: Nanosilver + AF dye, Group II: CHX loaded nanosilver + AF dye, Group III: CHX (2%) + AF dye, Group IV: NaOCl (2.5%) and Group V: EDTA (17%) + AF dye. Sample roots were sectioned at coronal, middle and apical sections (fig. 1). Linear penetration depths of AF dye in each cross section was measured and analyzed in each group by stereomicroscope and Image J software (fig. 2). Hauser et al, 2007

Discussion
Each of tested irrigating solutions possess different molecular sizes, this may have affected their penetration ability in dentine where the smallest the molecular size the deeper the penetration according to our results. Nanosilver particles by virtue of their size were believed to be able to penetrate deeply in dentine Shrestha et al, 2009.

Conclusion
Trying to fulfill the principle aim of endodontic treatment which is fighting bacteria inside the dentinal tubules, the new nanosilver based solution possess improved penetration ability to sufficient depth enables it to perform its antimicrobial effectiveness.

Results
Nanosilver group showed the statistically significantly highest mean dye penetration depth both coronally and mid root. CHX loaded nanosilver group showed statistically significantly lower mean value followed by NaOCl group coronally while at mid root CHX loaded nanosilver group and NaOCl group showed no statistically significant difference and lower mean values than nanosilver group. There was no statistically significant difference between the five groups apically (fig. 3).

References
An in-vitro model to evaluate the degradation of a simulant biofilm by sodium hypochlorite solution above and below the stagnation plane

*Ramachandran N, Ng Y, Gulabivala K

Unit of Endodontology, Department of Restorative Dentistry, UCL Eastman Dental Institute,

**Aim** To develop a transparent root canal model for studying the degradation characteristics of a simulant “biofilm”, and to monitor the consumption of sodium hypochlorite above and below the stagnation plane.

**Methodology** Thirty transparent models with a single simulated straight (n=15) or curved (n=15) root canal were fabricated. Type 1 stained (Chinese ink) Rat-tail collagen was used to fill the simulated canals and allowed to form a thin simulant “biofilm” on the canal walls. Canals (6 curved; 6 straight) with unstained collagen were used to locate the position of the stagnation plane. Canals (6 curved; 6 straight) coated with stained collagen were irrigated with 2.5% sodium hypochlorite (27 mL) at 0.1 mL/second delivered via a syringe-pump. The events were recorded by video-capture.

One frame per second of the video was extracted for image analysis above and below the stagnation plane. NaOCl draining out of the canal was sampled every 3 seconds to measure its concentration. The data were analysed descriptively.

**Results** The distance of the stagnation plane from the needle tip was 0.9±0.2mm or 0.8±0.3mm, in curved or straight canals, respectively. There was a net reduction in the proportion of area occupied by stained collagen in curved and straight canals; both above (29-95% in straight canals, 38-80% in curved canals) and below (16-71% in straight canals; 50-67% in curved canals) the stagnation plane. The general trend for removal of the stained-collagen above the stagnation plane was either gradual or in bursts, suggesting more mixing of irrigant whereas, below the stagnation plane it was generally slow with less removal of stained collagen.

**Conclusions** The transparent canal-stained collagen model provided valuable insights into the simulant-biofilm degradation process above and below the stagnation plane in simulated root canals. The data suggested that there was less mixing of irrigant below the stagnation plane in both straight, as well as curved canals.

Efficacy of new passive Ultrasonic NiTi file Activation for Removal of Calcium Hydroxide: A Microtomographic Study

*Kim Eundam, Lee Woocheol*
The aim of this study was to evaluate the efficacy of the new passive ultrasonic NiTi file irrigation system on calcium hydroxide (Ca(OH)2) removal using micro–computed tomography (micro-CT) scanning and to measure the volume and percentage of Ca(OH)2 remaining in the root canal system.

Methodology The root canals of 30 extracted human mandibular premolar teeth were decoronated under the cementoenamel junction and prepared with NiTi rotary instruments to size/taper 40/.06 at working length. All canals were then irrigated, dried, and filled with Ca(OH)2 (Metapaste; Meta Biomed co., LTD, Korea) and stored in 100% humidity for 7days. All teeth were scanned using micro-CT scanning to determine the Ca(OH)2 dressing volume. The teeth were randomly assigned to three experimental groups (each with n =10). The Group 1 was received conventional irrigation with 2.5% NaOCl and 17% EDTA with 30-G side-vented needle. In Group 2 and 3, instrumentation with patency file and passive ultrasonic irrigation was done using 30K CK tip (B&L, Biotech, USA) and ENDOSONIC Blue (Maruchi co., Wonju, Korea), respectively. The teeth were again scanned using micro-CT scanning to calculate volume and percentage of Ca(OH)2 remained.

Results Residual Ca(OH)2 were found mainly in the apical third of all root canals. Few amounts of Residual Ca(OH)2 of middle, coronal thirds of root canals were found and those were mostly placed at lateral canals. ENDOSONIC Blue system (Group 3) removed significantly more Ca(OH)2 than other groups. The remained Ca(OH)2 volume percent was calculated as occupied Ca(OH)2 volume after irrigation divided by Ca(OH)2 volume before irrigation. After irrigation, 48.77% of Ca(OH)2 volume percent was remained in Group 1, whereas 7.13% recorded in the Group 2 and 1.13% recorded in Group 3. (p < 0.05). Data were analyzed using one-way ANOVA test.

Conclusions The passive ultrasonic activation with NiTi file results in significantly lower amounts of Ca(OH)2 remnants in the canal compared with conventional irrigation or stainless steel ultrasonic tip irrigation. Since NiTi has characteristics of shape memory and super-elasticity, NiTi ultrasonic irrigation may have some advantages and further studies were required.

Evaluation of apical extruded debris and bacterial reduction of different mechanized file systems

*Miyagaki DC1, Schwambach LG1, Rodrigues CL1, Ribeiro MB2, Gomes BPF2

1Department of Endodontics, UPF, Passo Fundo, 2Endodontics, UNICAMP, Piracicaba, Brazil

Aim The purpose of this study was to compare different mechanized file systems on the viability of Enterococcus faecalis and amount of apical extrusion of debris and irrigants.
**Methodology** 40 single rooted teeth had their crowns removed, sterilized and contaminated by pure cultures of Enterococcus faecalis. The samples were randomly divided into 4 groups (n = 10): Reciproc, Logic, Protaper Next and Protaper Universal. 5.25% sodium hypochlorite was the irrigant used and the instrumentation was performed in accordance with the recommendations of each manufacturer. The E. faecalis colony forming units (CFUs) were counted in each root canal before and after instrumentation. Each tooth's debris was collected in a pre-weighed vial. After drying the debris in an incubator, the mass was measured three times consecutively; the mean was then calculated. The collected data were analyzed by Shapiro-Wilk test followed by one way ANOVA and Tukey test with a significance level of 5%.

**Results** The results showed that the Logic system despite presented lowest mean of microbial reduction, however, generated significantly less debris when compared to other systems. The Reciproc system was the most effective in reducing bacteria and Protaper Universal System obtained the highest average of extruded debris.

**Conclusions** It was possible to conclude that all systems caused extrusion of debris through the apex and presented a significant response in bacterial reduction.

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**GE68**

**Particle image velocimetry for evaluation of apical extrusion during root canal irrigation and laser induced agitation**

Jezsersek M¹, Pirnat L¹, Jereb T¹, Lukac N¹, *Tenyi A², Fidler A²

¹Laboratory for laser techniques, Faculty of Mechanical Engineering, ²Department of endodontics and restorative dentistry, Faculty of Medicine, University of Ljubljana, Ljubljana, Slovenia

**Aim** Evaluation of apical extrusion using particle image velocimetry (PIV) during conventional irrigation and Er:YAG laser assisted irrigation (LAI)(LightWalker ATS, λ = 2.94 µm, Fotona d.o.o).

**Methodology** A simulated canal was prepared to an apical size #25/0.08 taper in the apical part using a R25 endodontic instrument (VDW, München, Germany). The working length (WL) was 1 mm short of the apical foramen and apical constriction was standardized with size #10 Hedstroem file over-instrumentation (WL+2.5 mm). Irrigation was performed with flow rates of 5 and 15 ml/min using a side-vent 30-G needle (Transcodent, Kiel, Germany), placed 4 mm short of WL. During LAI, SSP pulse mode (PIPS) with three pulse energies (20, 40, 60 mJ) was used with X-Pulse and Varian fibre tips of 600 µm diameter at 10 Hz. The extruded water volumes were measured by the PIV method during 20 s time intervals. The measurement area was a 6 mm long glass tube with 1.8 mm inner diameter, connecting the apex and an open chamber, filled with water. 10 µm hollow-glass...
spheres (HSG, Dantec Dynamics, Skovlunde, Denmark) were used as PIV particles. Extrusions flow rates were calculated and statistically analysed (ANOVA with Bonferroni correction, P <0.05).

**Results** Extrusion for side-vent needle with flow rates of 5 and 15 ml/min was 15.76 (.22) and 65.48 (1.15) mm3/s, respectively. For LAI, extrusion with Varian ranged from .58 (.06) to 2.03 (.08) mm3/s and with X-Pulse ranged from 0.23(.08) to 3.23 (.06) mm3/s. LAI extrusion was lower than side-vent irrigation. Except for the 20 mJ, Varian resulted in lower extrusion compared to X-tip.

**Conclusions** PIV represents a suitable method for evaluation of apical extrusion. Within this study's limitations, LAI represent a safe method, as it was associated with significantly lower extrusion compared to side-vent needle irrigation, even with the highest pulse energies.

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**Irrigants/disinfection: Irritant agents**

GE69

**Antibacterial effects of Nd:YAG laser irradiation in infected root canal. In vivo study**

*Ajeti Nexhmije AN1, Apostolska Sonja,Kelmendi Tringa, Vula Violeta, Emini Lindihana, Aliu Xhevdet,Pustina Teuta ASKTVVELAX2

Department of Dental Pathology and Endodontics,, Denatl Branch, Medical Faculty, University of Prishtina "Hasan Prishtina", Prishtine, Kosova

**Aim** To determine antimicrobial efficiency of Nd:YAG laser in infected root canals combined with 2,5%NaOCl, 2%CHX and 0.9%NaCl.

**Methodology** This in vivo study includes 40 patient, malefemale with infected root canals. The samples groups were divided into three test group and one control group. Treatment protocol was as follows: Group 1(test, n=10) was irrigated with 0.9% NaCl( B Braun Germany)+ Nd:YAG laser(Fotona, Slovenia), group 2 (test, n=10) was irrigated with 2.5% NaOCl(Sigma Aldrich-Germany)+ Nd:YAG laser and group 3(test, n=10) was irrigated with 2% CHX (Sigma Aldrich, Spain) + Nd:YAG laser. Group 4(control, n=10) was irrigated only with 0.9% NaCl. From all of the treated teeth, bacterial sample (aerobe and anaerobe) were taken following this protocol: 1st sample was taken before instrumentation, 2nd sample was taken after instrumentation and Nd:YAG laser irradiation and 3rd sample was taken 3 days after treatment. Cultivated aerobe and anaerobe bacteria recovered.

**Results** For aerobe bacteria Kruskal Wallis test, $X^2 =15.546$, DF=2, have shown that were statistical significance between groups in first measurement and second measurement with this values $X^2 =22.051$, DF=2, p<0.01. And for anaerobe bacteria Kruskal Wallis test, $X^2 =12.734$, DF=2, p<0.01,
have shown that were statistical significance between groups only at third measurement. Nd:YAG laser combined with 2.5% NaOCl was more effective in reduction of aerobe and anaerobe bacteria in infected root canal.

**Conclusions** We can conclude that none of root canal irrigants that were used for treatment of infected root canals is capable to totally eradicate aerobe and anaerobe bacteria.

GE70

**Effect of sodium thiosulfate on bond strength of an epoxy resin–based sealer to NaOCl/citric acid-treated dentine**

*Karataş E1, Doğanay E1, Arslan H1, Büker M1, Uzun İ2, Özdoğan A3, Yapar M4*

1Department of Endodontics, Atatürk University. Faculty of Dentistry, Erzurum, 2Department of Endodontics, 19 Mayıs University Faculty of Dentistry, Samsun, 3Department of Prosthodontics, Atatürk University. Faculty of Dentistry, Erzurum, 4Department of Restorative Dentistry, Atatürk University. Faculty of Dentistry, Erzurum, Turkey

**Aim** The aim of this study was to evaluate the effect of sodium thiosulfate on the bond strength of an epoxy resin–based sealer to NaOCl/citric acid-treated dentine.

**Methodology** Fifteen maxillary central incisors with straight roots were selected. Three discs (1.0 ± 0.1 mm thick) were cut from the middle third of the roots under continuous water irrigation using a low speed saw. A 1-mm round tungsten carbide bur was used to drill two holes on the root dentine under water-cooling, perpendicular to the root slice. All of the specimens were immersed in 5.25% NaOCl for 30 minutes, then immersed in 10% citric acid for 1 minute, 5.25% NaOCl for 1 minute respectively. The specimens were randomly distributed into 3 groups as follows; group 1: control group (no irrigation was performed), group 2: distilled water group (immersed in distilled water for 10 minutes and group 3: sodium thiosulfate group (immersed in 5% sodium thiosulfate for 10 minutes). The holes were dried and filled with an epoxy resin–based sealer. Push-out test performed on each hole and bond strength values were recorded. The one-way Anova and LSD tests were performed for the bond strength data.

**Results** The bond strength of the specimens irrigated with sodium thiosulfate was higher than those of control group (P < .05). However, there were no significant differences between control and distilled water groups (P > .05).

**Conclusions** Within the limitations of the present study, it can be concluded that 5% sodium thiosulfate for 10 min reversed the bond strength of the sealer to NaOCl/citric acid-treated dentine.
General Endodontic Posters

Preparation: Cleaning ability
GE71
Contemporary approaches to instrumentation of non-round root canals
Solomonov MS, *Itzhak JB
Department of Endodontics, Sheba Hospital, Tel Hashomer, Israel
Aim To summarize the topic of irregularly-shaped root canals and the up-to-date attempts to instrument them, through review of recent scientific literature and clinical cases using the new instrumentation techniques.
Summary Irregularly-shaped root canals – oval, flat, C-shaped, etc. - pose a real challenge for clinicians and have been the target of several new instrumentation techniques. Structure principals and modes of operation of the new generations of instruments - XP-Endo Shaper and Finisher, TruShape, The Self-Adjusting File (SAF), and GentleFile - will be reviewed and analyzed in relation to this challenge. By analysis of data, including manufactures' claims, recent researches, clinical cases and clinical impressions, this topic will be addressed, with the aim to form a helpful guide for clinicians in choosing the appropriate instruments for different clinical situations. Recommendations for future researches will also be discussed.
Key Learning Points
• How to address the challenge of non-round root canals.
• New instruments should be assessed in an evidence-based approach, combining scientific research and clinical experience - to realize their potential to prepare non-round root canals
• Further research should help clarify whether the new generations of instruments can realize their potential.

GE72
Effectiveness of Ultrasonic Activation of Origanum Extract Solution and Sodium Hypochlorite on Root Canal Dentin Cleanliness in Retreatment: An Ex-vivo Study
*Yilmaz EF
Department of Endodontics, Suleyman Demirel University, Isparta, Turkey
Aim The aim of this study is evaluating efficacy of two different irrigation solutions under passive ultrasonic irrigation on root canal dentin cleanliness during retreatment.
Methodology Twenty-six mandibular premolars presenting Vertucci Type-I configuration and extracted for periodontal and orthodontic reasons were selected for his study. Teeth with external resorption, immature apices and cracks were excluded from the study. Crowns were separated from the cemento-enamel junction using a high-speed diamond disk to reach a root lenght of 16
mm. Working length was standardized at 15mm for all teeth. Root canal preparation performed by the same operator was as follows: All samples were prepared using crown-down technique up to F3 Ni-Ti rotary Protaper files (Dentsply-Maillefer) under constant irrigation with 5.25% NaOCl. Final irrigation sequence was performed using 2 mL of 17% EDTA and 2 mL of 5.25% NaOCl respectively. All samples were dried with paper points and obturated with single-cone gutta percha and MTA-Fillapex sealer. Teeth were stored under 100% humidity at 37°C for 2 weeks. D1, D2, and D3 Protaper Universal Retreatment files were used in in-and-out movements toward the apex to remove filling material. Finally, apical enlargement was carried out for all samples using F4 Ni-Ti rotary Protaper file. Samples were divided into 2 groups randomly (n=13). For final irrigation 5.25% NaOCl and 1.5% Origanum Extract Solution (OES) were used in group 1 and group 2 respectively. Each solution was activated ultrasonically (LM Dental AB, Nynashamn, Sweden) for 60 seconds. Samples were sectioned longitudinally using a diamond disk to groove on the buccal and lingual surfaces and separated into two halves. Digital images taken under stereomicroscope with X5.7 magnification were transferred to ImageJ analysis software to quantify the amount of residual filling material in millimeter square for each third.

**Results** There was no significant difference between Group 1 and Group 2 (P>0.05) for each third. The amount of residual material was found to be most in the apical third in each group. However, the coronal thirds revealed less material than the middle thirds.

**Conclusions** Under the conditions, none of the solutions can not remove filling material completely. A larger amount of filling material is left in the apical third regardless of the solution.

**Acknowledgements** This study was supported by Scientific Research Projects Coordination Unit of Suleyman Demirel University. (Project no: 4553)

**Preparation: Fracture resistance**

GE73

**Comparative study of dentinal microcracks formation through different instrumentation techniques: crown down vs. step back**


*Department of Endodontics, Universidad Complutense de Madrid, Madrid, Spain*

**Aim** The aim of the study is to compare the formation of dentinal cracks with two different instrumentation techniques: Crown down and Step back.

**Methodology** A sample of 95 roots were selected: 15 were left unprepared and served as control, and the remaining 80 roots were divided in 4 experimental groups with sample size of 20 roots in each. Group 1: Crown down with Large file of Wave One (40-0.08), group 2: Crown down with X3 file...
of Protaper Next (30-0.07), group 3: Step back following the files sequence of Wave One: Small (21-0.06), Primary (25-0.08) and Large, and group 4: Step back following the files sequence of Protaper Next: X1 (17-0.04), X2 (25-0.06) and X3. The roots were sectioned horizontally at 3, 6 and 9 mm from the apex and dentinal micro cracks were observed under a stereomicroscope

**Results** The data was analyzed with a chi square test. No cracks were observed in the control group. Statistically significant difference was found in both systems, 36.7% of cracks in Crown down vs 8.3% in Step back with Wave One and 21.6% of cracks in Crown down vs 8.3% in Step back with Protaper Next. Regarding to sectional analysis, a higher incidence of microcracks were observed in the middle third (p<0.05).

**Conclusions** Crown down instrumentation method produced more dentinal microcracks than Step back.

GE74

**Dehydration induces cracking in root dentine irrespective of instrumentation: a 2D and 3D study**

Shemesh H¹, Lindtner T2, Aznar Portoles C², *Zaslansky P³

¹Department of Endodontontology, ACTA, Amsterdam, Netherlands, ²Julius Wolff institute, Charité, Universitätsmedizin Berlin, Berlin, Germany, ³Department for Restorative and Preventive Dentistry, Charité, Universitätsmedizin Berlin, Berlin, Germany

**Aim** Dehydration was previously shown to alter dentin characteristics and even contribute to its structural stability. However, most studies on the influence of endodontic instrumentation on cracks and fractures were performed in vitro with compromised control of environmental hydration. Specifically µCT studies often lack information on the hydration state of the scanned samples. The aim of the current study is to explore the relationship between dehydration and crack formation in roots with and without endodontic intervention.

**Methodology** 53 extracted teeth were used. 30 teeth were imaged both moist (100 % relative humidity - RH) and after dehydration, thus allowing every tooth to serve as its own control. 23 additional teeth were instrumented with ProTaper until F3 and also dehydrated. The presence of cracks was determined both before and after dehydration by microscopy on 2D slices and in 3D by µCT. The µCT data was used to determine the total surface area of newly-formed cracks after dehydration.

**Results** Both 2D and 3D data revealed increased cracking with dehydration. Drying frequently led to cracking in >50% of roots, with a significant incidence appearing within 24 hours of ambient air-drying 35~55 %RH. Some cracking is occasionally observed even within minutes. More cracks were
identified in 3D \( \mu \)CT as compared with 2D microscopy. A correlation was found between dentine cross-section and the total newly-formed crack surface areas.

**Conclusions** Dehydration may induce cracks in dentine regardless of canal instrumentation. The in-vitro observed correlation between root dentine mass and newly-formed cracks implies that dentine dehydration engenders stresses well able to significantly damage roots.

**GE75**

**Effect of body temperature on cyclic fatigue resistance of different NiTi single file systems**

*Youssef E\(^{1,2}\), Jungbluth H\(^2\), Grüner M3, Reimann S\(^2\), Bourauel C\(^2\)*

\(^1\)Department of Periodontology, Operative and Preventive Dentistry \(^2\)Endowed chair of Oral Technology, Faculty of medicine, University of Bonn, Bonn, Germany

**Aim** Aim of the study was to assess the effect of body temperature (37°C) on the cyclic fatigue resistance of three single file systems WaveOne® GOLD (WOG), WaveOne™(WO), and One Shape® new generation.

**Methodology** Ten specimens from each file system (WOG primary, WO primary, and OS 25.06) were tested for cyclic fatigue in a custom made metal block at room temperature (20±2°C), and another ten specimens from each system were tested at body temperature (37±1°C). The metal block had an artificial canal with a 60° angle and a 5mm radius of curvature. The testing block was fixed to a metal holder wearing an attached heating element allowing accurate adjustment of temperature. A connected thermo sensor recorded temperature continuously. The metal holder was furthermore fixed to a universal testing machine. A force sensor ensured that all files were introduced to the canal freely and no mispositioning occurred. After lubricating canal walls with oil, each file was introduced 18 mm to the canal and operated following manufacturer’s instructions until separation of the file occurred. A camera setup was focused on the files and video recording was used to assess the time needed until separation.

**Results** All tested files showed statistically significant less time needed to fracture when operated at 37±1°C than at 20±2°C (P<0.001). Reciprocating files (WOG and WO) needed significantly more time to fracture than continuous rotation files (OS) at both, 20±2°C (WOG=224±14, WO= 221±28, OS=52±12 seconds) and 37±1°C (WOG=122±15, WO=135±25, OS=34±5 seconds). No statistically significant difference was observed between the results of WOG and WO systems at both temperatures (20±2 and 37±1°C).

**Conclusions** Body temperature resulted in decreased cyclic fatigue resistance of all tested file systems compared to room temperature. Reciprocating systems needed more time before occurrence of cyclic fatigue failure compared to continuously rotating systems.
Acknowledgements This study was supported by BONFOR-Scimed scholarship from University of Bonn.

GE76
Effect of Glide Path Creating on Cyclic Fatigue Resistance of Reciproc and Reciproc Blue NiTi Files: A Laboratory Study
Özyürek T¹, *Uslu G¹, Yılmaz K², Gündoğar M³
Department of Endodontics, ¹Ondokuz Mayis University, Samsun, ²Samsun Oral and Health Care Hospital, Samsun, ³Medipol University, İstanbul, Turkey

Aim To compare the cyclic fatigue resistances of Reciproc and Reciproc Blue files that used to prepare root canals of mandibular molar teeth with or without glide path.

Methodology 60 pcs Reciproc R25 (25/.08), and 60 pcs Reciproc Blue R25 (25/.08) files were involved to the present study. 40 teeth in “no glide path groups” and 40 teeth in “with glide path groups” were shaped by using Reciproc R25 and Reciproc Blue R25 files. Than the used and new files were subjected to static cyclic fatigue testing. The number of cycles to fracture was calculated and the length of the fractured fragment was determined by a digital micro caliper. 12 pieces of fractured files (n: 2/each) was examined with SEM to determine the fracture types of the files. The Kruskal-Wallis and post hoc Dunn tests were performed for statistically analyze the data by using SPSS 21.0 software.

Results Cyclic fatigue resistance of Reciproc Blue R25 file in as received condition was found to be higher than that of Reciproc R25 files in as received condition (P < 0.05). Reciproc Blue R25 files used in root canal preparation showed higher cyclic fatigue resistance than Reciproc R25 files used in root canal preparation (P < 0.05). There were no statistically significant difference between Reciproc R25 and Reciproc Blue R25 files used by creating glide path molar teeth and without creating glide path (P < 0.05). There was no statistically significant difference (P < 0.05) in the mean length of the fractured fragments of the instruments.

Conclusions Within the limitations of this in vitro study, it was concluded that creating glide path by using ProGlider files had no effect on cyclic fatigue resistances of Reciproc and Reciproc Blue files when compared to the case, where no glide path was formed.

GE77
Effect of restoration type on stresses in endodontically treated teeth with different tapered canals
Eraslan Öznur¹, *Eraslan Oguz², Belli Sema³
General Endodontic Posters

1Department of Endodontics, Konya Oral and Tooth Health Center, 2Department of Prosthodontics, Selcuk University Faculty of Dentistry, 3Department of Endodontics, Selcuk University Faculty of Dentistry, Konya, Turkey

Aim Taper of root canals and restoration type may affect the biomechanics of an endodontically treated tooth (ETT). This finite elemental stress analysis (FEA) study was aimed to test the effect of different root canal tapers and restoration types (composite resin and ceramic crown) after instrumentation on stress distribution in maxillary central incisor teeth.

Methodology -Four FEA models representing ETT with four different root canal tapers (0.2, 0.4, 0.6, and >0.6) were created. Three more models were created for each taper simulating; ETT kept unfilled (1), ETT obturated and restored by composite resin (2), ETT restored with ceramic crown. -Materials used in the study were assumed to be homogenous and isotropic. A 300 N load was applied from the palatal surface of the crown with a 135° angle. The SolidWorks/Cosmosworks structural analysis program was used for FEA analysis. Results were presented by considering von Mises criteria.

Results Stresses were concentrated at cervical regions of the FEA models simulating ETT which were kept un-filled. Concentrations and values of the stress at the cervical region were increased with the increase in taper. Obturation and restoration have forwarded the stresses from cervical to coronal dentin and enamel structure. Ceramic crown kept the stresses within its structure thus stresses at coronal dentin were decreased.

Conclusions If the prepared root canal kept unfilled, there is a fracture risk because of the high stresses at cervical region, thus obturation and restoration should be completed as soon as possible. Ceramic crown restoration is also recommended to protect tooth structures from high stresses when there is a canal with increased taper. However, additional tooth structure loss should be carefully considered while planning a ceramic crown as final restoration.

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GE78

Influence of proper or optimum torque reverse motion on cyclic fatigue resistance of 3 nickel-titanium rotary instruments

Ambu E1, Rovai F2, Corsentino G1, Campedelli F1, Chang SW3, Grandini S1

1Department of Endodontics and Restorative Dentistry, University of Siena, Siena, Italy
2Private practitioner, Perugia, Perugia, Italy, 3Department of Conservative Dentistry, Seoul National University Dental Hospital, Seoul, Republic of Korea
**General Endodontic Posters**

**Aim** The aim of this study was to evaluate the resistance to cyclic fatigue of HyFlex EDM OneFile (HEDM), Reciproc R25 (Rec) and WaveOne Primary (WO) used in proper rotation or in Optimum Torque Reverse motion (OTR).

**Methodology** A total of 72 nickel-titanium files were tested. 24 instruments for each brand were divided into 2 groups (n = 12) on the basis of the motion used: proper rotation (group 1) or OTR motion (group 2). Resistance to cyclic fatigue was determined by the recording time to fracture (TtF) in a stainless steel artificial canal with a 60° angle of curvature and 5 mm radius of curvature.

Data were analyzed by two-way analysis of variance with significance level at 0.05.

**Results** HEDM showed higher cyclic fatigue in OTR motion than proper rotation (P < .0001). No statistically significant difference was observed in OTR than proper motion for Rec and WO (P > .05). HEDM showed higher TtF when compared with other instruments, both in proper motion and OTR motion (P < .0001). Rec showed higher TtF than WO in both movements (P < .0001).

**Conclusions** Cyclic fatigue of HEDM in OTR motion was higher than in proper rotation. No difference was found in cyclic fatigue of Rec and WO activated in its own motion or OTR movement. HEDM showed higher cyclic fatigue resistance than all other instruments in both motions.

**Preparation: Shaping ability**

**GE79**

**Dentinal Microcrack Formation during Root Canal Preparations by Er,Cr:YSGG Laser**

*Ergin F1, Dumani A1, Ciftci V2, Yoldas O1, Yilmaz S1*

*Departments of 1Endodontics, 2Pediatric Dentistry, Cukurova University Faculty of Dentistry, Adana, Turkey*

**Aim** The purpose of this study was to compare the formation of microcracks following root canal preparation performed with hand files and erbium, chromium:yttrium, scandium, gallium, garnet (Er;Cr:YSGG) laser (Waterlase iPlus; Biolase Technology, Inc., San Clemente, CA, USA) irradiation with the EndoLase Radial firing tip (RFT) Root Canal Therapy Kit.

**Methodology** Sixty extracted single-rooted human mandibular premolar teeth were decoronated by using a diamond coated bur with water-cooling, leaving roots 13 mm in length. A silicon impression material was used for coating the cemental surface of roots to simulate periodontal ligament space. All roots were then embedded in acrylic blocks and divided into 2 experimental groups. The working length was set at 12 mm, 1 mm short of the anatomical apex. In the hand instrumentation group (n=30 teeth), the samples were prepared conventionally using standard K-files enlarged up to master apical file ISO size 40. In the laser group (n=30 teeth), instrumentation was done up to #25 K-file and
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then the canals were irradiated by an Er;Cr:YSGG laser using (RFT2 and RFT3, Endolase, Biolase Technology) with the panel settings of 1.25 W, 50 Hz, 34 % water, and 24% air according to manufacturers’ recommendations. Roots were then sectioned at 3, 6, and 9 mm from the apices, and the cut surfaces were observed under a microscope and checked for presence of dentinal microcracks.

**Results** The prevalence of microcracks showed no significant difference (p>0.05) between the roots prepared with the hand files when compared with the ones prepared with the Er;Cr:YSGG laser.

**Conclusions** The Er,Cr:YSGG laser technique facilitated enlargement of root canals and showed similar microcrack formation when compared with the hand instrumentation technique.

GE80


*Voigt L1, Steffen H1, Drefs M1, Lipke E2, Uhl G2

1Dental Clinic, 2Department of Zoology, Greifswald, Germany

**Aim** The aim of this study was to compare the canal shaping properties of the new single-file system F6 SkyTaper (Komet Brasseler, Lemgo, Germany) with established systems ProTaper Next (Dentsply Maillefer, Ballaigues, Switzerland) and WaveOne (Dentsply Maillefer, Ballaigues, Switzerland) using three-dimensionally reconstructed root canals of extracted human mandibular molars.

**Methodology** Eighteen mandibular molars, divided in three randomized groups, were scanned before and after instrumentation using X-ray micro-computed tomography (micro-CT). Group 1 was prepared with ProTaper Next, Group 2 with F6 SkyTaper and Group 3 with WaveOne respectively. Three dimensional surface reconstructions of respective root canals were obtained using Amira software (FEI, Visualization Science Group). The surface area, the volume and the canal transportation were measured before and after instrumentation.

**Results** Instrumentation of canals increased surface area and volume. Significant differences regarding the gain of surface area and volume could not be observed between the three experimental groups (p>0.05). The WaveOne system produced more transportation than the ProTaper Next and F6 SkyTaper systems 6 and 7 mm coronal of the apex (p<0.05). On the other points there were no significant differences among the three instrument systems.

**Conclusions** In comparison with ProTaper Next and WaveOne, the new file F6 SkyTaper shows equivalent results relating to the parameters such as surface area and volume. The root canals prepared using WaveOne demonstrated more transportation near the middle of the root than the canals instrumented by ProTaper Next and F6 SkyTaper.
**Acknowledgements** The authors would like to thank J. Krieger (University of Greifswald) for providing the micro-CT scans of the teeth. The Micro-CT was financially supported by German Research Foundation (DFG INST292/119-1FUGG, DFG INST 292/120-1 FUGG). We cordially thanks P

**Filling: Leakage**

GE81

**Apical leakage in two instrumentation and obturation techniques: a comparative study**

*Vula V, Hoxha V, Dragusha E, Ajeti N, Kuçi A*

*Dental Pathology and Endodontics, University Dentistry Clinical Center of Kosova, Prishtina, Kosova*

**Aim** Initial instrumentation and final obturation are prerequisites that insure apical seal. The purpose of this study was to compare the apical leakage of the canal systems in two instrumentation and obturation techniques.

**Methodology** This study included 80 human single rooted teeth divided into two experimental groups and the remaining 20 teeth in two control groups. Experimental group 1 were instrumented with crown-down technique with Protaper (Dentsply, Germany) and obturated with ProRoot MTA (Dentsply, USA), AHPlus (Dentsply, Germany) and Thermafill (). Experimental Group 2 were instrumented with sep-back technique using K-Files (Dentsply, Swiss) and obturated with ProRoot MTA (Dentsply USA), AHPlus (Dentsply, Germany) and cold lateral condensation of gutta-percha. Apical leakage was measured by dye penetration observation of methylene blue 2%. After incubation (37 degrees C for 7 days in 100% humidity) the teeth were longitudinally sectioned and linear dye penetration at the apical one third was observed with a electronic stereomicroscope (Brunel, UK) at 20X and 30X magnification.

**Results** The results were statistically tested using descriptive analysis and T-tests. Group 1 showed maximum level of dye penetration for MTA (0.14 mm) and AHPlus (0.14 mm) and Group 2 for MTA (1.07 mm) and AHplus (0.89 mm).

**Conclusions** There was statistically significant difference in dye penetration between teeth instrumented with crown-down technique and obturated with Thermafill versus teeth instrumented with step-back technique and obturated with cold lateral compaction of gutta-percha.

GE83

**Sealing ability of bioceramic based material and mineral trioxide aggregate in retro-cavities prepared with Er,Cr:YSGG laser and ultrasonic technique**

*Bago I¹, Lucić R¹, Budimir A², Šimundić Munitić M³, Toljan I⁴, Anić I¹
Aim The aim of the in vitro study was to compare the apical sealing ability of Bioceramic Root Repair Material (BC-RRM) and Mineral Trioxide Aggregate (MTA) in retro-cavities prepared by erbium, chromium: yttrium, scandium, gallium, garnet (Er,Cr:YSGG) laser and ultrasonic technique.

Methodology The 48 human single-rooted teeth were instrumented with ProTaper Next technique and divided in two groups according to the retro-cavity preparation technique used: Group 1: ultrasonic technique, Group 2: Er,Cr:YSGG laser (power: 3.5 W, frequency: 25 Hz, fluence: 28 J/cm²). In each group, the retrograde cavities were filled with TotalFill BC-RRM (Brasseler, Savannah, USA) and with MTA (Angelus, Lordrina, Brasil). The positive controls were filled with temporary material and negative controls with utility wax and the whole surface covered with nail varnish. The specimens were mounted in Eppendorf tubes and sterilized in plasma. The root canals were inoculated with Enterococcus faecalis suspension, and the tubes were filled with fetal bovine serum leaving the apical part in the serum. After 30 days, the canals were sampled, serially diluted, cultured and colony forming units (CFUs) were counted. The presence of the bacteria was also confirmed with polymerase chain reaction. The Mann-Whitney U test and Kruskal-Wallis test were used for the results analysis.

Results There was no significant difference between the ultrasonic groups and the laser-MTA group regarding the number of CFUs (p>0.05). The laser-BC-RRM showed the highest number of remaining viable bacteria in canals (p<0.001). In the laser-BC-RRM group, all specimens were positive. In the ultrasonic-MTA group, two specimens had viable bacteria in canals, and in the ultrasonic-BC-RRM group four canals were positive.

Conclusions Both retro-filling materials in ultrasonic preparations presented similar sealing ability. The BC-RRM showed more leakage when used in the Er,Cr:YSGG laser retro-cavities.

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Sealing of root perforation with three different materials

*Stavileci M, Hoxha V, Bajrami D, Dragidella A, Kamberi B

Department of Dental Pathology and Endodontics, University of Prishtina, Faculty of Medicine, Dental School, Prishtina, Kosova
**Aim**
The aim of this study was sealing ability evaluation of Biodentine, MTA and glass ionomer cement as root perforation repaired materials.

**Methodology**
Forty extracted human lower molars were used for this study. After access cavity preparation and pulp tissue and debris cleaning, root perforations were made on the center of the floor and teeth were divided into experimental and control groups. Root perforation of ten teeth (group A) were repaired with MTA (ProRoot, Tulsa, Dentsply), root perforation of ten teeth (group B) were repaired with Biodentine TM (Septodont, France) and root perforation of ten teeth (group C) were repaired with glass ionomer cement. Root perforation of five teeth were not repaired and served as positive control group. Five intact teeth served as negative control group. The samples were immersed in 2% methylene blue and after rinse were sectioned and examined under stereomicroscope for dye penetration evaluation.

**Results**
Data were statistically analysed using analysis of variance (ANOVA) at level of significance p=0.05. Root perforation repaired with Biodentine showed significantly less dye penetration, compared with MTA and glass ionomer cement (P<0.05).

**Conclusions**
All repaired materials showed some degree of dye penetration. Biodentine showed least microleakage.

**Filling: Sealers**

**GE85**

*A comparative in-vitro study of three different sealer placement techniques in straight root canals*

*Holscher C, Müller A, Hülsmann M*

*Department of Preventive Dentistry, Periodontology and Cariology, University of Göttingen, Göttingen, Germany, Georg August University of Göttingen, Göttingen, Germany*

**Aim**
To examine the efficiency of three different techniques (lentulo, ultrasonic tip, CanalBrush) of sealer placement (AH-Plus, Dentsply, Konstanz, Germany) in straight root canals with different sizes (35/.02; 45/.02).

**Methodology**
The root canals of one-hundred and twenty extracted single-rooted human teeth were randomly divided into two groups (n=60), shortened to a standardized length of 20 mm and prepared to size 35 taper .02 (G1) or size 45 taper .02 (G2) using NiTi-files (FlexMaster, VDW, Munich, Germany). The teeth were embedded in plastic tubes and split longitudinally. Grooves with a standardized size were prepared at 3 and 6 mm coronal of the root tip and the root halves reassembled. Each group was divided into 3 subgroups (n=20) and a defined amount of sealer placed with one of the following techniques: lentulo (VDW, Munich, Germany), ultrasonic tip (Endosonore File, Dentsply Maillefer, Ballaigues, Switzerland), or CanalBrush (Coltène Whaledent, Langenau,
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Germany). After incubation for 4 weeks at 100% humidity and 37°C, digital images were taken at 40x magnification. Two calibrated observers independently examined each picture twice using a 4-stage score for distribution of the sealer in the root canal and in the standard grooves.

**Results** Inter- and intraobserver agreement were 81% and 89%, respectively. Preparation to size 45 taper 0.02 resulted in significantly best sealer distribution within all methods. Regarding size 35 taper .02 CanalBrush resulted in significantly better results than lentulo or ultrasonic tip. CanalBrush and lentulo were significantly superior to ultrasonics in filling the grooves. Five CanalBrushs fractured during sealer placement.

**Conclusions** Preparation to size 45 taper .02 resulted in best sealer placement. CanalBrush performed significantly better than the lentulo or ultrasonics regarding sealer distribution in straight root canals.

GE86

**Effect of additive laser and sonic activation device use on push out bond strength of a novel sealer; BioRoot RCS**

*Mutlu SN, Eldeniz AU*

*Department of Endodontics, Selcuk University, Faculty of Dentistry, Konya, Turkey*

**Aim** To evaluate the influence of additional Nd:YAG laser and two sonic devices use for smear layer removal and push out bond strength of two bioceramic sealers to dentine.

**Methodology** Seventy single-rooted teeth were instrumented with ProTaper Universal files to size F4 and irrigated with NaOCl. Roots were randomly divided into 5 main groups (n=13) and treated as follows; Group 1; Endodontic needles (EN) (1 min-6 ml saline) and then were divided into two subgroups according to the sealer used; MTA Fillapex or BioRoot RCS with gutta-percha Group 2; EN with 3% NaOCl (3ml-30 sec), %17 EDTA (3ml-30sec) and obturated with one of the sealers (n=6). Group 3; Vibringe with 3% NaOCl (3ml- 30 sec), %17 EDTA (3ml-30sec) and obturated as previously. Group 4; EN 3% NaOCl (3ml- 30 sec) and %17 EDTA (3ml-30sec) with EndoActivator application and obturated as others. Group 5; Irrigated as in Group 2 with Nd:YAG laser application (40 sec) and obturated. After storing in an incubator for 1 week, one root from each group was used to examine smear layer removal. The test specimens were subjected to the push out test (0.5 mm/min).

Interactions amongst the irrigation methods, sealers and root regions were analysed using a three-way analysis of variance (P < 0.05). Tukey HSD multiple comparison test was used for post hoc comparisons (α=0.05).

**Results** Push out bond strength values were significantly increased when root dentine irrigated with EN in comparison with Vibringe and EndoActivator groups (P<0.05). Highest bond strength values
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were obtained with BioRootRCS sealer (P<0.05). The push out bond strength in the middle portion of the root was significantly higher than the coronal region (P<0.05).

Conclusions The use of sonic activation devices EndoActivator or Vibrange did not significantly improve push out bond strength of bioceramic sealers to dentine when compared with conventional irrigation with endodontic needles.

Acknowledgements Authors would like to thank Septodont Company for BioROOT RCS sealer.

GE87

Evaluation of anti-inflammation and osteogenic differentiation of various root canal sealers

*Lee JH, Chang HS, Hwang IN, Oh WM, Hwang YC, Lee BN

Department of Conservative dentistry, Chonnam National University, School of dentistry, Gwangju, Republic of Korea

Aim The properties of an ideal root canal sealer include creating a bacteria-resistant seal, possessing antimicrobial activities, and providing good adhesion between itself and the intraradicular dentin after setting. The aim of this study was to evaluate the effects of 3 root canal sealers on the cell viability, inflammatory response, and osteogenic potential of MC3T3-E1 cells.

Methodology Under aseptic condition, AH plus (Dentsply Caulk, Milford, DE USA), MTA fillapex (Angelus, Londrina, PR, Brazil), and EndoSequence BC (Brasseler USA, Savannah, GA USA) were mixed according to the manufacturer’s instruction and samples were prepared as extraction media (final dilution 1:10). We used LPS (100ng/ml) treatment to evaluate inflammatory response this study and cell viability was evaluated by WST-1 assay. Levels of inflammatory mediators (IL-1β, IL-6, and TNF-α) were measured by qRT-PCR with or without LPS treatment. Osteogenic potential was evaluated with alkaline phosphatase staining, alizarin red staining, and the osteogenic marker genes (ALP, BSP, and OCN) were analyzed by qRT-PCR. One-way analysis of variance followed by Tukey’s post hoc test was used to determine any statistically significant differences according to the test materials. Differences were considered significant at p < .05.

Results There was no statistically significant difference in cell viability for the type of sealers or concentrations of LPS. Inflammatory mediators were significantly higher in LPS-treated groups compared with group without LPS treatment, and all sealers decreased the LPS-induced inflammation mediators (p < .05). The expression of osteogenic marker genes, ALP activity and mineralized nodule formation decreased by LPS treatment, but EndoSequence BC and MTA fillapex, calcium-silicate based sealers, showed significantly higher ALP activity and mineralized nodule formation compared with LPS treatment group (p < .05).
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Conclusions AH plus, MTA Fillapex, and EndoSequence BC induce a lower expression of inflammatory mediators and enhance osteogenic differentiation in MC3T3-E1 cells.

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GE88

In vitro Comparative Study of Adhesion Force in Dentine of Three Cement Sealers BC-Sealer, AH-Plus and MTA Fillapex

Carrillo AG1, *Velarde V1, Garcia JC1, Carrillo LH1, Hofmann ME1, Villareal L2, Gonzalez B3, Bustamante T1, Cadena MA1

1Departament of Endodontontology, post graduate, 2Escuela de Ciencias de la Ingeniería y Tecnología, Valle de las Palmas, 3Facultad de Ciencias Químicas e Ingeniería, Valle de las Palmas, Universidad Autonoma de Baja California, Tijuana, Baja California, Mexico

Aim Sealers based on calcium silicate have the ability to provide excellent sealing and bioactivity. The purpose of this study was to evaluate the adhesion forces of EndoSequence BC-Sealer® a bioceramic based premixed calcium silicate-phosphate (BC; Brasseler USA, Savannah, GA), compared with a cement-based MTA (Mineral Trioxide Aggregate) Fillapex® MTA (Angelus), and a cement based on epoxy resin AH-Plus® (DeTrey/Dentsply, Ballaigues, Switzerland), by comparing adherence to dentine between filled teeth with single cone technique (CU) BC-Sealer®, lateral condensation (CL) MTA Fillapex® and AH-Plus®.

Methodology For this, 45 uniradicular extracted teeth, palatal roots of upper molars and distal roots of lower molars with large and straight canals were used, they were randomly divided into 3 groups (n = 15), Group 1, BC-Sealer® CU; Group 2, MTA Fillapex® CL; Group 3, AH-Plus® CL. The roots were cut into specimens of 4 mm thick in the middle and apical thirds, leaving 30 specimens per group and the adhesion strength was measured using a standardized compression test.

Studies of scanning electron microscopy were performed in a field emission microscope JEOL JSM 7600F. Thereafter, samples were placed on a baking electron microscope and images were captured in different areas at different magnitudes of amplification.

Results As a result, Group 1, BC-Sealer® CU had the bond strength statistically superior to Group 2, MTA Fillapex® CL and Group 3, AH-Plus® CL.

Conclusions Finally, it was concluded that BC-Sealer® CU material proved to be the best adhesion in both thirds of the root canal being significantly noticeable in the middle third, compared to MTA Fillapex® CL, and AH-Plus® CL.
Effect of different smear layer removal and condensation techniques on the adaptation ability of MTA

*Turkyilmaz A, Ozbay Y, Erdemir A

Department of Endodontics, Faculty of Dentistry, Kirikkale University, Kirikkale, Turkey

**Aim**
To evaluate the effect of different smear layer removal and condensation techniques on the adaptation ability of Mineral Trioxide Aggregate (MTA).

**Methodology**
In this study 80 extracted single-rooted human teeth were selected and prepared to #F4 file using ProTaper rotary files (Dentsply Maillefer, Ballaigues, Switzerland). The roots were randomly divided into 4 groups according to irrigation protocols. NaOCl was used as an irrigant in Group 1 and the other groups were treated with 2.5% NaOCl and 17% EDTA. Irrigation solutions were applied with conventional syringe irrigation (Group 2), passive ultrasonic irrigation (PUI) activation (Group 3) and Er:YAG laser using with photon-induced photoacoustic streaming (PIPS) activation (Group 4). 3 mm apical portion was removed and two 1 mm thickness dentin discs were obtained at 1st mm (apical) and 7th mm (coronal) of the remained roots. Then the groups were divided into 2 subgroups according to MTA condensation techniques. MTA was applied to dentin discs using plugger condensation with and without ultrasonic activation. After obturation, all discs were stored at 100% humidity condition at 37°C during 24 hours for MTA setting. The adaptation ability of MTA was investigated using scanning electron microscope (SEM). The data were analyzed by using two analysis of variance followed by post hoc Tukey tests.

**Results**
The use of Er:YAG laser with PIPS in removing of the smear layer yielded the highest adaptation ability. MTA application using indirect ultrasonic vibration was decreased adaptation ability compared to MTA application without ultrasonic vibration (p<0.05). MTA adaptation was increased more effectively at the coronal level compared to the apical level (p<0.05).

**Conclusions**
This study showed that removal of the smear layer improved the adaptation ability of MTA. Marginal adaptation of MTA was adversely affected by using ultrasonic plugger activation.

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Management Of Complicated Clinical Cases Using With MTA: Report of Six Cases

KIRAZ GÜLESIN, TULI GUZIN, DINC VULKAN, ÜREYEN KAFA BULEM, KECECI AYSE DİLMEN
Bismil University, Faculty of Dentistry, Department of Endodontics

INTRODUCTION

MTA is a biocompatible antimicrobial calcium hydroxide that is extremely biocompatible, capable of stimulating healing and apical closure. Clinical applications of MTA include pulpotomies, root-end fillings, retrograde root fillings, perforation repair, post-endovascular filling, and root perforation. MTA is a mineral trioxide aggregate, which is a material that is used in endodontics.

CASE SERIES

Case 1: A 45-year-old female who had a previous endodontic treatment and completion of root canal associated with a lower right maxilla tooth, was referred to our clinic. Clinical and radiographic examination revealed incomplete coronal and furcation perforation. Coronal perforation was treated with MTA and root canal treatment was completed.

Case 2: A 53-year-old male who had a previous endodontic treatment and completion of root canal associated with a lower right maxilla tooth, was referred to our clinic. Clinical and radiographic examination revealed incomplete coronal and furcation perforation. Coronal perforation was treated with MTA and root canal treatment was completed.

Case 3: A 42-year-old male who had a previous endodontic treatment and completion of root canal associated with a lower right maxilla tooth, was referred to our clinic. Clinical and radiographic examination revealed incomplete coronal and furcation perforation. Coronal perforation was treated with MTA and root canal treatment was completed.

Case 4: A 14-year-old male who had a previous endodontic treatment and completion of root canal associated with a lower right maxilla tooth, was referred to our clinic. Clinical and radiographic examination revealed incomplete coronal and furcation perforation. Coronal perforation was treated with MTA and root canal treatment was completed.

Case 5: A 47-year-old female who had a previous endodontic treatment and completion of root canal associated with a lower right maxilla tooth, was referred to our clinic. Radiographic and clinical examination revealed incomplete coronal and furcation perforation. Coronal perforation was treated with MTA and root canal treatment was completed.

Case 6: A 59-year-old female who had a previous endodontic treatment and completion of root canal associated with a lower right maxilla tooth, was referred to our clinic. Radiographic and clinical examination revealed incomplete coronal and furcation perforation. Coronal perforation was treated with MTA and root canal treatment was completed.

DISCUSSION

The success of endodontic treatment using MTA is dependent on the proper placement and technique. MTA has been shown to be effective in treating endodontic perforations and root fracture cases. However, the success rate varies depending on the location and extent of the perforation. Radiographic examination is crucial in determining the success of the treatment.

CONCLUSION & CLINICAL RELEVANCE

MTA is a valuable material in endodontics, particularly in cases of perforation and root fracture. It should be used in combination with other materials and techniques to achieve the best possible outcome. Radiographic follow-up is essential to monitor the healing process and ensure long-term success.

MTA has been shown to be effective in treating endodontic perforations and root fractures. Its biocompatibility and sealing properties make it a valuable material in endodontic treatment. However, the success rate varies depending on the location and extent of the perforation. Radiographic examination is crucial in determining the success of the treatment.
MISERAL TRIOXIDE AGGREGATE APICAL PLUG METHOD FOR THE MANAGEMENT OF IMMATURE ANTERIOR TEETH: 2 CASE REPORTS

Sezin YEĞİN & Nihal AKKAYA
Ankara University, Dept of Endodontics

Aim: To evaluate healing of immature anterior teeth that treated with mineral trioxide aggregate to obtain an apical barrier.

Introduction: Various etiologic factors such as trauma, caries or other pulpal pathosis can impede root development completely. In this situations, root canal instrumentation and obturations is difficult to achieve due to large canal with thin canal walls and open apices. In order to control root filling material and induce closure of apical foremen, calcium hydroxide has been used for many years. In spite of its efficacy, this treatment approach involves some disadvantages such as multiapointment and risk of root fracture. Mineral trioxide aggregate is proposed as an alternative material to calcium hydroxide for forming apical barrier.

Case Presentation: The following two cases that had trauma histories. Based on clinic and radiographic findings, the diagnosis of pulp necrosis and open apex were made for all cases. After access cavity and root canal instrumentation were prepared. Root canal debridement was done using alternate irrigation with 2.5% NaOCl and saline. The root canals were then dried with sterile paper points. Then a paste which contains calcium hydroxide and steril salvon solution were placed into the root canal system. This procedure was applied twice in a two weeks period. After two weeks the calcium hydroxide paste was removed from the canal. MTA (Angelus, Londrina, PR, Brazil) mixture was placed in the apical region of the canals (4 mm). A wet cotton pellet was placed in the pulp chambers and the access cavities were sealed with cavit. After 3 days the cavity and the cotton pellet was removed and the rest of the all canals were obturated with gutta percha cones and root canal sealer. The coronal access cavities were sealed with composite resin.

Discussion: The use of MTA had simplifed the procedure of repairing an open apex, where MTA can be used as an apical plug over an open apex. The success of MTA apical plug has been attributed mainly to its good sealing ability,[1] biocompatibility,[2] and ability to promote pulpal and periodontal tissue regeneration.

Conclusion: At 6 months follow-up the two cases were totally asymptomatic. The healing of the periapical and the formation of the apical closure was seen radiographically.


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Mineral trioxide aggregate versus calcium hydroxide: evaluation of effectiveness in vital pulp therapy

*Ostanina DA, Zablotskaya MV, Zablotskaya NV, Jekova AA

Department of Carieology and Endodontics, Moscow State University of Medicine and Dentistry, Moscow, Russia

Aim The era of vital pulp therapy has been greatly enhanced with the introduction of various pulp capping materials. The aim of the report is to investigate the physical and chemical properties of Trioxident (VladMiVa, Russia), ProRoot MTA (Dentsply, USA) and MTA Angelus (Angelus, Brazil) and to evaluate their effectiveness in comparison with calcium hydroxide preparations in vital pulp therapy.

Summary The research followed by an opinion poll, which was conducted among 355 dentists from different countries on the topic of vital pulp therapy with the use of Google Forms service. The laboratory study included Trioxident (VladMiVa, Russia), ProRoot MTA (Dentsply, USA) and MTA Angelus (Angelus, Brazil). Physical and chemical properties of the materials were characterized by scanning electronic microscopy (SEM); material porosity was investigated by light microscopy. In addition, the setting time, pH of the solution and radiopacity were analyzed. According to the results of the analysis, the material with the best characteristics was chosen. 22 patients aged 11-35 with reversible pulpitis took part in the clinical research. The treatment was done by a classic scheme, by dividing the participants into 2 groups. In the first group was used Trioxident as a capping material. In the second group was used a calcium hydroxide preparation. The monitoring of the treatment results was carried in 7 days, 1 month and 6 months. The results was statistically analyzed (SPSS).

Key Learning Points

• The survey showed that 67.1% of dentists consider the pulp capping materials effective. However, just 47.8% of the pollees uses these materials in restorative dentistry.
• SEM analysis shows that the tested MTA products were composed primarily of Portland cement. However, Trioxident additionally consists of cooper compounds, which lifts its bacteriostatic properties. Trioxident has the highest pH index – 12.8 and the shortest time of hardening. According to the results of laboratory analysis, Trioxident was selected for the use in further research.
• The clinical results confirm the analyzed MTA product Trioxident is a useful tool for deep caries lesions and reversible pulpitis treatment in 90% cases after 6 months of supervision.
• The satisfactory treatment by calcium hydroxide preparation was shown just in 63% cases.
ONE VISIT PULPECTOMY with MTA:

3 YEARS FOLLOW-UP

Berna Gokkaya¹, Betul Kargul²

¹Kucukcekmece Oral and Dental Health Hospital, Pediatric Dentistry Clinics, Istanbul, Turkey
²Marmara University, Department of Pediatric Dentistry, Istanbul, Turkey

Aim: To discuss the use of Mineral Trioxide Aggregate (MTA) for pulpectomy of primary molars for root canal fillings material.

Introduction: Mineral Trioxide Aggregate (MTA), has excellent biocompatibility, sealing ability, stimulating bone and dentin bridge formation, cementum and periodontal ligament regeneration capability, antimicrobial properties and also can be made in one session is preferred for a material used. MTA (ProRoot MTA; Dentsply, Tulsa Dental, USA) is recommended material for pulpotomy root canal treatment, pulp capping, apexification, repair of root resorption and resorptive defects.

Case Presentation: 5-year-old girl with deep dentin caries on mandibular right primary second molar tooth (65), pain and mobility was presented to the Department of Pediatric Dentistry, Faculty of Dentistry, University of Marmara. Patient’s medical history revealed no significant findings. Radiographic examination also revealed furcation and periapical radiolucency. After extirpation, MTA was mixed according to the manufacturer’s instructions and compacted into the canal. On 3-year follow-up, the patient had no signs or symptoms, and radiographic examination demonstrated complete resolution of periapical radiolucency.

Discussion: MTA displayed more microleakage than lateral-condensed as well as gutta percha as root canal filling materials.

Conclusions and clinical Relevance: Although successful results on this case, further clinical studies with longer follow-up periods are necessary. One visit application of MTA for root filling in primary teeth may be an alternative treatment option for other filling materials.

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Radiographic outcomes of orthograde mineral trioxide aggregate grafting and mineral trioxide aggregate - based endodontic sealer obturation.

Orhan E¹, Kanat A¹, Irmak O², *Ertugrul IF³
¹Department of Endodontics, Eskisehir Osmangazi University, Faculty of Dentistry, Eskisehir,
²Department of Restorative Dentistry, Eskisehir Osmangazi University, Faculty of Dentistry, Eskisehir,
³Department of Endodontics, Pamukkale University, Faculty of Dentistry, Denizli, Turkey

Aim This study aimed to evaluate the radiographic success of non-surgical root canal treatment of orthograde mineral trioxide aggregate grafting (MTA) and MTA-based endodontic sealer obturation

Methodology The radiographic follow-up data of 404 teeth with periapical lesion which were obturated with single-visit MTA-based endodontic sealer (MTA Fillapex, Angelus, Brazil) + gutta percha (GP), single-visit orthograde MTA grafting (OrthoMTA, BioMTA, Seoul, Korea) and two-visit resin-based sealer (AH Plus, De Trey, Konstanz, Germany) + GP (Control) were retrieved from the archives to evaluate periapical healing at the end of 12 months after non-surgical root canal treatment. The periapical index (PAI) scores of teeth treated with non-surgical root canal treatment were analyzed.

Results The radiographic outcome of root canal treated teeth were no differences statistically significant (P > 0.05).

Conclusions Regarding the evaluation of the radiographic success of root canal treatments evaluated it was found that the success rate in single-visit orthograde MTA grafting is higher, however not statistically significant. Further prospective studies with larger sample sizes should be conducted to achieve more favorable results of the orthograde MTA grafting technique and periapical healing.

Acknowledgements This retrospective study approved by ethical committee.
Single-visit orthograde mineral trioxide aggregate canal grafting of compromised teeth

Ekim Onur ORHAN, Babak Mobaraki
Department of Endodontics, Faculty of Dentistry, Eskişehir Osmangazi University, Eskişehir, Turkey

Aim: The purpose of the report was to compose fully documented cases treated with the orthograde mineral trioxide aggregate canal grafting technique in compromised teeth.

Introduction: OrthoMTA (BioMTA, Seoul, Korea) is a new developed calcium silicate-based cement (CSC) for root canal obturation. According to the manufacturer, orthograde mineral trioxide aggregate grafting technique is called “Biofilling” of the root canal system with OrthoMTA. Indications were primary/secondary root canal infection, traumatic dental injury, root resorptions, combined endodontic lesions, single-visit apicectomy, apical surgery.

Case Presentation: Cases presented below were treated with Biofilling technique according to the manufacturer recommendations. (fig.1)

Discussion: The teeth presented acceptable functional and/or total healing during the follow-up examination without relapse. Clinical symptoms such as pain, dysfunction, sinus tract progressively disappeared in the following 3 weeks. Similarly, periapical healing was seen by X-ray examinations in the following 6-12 months.

Conclusion and Clinical Relevance: Single-visit orthograde mineral trioxide aggregate grafting technique using OrthoMTA can be considered an acceptable root canal treatment, and this may be an alternative to the use of gutta percha with root canal sealer obturation.

References:
THE RETROGRAD TREATMENT OF PERSISTENT PERIAPICAL LESION USING MTA

Introduction:
Surgical endodontics is a reliable method for the treatment of teeth with periapical lesions that do not respond to conventional root canal treatment or when orthograde treatment is not feasible.

Case Summary:
The aim of this case report presented with chronic periapical pathology with apical curettage and retrograde filling with MTA as well as soft tissue managed with flap design and one year follow-up. 20 years old male patient was referred to our clinic with percussion pain in tooth of right maxillary premolar area. Radiography showed apical bone resorption. The apical area was curedtted and marginal root resection. After preparation of apical area for the purpose of retrograde filling, Mineral Trioxide Aggregate (ProRoot MTA, Demipry) was placed. Regular follow-up was done from the time of operating procedure as 1 month, 3 months and every 6 months.

Conclusion:
Regular follow-up was done from the time of operating procedure as 1 month, 3 months and every 6 months. There was no significant sign and symptoms clinically. Radiograph showed formation of new bone at periapical area and the lesion size was reduced.

References:
TREATMENT OF NECROTIC IMMATURE TOOTH USING CALCIUM HYDROXIDE AND MINERAL TRIOXIDE AGGREGATE: A CASE REPORT

Didem Akış, M. Emir Dincel, Müşfe Özgen, Seçkin Dindar
Istanbul University, Faculty of Dentistry, Department of Endodontics

The aim
To explain the specification of a traumatized immature maxillary left central incisor with perisial lesion by using Mineral Trioxide Aggregate (MTA) as a surgical barrier material.

Introduction
Pulp necrosis is one of the main complications of dental trauma. When it happens on an immature tooth, pulp necrosis implies a lack of root maturation and apical closure (1). Consequently, the root canal is large, with thin and fragile walls and the apex remains open (2). It is then mandatory to implement a therapy, called specification to induce a hard calcific barrier at the apical end of the root (1). One of the treatment modality for specification is utilization of Calcium Hydroxide (CH) as an intraradicular medication. Over the last decade, MTA has been reported as a possible answer to many clinical endodontic challenges. It offers the option of a two visits specification procedure, which has been benefit of reduced number of radiographs over the multiple visit calcium hydroxide specification (3).

Case Presentation
A 16-year-old male patient was referred to our clinic with complaints of mobility and crown fracture. A large radioluscent lesion around the apex of maxillary left central incisor along with incomplete root formation was detected by periapical radiograph. A diagnosis of chronic suppurative apical abscess was made (Fig. 1).

Treatment Approach
Access opening was done using high-speed hand piece. Necrotic pulp and organic debris were extracted under copious irrigation using normal saline. The working length was determined by radiographically (Fig. 2) and the root canal was instrumented using K-type hand files. The canal was irrigated and CH powder mixed with glycerine (Ebaquin, Aksh Co; Izmir, Turkey) was given as intraradicular medication. After 2 weeks, CH irrigation was removed with hand files and NaOCl irrigation. This was followed by placement of MTA plug (Fig. 3) and rest of the canal was filled with cold lateral compaction technique by using a root based root canal sealer (AH26, Dentsply, Konstanz) and gutta-percha cones (Fig. 4). Esthetic rehabilitation was done using light cured composite resin.

Discussion
The most significant problem associated with classical specification using CH is the long period of treatment which may be between 8-21 months (4). During specification with this material, there are possibilities of canal re-infection and cervical fracture (1). To avoid these inconveniences, the use of a new material potentially inducing mineralization such as MTA was suggested. The application of MTA in teeth with divergent apices becomes unmanageable due to the difficulty in adapting this material. For this reason, the prior use of CH becomes necessary to create conditions to facilitate MTA setting and improves its proprio (5). As described in the reported case, the use of these two materials (CH, MTA) in teeth with incomplete root formation demonstrate classical and radiographic success at follow-up periods.

Conclusion and Clinical Relevance
In the MTA plug technique, root canals must be disinfected with temporary CH before placing MTA for two weeks (6). Hence, we used CH in this case, as between the appointments in the root canal for disinfection was for disinfector. At the 7-month recall, radiologic examinations showed the resolution of the periradicular pathology (Fig. 5).

References
Filling: Other
GE98

Comparative evaluation of the quality of root fillings in the traditional endodontic dental treatment in experiment

*Zablotskaya MV, Mitronin AV, Zablotskaya NV, Ostanina DA, Cuprianova MS

1Department of Cariesology and Endodontics, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Faculty of Dentistry, Moscow, 2Department of Cariesology and Endodontics, Yaroslavl Medical University, Yaroslavl, Russian Federation

Aim To evaluate the degree of fit of the root fillings to the walls of the channels via USB-light microscope with two traditional methods of filling with gutta-percha.

Methodology Was used 24 single rooted teeth removed from patients aged from 16 to 34 years, not previously endodontic treated. Root canals (RC) teeth treated instrumentally by «Crown-Down» using hand tools «ProTaper». Provide medical treatment and filling of RC two most popular methods: with sealer «AH Plus» (Dentsply) lateral condensation and «Thermafil» system (teeth 12). Three days after the sealing of the roots of teeth sawed at the wellhead, middle and apical thirds of the fine diamond cutter (20 teeth). Another 4 teeth sawed longitudinally along the spacecraft. Spills photographed using a USB-microscope at a magnification of ×15 to 40×. Quality was evaluated by filling the exponent to fit the root fillings RC walls (FEF): $\text{FEF} = \frac{S_{\text{fm}}}{S_{\text{sa}}} \times 100\%$, where: $S_{\text{fm}}$ – the area of the filling material filling the gap RC; $S_{\text{sa}}$ – sectional area of the spacecraft.

Results Spills longitudinal teeth for RC clearly visible areas not filled with a root filling (fig.1). Comparison of two different methods in terms of FEF was in favor of «Thermafil» system only in the third RC wellhead ($p<0.05$, tabl., fig. 2). In other areas of statistically significant differences were found.

Conclusions The results of the study can be concluded that both techniques (lateral condensation of gutta-percha and the use of «Termafil» system) demonstrated in the experiment a high degree of fit to the walls of the filling RC. However, no one saw cut root was observed rate of 100%. This suggests an insufficient endodontic treatment. It is in these areas of the root canal remain micro voids, because along with open dentinal tubules are reservoirs of pathogenic biofilm persistence. Installed denser obturation RC «Termafil» system in their mouth-hand side. Quality ductwork sealing hot and cold gutta-percha, whose other parts of statistically significant differences were found.

GE99

Evaluation of Different Root Canal Techniques on Micro-CT
Sevimay S, *Celikten B, Huang Y, Yalnaz H
**Aim** The aim of the study was to measure percentage of volume of voids and gaps in oval shaped root canals, fillings completed by Thermafil, continuous wave obturation (ElementsTM Free) and cold lateral compaction techniques by using micro-computed tomography (micro-CT) analysis.

**Methodology** Thirty-six single-rooted maxillary second premolar teeth with oval-shaped canals were selected, and root canals were prepared by using rotary files and then randomly divided into three groups (n=12) according to the filling technique. Group 1 was obturated with Thermafil obturators, group 2 with continuous wave obturation (ElementsTM Free) and group 3 with cold lateral compaction technique. AH Plus sealer was used in all groups. Each specimen of filled canals was scanned using a micro-CT device at an isotropic resolution of 13.67 µm. Data were obtained and statistically analyzes was used Kruskal–Wallis test (P < 0.05).

**Results** The percentage of gutta percha filled canal area using continuous wave obturation technique was greater in oval canals. The percentages of voids in this group was lower than other groups. No significant differences were found between the Thermafil Obturation and cold lateral compaction groups.

**Conclusions** All root canal filling techniques did not prevent to voids and continuous wave obturation technique was better results compare to other two techniques.

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**Fracture resistance of roots obturated with a single expandable polymer cone.**

*Elsayed MA¹, Elgendy AA²*

1Department of Endodontics, Faculty of Dentistry, Assiut University, Assiut, Egypt
2Department of Endodontics, Faculty of Dentistry, Assiut University, Assiut, Egypt

**Aim** The aim of this study was to compare in vitro the root fracture resistance after filling either with smartseal system (propointPT cone and smartpastebio sealer) or with gutta percha in combination with either MTAfillapex or AH plus sealers.

**Methodology** Sixty single-canal extracted teeth were selected. The crowns were removed at the cemento-enamel junction, roots were divided into four groups (n=15). All root canals except for the Group 4 were shaped until F4 file with ProTaper rotary system. Group 1: (smart seal system) specimens were filled with a bioceramic sealer (Smartpaste bio), and F4 propoint PT. Group 2: were filled with MTAfillapex and F4 gutta-percha single cone. Group 3: were filled with AH Plus sealer and F4 gutta-percha single cone. In group 4 the roots were neither shaped nor filled and served as
Results Roots in the negative control group and (smart seal system) group showed significantly higher values (380.7± 59 N) and (347.2±56 N) respectively. There was no significant difference between the MTA fillapex/GP group and AH plus /GP group (227.4 ±43 N) and (254.4 ± 55 N) respectively.

Conclusions It can be concluded that the smartseal system did improve the fracture resistance the endodontically treated roots more than MTA Fillapex / gutta-percha or AH Plus/ gutta-percha combinations.

GE101

Should conventional obturation with a tricalcium silicate sealer be seen as an option for immature teeth with wide apices?

*Hamdan R, Dionnet C, Georgelin-Gurgel M, Diemer F
Department of Endodontics, Paul Sabatier University, Toulouse, France

Aim The aim of this study was to assess whether an obturation, combining a custom gutta-percha cone with the BIOROOTTM-RCS sealer, displays comparable sealing quality to orthograde apical plugs of MTA in immature teeth with irregular wide apices.

Methodology Thirty-four immature permanent teeth with apical diameter varying between (1-3mm) were chosen for this study and were divided into two groups. The teeth were imbedded in wet sponge, which simulated the periapex. In the first group; 5mm orthograde plugs of MTA were placed using an appropriate plunger. In the second group; a custom gutta-percha cone was fabricated and used for root canal filling with the BIOROOTTM-RCS sealer. The specimens were stored at 37°C and 100% humidity during five weeks to allow the complete set of filling materials. The apical leakage was evaluated using dye penetration test with 50%-weight silver-nitrate. The teeth were then embedded in transparent resin and sectioned transversally at 1 and 3mm from the apex. The slices were examined under optical microscope and were given scores from (0) to (4). When scoring a slice was difficult, spectroscopy for energy dispersion using a scanning electron microscope was used to confirm the score. The results were compared using the Fisher test with p < 0.05.

Results For the first examiner; at 1mm: p= 1, at 3mm p= 0.05. For the second examiner; at 1mm p= 1, at 3mm p= 0.26. The difference of micro-leakage was not significant.

Conclusions Within the limits of this study, it can be concluded that a fabricated custom gutta-percha cone combined with tricalcium silicate sealer BIOROOTTM RCS (Septodont, Saint-Maur Des
GE102

**Streptococcus mutans in decay teeth during pregnancy**

*Shllaku F¹, Dragidella A¹, Stavileci M¹, Muharremi D¹, Zhubi-Dida A²*

*Departments of ¹Dental Pathology and Endodontics, ²Prosthodontics, University Dentistry Clinical Center of Kosovo, Prishtina, Kosova*

**Aim** The aim of the study was evaluation of the presence of Streptococcus mutans in decay teeth in pregnant women during pregnancy and evaluation of incidence of DMF index (decay-missing-filling).

**Methodology** For DMF index evaluation, 62 pregnant women between age 20-25 years were tested at 12, 26 and 36 weeks of pregnancy. At all pregnant women at 12 week, teeth preparation and permanent filling of the teeth was performed. Control was done at 26 week of pregnancy to evaluate the presence of S.mutans. Microbiological samples were taken from decay lesions and evaluated with standard microbiological methods: blood agar, endoagar and agar chocolate. S.mutans was identified also with computer method API System-rapid ID 32 strep.

**Results** The presence of S.mutans between trimesters was significant (p<0.05), but between first and third trimester was at higher significance (p<0.0001).

**Conclusions** Based on the results of this study it may be concluded: Increasing DMF tendency during pregnancy, with a significantly important difference between trimesters; Number of pregnancies significantly influences in DMF increasing; S.mutans in pregnant decay teeth show the decreasing tendency at the end of second trimester and third trimester.

GE103

**The effect of different filling techniques on apical crack initiation and propagation after retreatment procedures**

*Dincer AN, Guneser MB, Kebudi Benezra M, Kaplan F*

*Department of Endodontics, Bezmialem Vakif University, Faculty of Dentistry, Istanbul, Turkey*

**Aim** The purpose of this study is to determine the effect of warm vertical compaction, single-cone obturation and cold lateral compaction techniques on apical dentin crack initiation and propagation after the removal of root canal filling and additional instrumentation.

**Methodology** Freshly extracted mandibular incisor teeth with single root and canal were used for this study. An apical portion of 1.5 mm of the teeth was grounded perpendicular to the tooth axis and examined under stereomicroscope and baseline images were recorded. All teeth were
instrumented with Wave One Gold Primary file (Dentsply Maillefer, Ballaigues, Switzerland) followed by single-cone obturation. ProTaper Universal Retreatment files (Dentsply Maillefer) were used to remove root canal filling. Additional instrumentation was performed with WaveOne Gold Medium file (Dentsply Maillefer). Thereafter, teeth were divided into three experimental groups (n=15). In group 1, warm vertical compaction; in group 2, single-cone obturation; in group 3, cold lateral compaction were used to fill the root canals. After each procedure, apical surface of the roots were examined under stereomicroscope with X30 magnification to determine crack initiation and propagation. Data were analysed with Chi-square test and Cochran’s Q test. The significant level was set at 0.05.

**Results** No apical crack were found in the baseline images. After initial root canal preparation, single-cone obturation, removal of root canal filling and additional instrumentation of root canals, 30 of 45 teeth displayed apical cracks. There is no significant difference between groups regarding the apical crack initiation and propagation (p>0.05). In warm vertical compaction group, there is no crack initiation but crack propagation was examined in 4 specimens. In single-cone obturation and cold lateral compaction group, crack initiation was examined in 2, crack propagation was observed in 2 specimens.

**Conclusions** Endodontic procedures including root canal preparation, removal of root canal filling, additional instrumentation and re-obturation of root canals may cause crack initiation and propagation.
Evaluation of a technique/materials

GE104

Comparative evaluation of the forces applied to dental structures during condensation of cold gutta-percha cones in-vitro.

Palamidakis FD, Kontakiotos EG, Panopoulos P, *Farmakis ETR

Department of Endodontics, National and Kapodistrian University of Athens, Faculty of Dentistry, Athens, Greece

Aim To measure in vitro the forces applied to dental structures, both during lateral condensation (LC) and vertical compaction (VC) of cold gutta-percha (GP) cones, by general practitioners and by specialists in Endodontics.

Methodology A total of 80 mandibular premolars’ roots of similar anatomy were collected. Root canal preparations were performed by a single operator, specialist in endodontics, using the protocol of step-back hand instrumentation technique, to a size 40/.02 master apical file. The step-back preparation was completed with a K-file size of 80/.02, 6 mm short of the working length. Following, the roots were mounted to a customized digital force gauge device (EGK gauge device). Two groups, each one consisting of 8 practitioners, were formed of specialists in endodontics (Group A) and of general dentists (Group B). Each one of the sixteen participants in the survey performed five obturations. The forces distribution was separately recorded by the EGK gauge device, giving a total of 80 force-time graphs. The graphs were analyzed to estimate the mean values concerning the LC and VC mean forces values per participant, and per group in total. The same approach was followed in order to evaluate the mean duration of the obturations performed. Possible statistically significant differences concerning data mean values between the two groups were further evaluated via appropriate statistical investigation tests.

Results Both LC and VC forces’ mean values between the two groups were found statistically different (10.70Nt Group A vs 7.48Nt Group B, p<0.001 - 13.49Nt Group A vs 10.97Nt Group B respectively). The mean total VC force was 12.23Nt, whereas the mean total LC force was 9.08Nt; statistically significant difference (p<0.001). The evaluation concerning the mean duration of obturation between the two groups revealed that the corresponding mean values were statistically highly different (Group A 162.48 sec vs Group B 210.77 sec, p<0.01).

Conclusions There are significant differences on the forces applied and the time needed to complete the obturation, between General Practitioners and Specialists in Endodontics, during lateral condensation of cold gutta-percha cones in-vitro. Further investigation to correlate the forces recorded, with possible formation of dentinal defects is needed.
Comparative study of the apical deformation produced by three mechanical rotary instrumentation systems

*Lozano Barbero M, Garcia Barbero E, Martin Gonzalez D

Universidad Complutense de Madrid, Madrid, Spain

**Aim** To compare the degree of apical deformation, broadening and apical tip after using 3 mechanical instrumentation systems: Protaper Next® (PTN), Wave One Gold® (WOG) and Twisted Files Adaptive® (TFA); 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** 45 double-curved methacrylate blocs were used (Endo-Training Bloc-s®.02 Taper de Dentsply Maillefer®). Each bloc was numbered and 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 3 groups (n=15), 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 (X2 0,25 PTN, Primary 25.07 WOG and SM2 25.06 TFA) and next with the following file that corresponded in each one of the systems (X3 0,30 PTN, Medium 35.06 WOG and SM3 35.04 TFA). 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** No statistically significant differences were found between the 3 groups (P>0.05). After the second instrumentation, PTN is found to widen significantly less than WOG and TFA (P<0.05). Comparing both instrumentations: PTN does not present statistically significant differences between variables (P>0.05). With WOG there were not significant differences in deformation (P>0.05) observed, but there were differences in widening and tip (P<0.05). With TFA, there were significant differences between variables (P<0.05).

**Conclusions** With a 0.25 tip none of the 3 systems deform the canal. However, by using the immediately larger tip of each system we can conclude that PTN widens significantly less than all other systems because the tip of the instrument is smaller. On the other hand, TFA and WOG widen the same but TFA deforms more.
Comparing The Physical Properties of Calcium Silicate Based Cements with Micro Computed Tomography in Different Conditions

*Akinci L, Simsek N, Aydinbelge HA

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

Aim This study used micro–computed tomography (µCT) to evaluate the effects of different pH and blood on the three-dimensional morphology of calcium silicate cements in root-end fillings.

Methodology Eighty-four single-rooted teeth were cleaned, shaped, and obturated in the same manner. After root-end resection, 3 mm deep root-end cavities were ultrasonically prepared. The samples were randomly divided into four test groups (n = 21). ProRoot MTA, Angelus MTA, Bioaggregate, and Biodentine were freshly prepared and analysed with µCT. The test groups were divided into three subgroups (n = 7) and exposed for four days to environments containing acid, alkali, or blood. After this treatment, the samples were scanned again with µCT to assess the filling materials for internal changes in volume, density, and porosity.

Results The statistical analysis revealed that volume changes had occurred in materials exposed to acidic pH, with significant differences found for all cements (p < 0.001); Biodentine showed the highest amount of volume loss. Statistically significant differences in volume change were observed among the Biodentine subgroups exposed to acid, alkali, or blood (p = 0.001). Biodentine also showed the highest percentage of density change after treatment with acidic pH. The volume changes of all the materials exposed to acidic pH were found to be statistically different from the volume changes after exposure to other environments (p = 0.001). Angelus MTA showed the lowest percentages of volume and density changes after treatment with acidic pH. Significantly less change in porosity due to acidic pH treatment was observed in Biodentine compared with Angelus MTA and ProRoot MTA. There was no difference between the porosity changes resulting from alkali and blood exposure.

Conclusions The three-dimensional structures of all the materials generally changed after treatment with acidic pH, while fewer changes occurred to the structures of materials treated with blood and alkali.

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Determining the sealing ability of four root's canal filling techniques by micro-CT.

*Lindihana E¹, Apostolska S¹, Rendzova V¹, Ajeti N²
Aim The aim of this thesis is to evaluate and determine the percentage of the volume of gaps and spaces of root canals obturated with different obturation materials assisted by microcomputer-tomography.

Methodology This thesis includes 80 frontal human extracted teeth, which are de-crowned and divided in two major groups. The first group is processed with a standard technique of processing. Additionally, the root canals are divided in two subgroups and obturated with Thermafill and GuttaFlow. The root canals from the second group are processed with an ultrasonic technique and obturated with a technique of lateral condensation and single cone technique. The root canals are scanned by a micro-CT scanner and the percentage of gaps in the root canals is evaluated.

Results According to the statistical analyses none of the root canals showed no gaps. A bigger percentage of gaps has been recorded in the root canals obturated with the Thermafill technique (13.61%), while a smaller percentage of gaps has been recorded in the root canals obturated with a single cone technique. The one factor ANOVA for numeric marks of monitoring showed $F=17.8$, $DF=3$, $p<0.01$.

Conclusions The results show that there is a statistically significant difference in the total percentage of gaps in the evaluated groups.
indenter with a load of 200 g for 20 s during the whole experimental periods (1, 3 and 7 days). Three indentations were made around the pulp space, 1 mm from canal wall and a mean microhardness value was calculated for each dentine specimen. One way ANOVA and Tukey HSD tests were used to analyse statistical differences (P<0.05).

**Results** Statistical analysis showed that three calcium hydroxide mixtures did not significantly alter dentine microhardness after 1 and 7-days (P>0.05). Ca(OH)2-glycerine mixture reduced root dentin microhardness significantly than chlorhexidine and octenidine mixtures after 3-days (P<0.05). The reduction in dentine microhardness following the use of a Ca(OH)2-glycerine combination was greater than that after a Ca(OH)2-octenidine hydrochloride and Ca(OH)2 chlorhexidine mixtures.

**Conclusions** The use of Ca(OH)2-glycerine mixture for intracanal dressing softens dentine more than Ca(OH)2-chlorhexidine and Ca(OH)2-octenidine hydrochloride combinations. Further studies is needed to evaluate long term effect of Ca(OH)2-chlorhexidine and Ca(OH)2-octenidine hydrochloride mixtures.

**Acknowledgements** Author would like to thank Selcuk University, Faculty of Dentistry and KOSGEB for their support to this Project.

GE109

**Efficiency of three different retreatment techniques in the removal of gutta-percha and bioceramic root canal sealer**

*Marinova-Takorova MB, Radeva E*

*Department of Conservative Dentistry, Faculty of Dental Medicine, Medical University - Sofia, Sofia, Bulgaria*

**Aim** The aim of the presented study was to evaluate and compare the efficacy of ProTaper retreatment files, ultrasound and hand instruments in the retreatment of root canals filled with gutta-percha and bioceramic sealer.

**Methodology** Thirty-three single rooted teeth were selected and sectioned to obtain standardized 15mm root samples. They were enlarged to size F2, using ProTaper Universal files. The roots were filled with gutta-percha and bioceramic based sealer (MTA Fillapex). Teeth were randomly assigned into three groups, according to the retreatment method: Gr1 – retreated using ProTaper retreatment files, Gr2 – hand instruments and Gr3 – ultrasonic endodontic files. Time needed for the removal of root canal filling was estimated. Teeth were sectioned longitudinally and observed under operating microscope (16x magnification). The amount of residual material in the different portions (apical, coronal, middle) of the canal was compared. The data was statistically analyzed using SPSS 20.0.
Results No statistically significant differences were observed concerning the time needed for the removal of the root canal filling (p>0.05). Residual material was detected after all retreatment techniques. Least residual material was left in the apical region when ultrasonic files were used (68.2% of the cases was achieved clean dentine surface). In the middle portions the effectiveness of the studied techniques was the same. The greatest amount of residual material was found in the coronal part in Gr1 (in 36.2% more than 1/3 of dentin surface was covered with filling material).

Conclusions The time needed for the retreatment with the three techniques studied was comparable – no statistically significant differences were found. Remnants of filling material were observed in all techniques. Best results in the apical and coronal part were observed with the ultrasound; in the middle part the effectiveness of the studied techniques was the same.

GE110

Enlargement of the apical foramen of mature teeth by instrumentation and apicectomy. A study of effectiveness and the formation of dentinal cracks.

*Bucchi C1, Gimeno A2, Manzanares MC1
Departments of 1Pathology and Experimental Therapeutics, 2Biotherium Campus Bellvitge, Universidad de Barcelona, Barcelona, Spain

Aim Apical foramen enlargement (AFE) would be necessary for regenerative treatments of mature teeth. In the literature AFE of mature teeth has been performed through instrumentation and apicectomy, however no standardized methods have been described yet. The aim of this study was to describe the effectiveness of five standardized methods for AFE of mature teeth, as well as its effects on the dental structure.

Methodology 200 human teeth were randomly assigned to groups (n= 50 each): (I) instrumentation 0.5mm above the apex, (II) instrumentation at apex level, (III) instrumentation 0.5mm beyond the apex and (IV) apicectomy at 2 and 4mm from the apex. 10 teeth were left as controls and no treatment was performed. Instrumentation was applied up to file #80 for groups I, II and III. The diameter of the apical foramen before and after treatment was measured. The formation of clinically visible fractures (CVF) and dentinal cracks was analysed clinically and with environmental scanning electron microscopy, respectively. 32 sheep’s teeth set in their mandibles were also instrumented, in order to evaluate dentinal cracks and CVF in in situ instrumented teeth.

Results The size of the apical foramen was augmented 0.15mm, 0.47mm, 0.54mm 0.06mm and 0.32mm in human teeth of groups I, II, III, apicectomy at 2 and 4mm, respectively. The differences were statistically significant. CVF were more frequent as the working length was augmented. No statistical differences were found for dentinal crack formation. For sheep’s teeth the post-treatment
apical foramen diameter was similar among groups. No teeth presented CVF. The presence of microcracks was observed in only one tooth. The prevalence of dentinal cracks was statistically greater in human teeth.

**Conclusions** Instrumentation at apex level seems to be the most effective and least harmful technique for AFE. Apicectomy is not a useful method for AFE. Sheep’s teeth, which were set in the alveolar bone, showed significant less damage than the extracted human teeth.

**GE111**

**Evaluation of the Quality of Different Root Canal Filling Techniques by Micro Computerized Tomography**

*Alim Betül, Garip Berker Y

*Department of Endodontics, Marmara University Faculty of Dentistry, Istanbul, Turkey*

**Aim** In recent years, many studies have been carried out to ensure that the curved root canals can be sealed. The aim of this study is visualizing the apical, middle and coronal parts of the roots for filling the curved root canals using lateral condensation technique, single-cone technique, continuous wave obturation technique and thermoplasticized gutta-percha core carrier root canal obturation technique by Micro-CT and comparing the filling efficiencies of these different techniques.

**Summary** In our study, 60 mandibular first molar teeth with MB / ML curved root canals more than 25 degrees (Schineider’s method, 1971) obturated with lateral condensation technique (Group 1), single cone technique (Group 2), continuous wave obturation technique (Group 3), thermoplasticized gutta-percha core carrier technique (Group 4) and apical, middle and coronal third imaging was obtained by Micro-CT. In apical and middle third, the most successful root canal filling was revealed as lateral condensation technique. No statistically significant difference was found in the coronal third.

**Key Learning Points**

- Micro-CT, Lateral condensation technique, single cone technique, continuous wave condensation technique, thermoplasticized gutta-percha core carrier technique.

**GE112**

**Evaluation of the Tip Diameter and Taper Size of 0.06 Gutta-Percha Points From Three Different Brands**

*Erdemir ALI, Genc Sen O, Kaya M

*Department of Endodontics, Yuzuncu Yil University, Dentistry Faculty, Van, Turkey*
**General Endodontic Posters**

**Aim** The aim of this study was to examine the tip diameters and tapers of gutta-percha (GP) points from three different brands and establish their conformation to expected standards.

**Methodology** Size #30 GP points with an 0.06 taper from three different brands were used (Diadent, Pearl Endo, Ocean). Fifteen GP points from each brand were randomly selected and examined according to the ANSI/ADA Specification No. 78 using the Toolmaker's measuring microscope (TM-505, Mitutoyo, Tokyo, Japan) with an accuracy of 10-4 mm. Tip diameters (D0) and calculated taper sizes were recorded. A one-way ANOVA was used along with post-hoc Tukey tests to determine the differences among groups in terms of absolute mean percent difference from the manufacturer's reported (nominal) cone diameters and tapers.

**Results** The amounts of deviations in D0 diameters were found to be similar among groups (p>0.05). Ocean GP points showed significantly greater deviation from the nominal taper compared to Diadent and Pearl Endo points (p<0.05).

**Conclusions** Almost all of the tip diameters met the ANSI/ADA No. 78 specification guidelines. All of the GP points from three different commercial brands showed some degree of deviation from nominal taper. However, ocean points showed the greatest deviation from the nominal taper.

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GE113

**Evaluation of Two Different Silicate-based Cements as a Pulp Capping Agent on Inflamed Pulp In Vitro and In Vivo**

*Kim YH, Kim DH, Lee BN, Chang HS, Hwang IN, Oh WM, Hwang YC
Department of Conservative Dentistry, Chonnam National University, Gwangju, Republic of Korea

**Aim** Direct pulp capping is controversial for cariously exposed pulp because of unpredictable severity of inflammatory condition of underlying pulp tissue and variable long-term clinical success. Various pulp-capping materials have been used and silicate-based cement materials have been successfully used in vital pulp treatment. This study was aimed to evaluate the inflammatory response and hard tissue formation of inflamed dental pulps of rat maxillary molars after capping.

**Methodology** LPS-treated human dental pulp cells (hDPCs) were directly cultured on Dycal, Endocem MTA and ProRoot MTA. IL-1β, IL-6, BSP, DSPP gene level was analysed by real-time PCR and Protein expression was analysed by ELISA. 36 maxillary SD rat molars were exposed to the oral environment for 48 hours. The exposed pulps were randomly divided into 6 groups (n=6) according to pulp-capping materials (Dycal, Endocem MTA, ProRoot MTA) and time (7 or 28days). The cavities
were capped and sealed with Ionosit (RMGI). The animals were sacrificed after 7 and 28 days. Histological specimens were prepared and evaluated for inflammatory response and hard tissue formation.

**Results** When LPS treated-hDPCs cultured with capping materials for 7 days, the mRNA level of IL-1β, IL-6 increased significantly in all groups. (p < .05). The secretions of pro-inflammatory cytokines were also increased. However, there was no statistical difference for each group. At 28 days, the mRNA level IL-1β, IL-6 was decreased and BSP, DSPP level was increased in Endocem groups and ProRoot groups compared to controls. But, there was more BSP, DSP expression in ProRoot MTA group. (p < .05). 7 days after pulp capping, all experimental groups showed disruption of the odontoblast layer in areas corresponding to the pulpal exposure. Acute inflammation was found in all experimental groups. After 28 days, slight to moderate inflammation was found in all experimental groups. The new hard tissue was formed onto canal walls and root canal space in both Endocem MTA and ProRoot MTA groups. But, hard tissue formation was thicker in ProRoot MTA groups.

**Conclusions** Although there was no significant difference with anti-inflammatory effect, ProRoot MTA had better potential to stimulate hard tissue formation compared with Endocem MTA.

**GE114**

**Experimental substantiation of the use of biomaterials in the simulation of accidental opening of the pulp.**

*Krechina EK*, *Volkov AA*, *Abdurakhmanova ZU*

Departments of *1Functional diagnostics, 2Morphology, Federal State Institution Central Research Institute of Dental and Maxillofacial Surgery, Moscow, Russian Federation*

**Aim** To analyze the effect of biomaterials on pulp regeneration during the experiment.

**Methodology** The experiment was conducted on 3 little pigs on the basis of the Scientific Center of biomedical technologies RAMS. Animals of the experimental group (3 pigs, 18 molars) were subject to simulated pulp accidental opening. Under general anesthesia damage on the chewing surfaces of the molars. The damage was done, to the pulp cavity was accurately opened. Two drugs were loaded accurately on the autopsy pulp horn: Biodentine (Septodont, France) and Aureoseal (OGNA, Italy), the cavity was closed with sealant FUJI IX (GC, Japan). After 2 weeks (the first animal), 4 weeks (the second animal), 12 weeks (third animal) pigs were euthanized by an overdose of intravenous in accordance with Annex № 4 to the Rules of Works Done Using Experimental Animals and jaw blocks were taken as samples. Histological examination of the teeth was carried out using little pigs casting method in methyl methacrylate (OsteoBead, Sigma, USA). Slices 35-50 micron thick were prepared.
from the samples and stained using method of "Heavenly trihrom". Documentation was carried out using the Leica DM100 microscope and digital camera EC3 in reflected and transmitted light.

Results Histological examination showed no significant difference between the two test materials. In both groups in 2 weeks time odontoblast proliferation was detected at the edges of damaged dentin to form islands of dentin unstructured mineralized matrix and odontoblasts under filling material. After 4 weeks dentinal bridges were identified, which had regular mineralized material and were placed directly under the filling material. After 12 weeks, the newly formed dentin is almost indistinguishable from undamaged areas, however, due to the volume of bedding pulp chamber dentin was reduced to 1/3.

Conclusions The studied material support and contribute to the regeneration of hard tissues of a tooth (dentine).

GE115

SEM evaluation of the smear layer removal capacity of a new irrigating solution with irrigation activation techniques
Demiral M, *Uzun I

Department of Endodontics, 1Oral Dental Health Center, Istanbul, 2University, Samsun, Turkey

Aim The purpose of this thesis was to analyse the smear layer removal efficacy of a new irrigant with 2 activation techniques during irrigation which is one of the most important stages of root canal treatment.

Methodology In this study, maxillary human incisors prepared and final irrigation protocols performed by two activation techniques. Roots were separated then photomicrographs scored by number of open dentinal tubulus which taken with SEM. Data examined and correlated for the smear layer removal capacity of irrigant and activation techniques. Data was analysed statistically by Kruskall- Wallis and Mann- Whitney U tests with significance at 0.05 or less.

Results In this thesis 3 irrigation solutions and 2 irrigation activation techniques evaluated and found that irrigation activation statistically increases the smear layer removal capacity of irrigants. The correllation is not statistically significant when activation techniques compared with each other. QMix irrigation solution is efficient as EDTA for smear layer removal. The number of open dentinal tubulus is statistically differs for apical third of root canal when compared with the coronal third.(p>0.005) (p<0.005)

Conclusions QMix is an efficient irrigation solution for the aim of smear layer removal. Irrigation activation techniques increases the smear layer removal capacities of irrigation solutions.
Usage-induced degradation of Wave One Gold after Clinical Use

Iacono F, *Cabrini FS, Nucci C, Gandolfi MG, Pirani C

School of Dentistry, Endodontic Clinical Section, Master in Clinical Endodontology, Department of Biomedical and Neuromotor Sciences, University of Bologna, Bologna, Italy

Aim To evaluate the surface characteristics of the recently introduced Wave One Gold NiTi instruments before and after clinical use.

Methodology Ten Wave One Gold Primary files (Maillefer, Switzerland) were inspected by Scanning Electron Microscope (SEM) (JSM-5200, JEOL, Japan) in as-received condition and after clinical uses. Each file was used in multi-rooted teeth to instrument 3-4 canals each. Working length was electronically established (Root ZX, Morita, Japan) and an adequate glide path was ensured by a 10 K-file (Maillefer) and ProGlider instrument (Maillefer). Wave One Gold Primary files were used following the manufacturer’s recommendation on a X-Smart Plus motor (Maillefer) in "WaveOne All" reciprocating setting. During treatment, irrigation was provided with 3ml of 5% NaOCl (Ogna, Muggiò, Italy) and with 3ml of 10% EDTA (Ogna). A single trained operator performed all treatments and endodontic procedures were confirmed with periapical radiographs. Post-operatively, Wave One Gold were autoclaved, discarded and inspected by SEM in the same points and with the same angulation of previous investigation, to compare surface characteristics and to identify the usage-induced degradation. Number of fractures, microcracks, blunt/disruption of cutting edge and tip deformations were reported.

Results No instrument fractured. Metal strips were noticed on the cutting edge of new instruments and partially maintained after clinical use. Tip profile and milling grooves of the machining process remained well-defined and only limited area of blades flattening were observed. Only one instrument presented an isolated microcrack on the surface of a cutting edge.

Conclusions Wave One Gold instruments demonstrated a safe clinical use in multi-rooted teeth showing only a limited degree of usage-induced degradation.

Restoration of root filled teeth

Cementation of new hollow posts. A confocal microscopy study.

*Gilberti L1, Sanchez A2, Forner L2, Llena MC2, Rodriguez FJ3, Salgarello S1, Tonini R1

1Specialità medico chirurgiche, scienze radiologiche e sanità pubblica, Università degli studi di Brescia, Brescia, Italy, 2Stomatología, Universitat de València, Valencia, Spain, 3Dermatology, stomatology and radiology, Universidad de Murcia, Murcia, Spain
General Endodontic Posters

**Aim** A new hollow post has been introduced for postendodontic build-up. Cement penetrates along the inner part of the post in a coronal-apical way, then, it flows back between the external wall of the post and the inner surface of the root canal. The aim of this research is to compare dentinal penetration of cement between traditional solid fiber posts and hollow posts.

**Methodology** Two groups of fibre posts were studied (ni=10): group 1, solid post (Tech2000); group 2, hollow posts (Techole). Each post was placed in a root canal in an endodontically treated teeth with a self-adhesive cement (Newtechcem). We used roots with one canal from extracted teeth (with the approval of the Ethic Committee of the University). Cement was stained with a fluorochrome (Rhodamine B). Sections from coronal, medium and apical thirds were obtained and observed with confocal laser microscope (Leika). We measured the percentage of perimeter in which dentinal tubules penetration of cement appeared. T- test was used for the statistical analysis with a significance level of 95%.

**Results** The average percentages of perimeter penetration of the stained cement was 53.02 ± 28.77 (group 1) and 51.12 ± 25.56 (group 2), without significant differences (p<0.05) between both groups. When comparing the different thirds between groups 1 and 2, we did not find statistically significant differences (p<0.05).

**Conclusions** Cementation of both post systems showed a similar ability to penetrate in the dentinal tubules along the perimeter of the root canal walls.

GE118

**Evaluation of SEM and Micro-hardness of a New Fiber Post System**

Aydemir S\(^1\), *Cimilli ZH\(^2\), Calapaj M\(^3\), Lo Giudice R\(^4\), Centofanti A\(^5\), Kartal N\(^2\)

\(^1\)Department of Endodontics, Kocaeli University Faculty of Dentistry, Kocaeli, Turkey, \(^2\)Department of Restorative Dentistry, Marmara University Faculty of Dentistry, Istanbul, Turkey, \(^3\)Department of Biomedical and Dental Sciences and Morphofunctional Imaging, Messina University, Messina, Italy, \(^4\)Department of Clinical and Experimental Medicine, Messina University, Messina, Italy, \(^5\)Department of Biomedical and Dental Sciences and Morphofunctional Imaging, Messina University, Messina, Italy

**Aim** The aim of this study was to evaluate the resin cement with SEM and micro-hardness for a new designed fiber post (Techole, Rovello Porro, Isasan, Italy).

**Methodology** Twelve extracted human maxillary central teeth were used. The root canals were prepared with Protaper Next system. Then, the root canals were obturated with gutta-percha and AH plus root canal sealer using cold lateral compaction technique. The post holes were prepared with Gates Gladden drills until 4 mm gutta-percha left in the apical area. Techole fiber posts were cemented according to the manufacturer’s instructions. After that, the roots were transversely
sectioned as coronal, medium and apical. A total of 36 specimens were evaluated with SEM and microhardness testing. The microhardness analysis was performed with 300 gr load for 15 seconds using Wilson Wolpert Micro-Vicker's 401MVD (Aachen, Instron Deutschland GmbH, Germany). Six measurements from each specimens on the resin cement were recorded. All specimens were observed under SEM at different magnifications.

**Results** There is no significantly difference between the sections as coronal, medium and apical for microhardness measurements (p≥0.05). No gap formation was detected between the resin cement and fiber post on the SEM analysis.

**Conclusions** Because of the limitations of in vitro conditions, long-term clinical evaluation for Techole fiber post should be observed.

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**Retreatment**

GE119

Comparison of the the fracture resistance of the roots using different retreatment techniques with or without GuttaSolv: an in vitro study

*Aydemir S, Arukaslan G*

*Department of Endodontics, Kocaeli University Faculty of Dentistry, Kocaeli, Turkey*

**Aim** The aim of this study was to evaluate the effect of GuttaSolv on the fracture resistance of the retreated roots using different techniques.

**Summary** Seventy extracted single rooted, human mandibular premolar teeth were used. All teeth were decoronated to adjust the remaining root length to 14 mm. The root canals were prepared with Protaper rotary instruments till size F2 and filled with gutta-percha and Ah Plus root canal sealer using cold lateral compaction technique. The specimens were randomly divided into seven groups for retreatment procedures as follows: In Group 1, the root canals were not retreated. These were used as control. In Group 2, Gates-Glidden drills and stainless steal H-files were used to remove of the root canal obturation materials. In Group 3, Gates-Glidden drills and stainless steal H-files were used with GuttaSolv. In Group 4, Protaper Universal Retreatment instruments were used. In Group 5, Protaper Universal Retreatment instruments and GuttaSolv were used. In Group 6, the root canals were retreated with WaveOne reciprocating system. Finally in Group 7, the retreatment procedures were performed with WaveOne reciprocating system with GuttaSolv. After removal of the all root canal materials, the root canals were irrigated and filled as described earlier with standardized master cone. For all groups fracture resistance value (N) was measured and recorded using a universal testing machine. No statistically significant difference was detected among groups for the fracture resistance values (p>0.05).
**General Endodontic Posters**

**Key Learning Points**
- Under the limitations of this in vitro study, there is no significant effect of the endodontic retreatment procedure using hand files, Protaper Universal and WaveOne reciprocating system with or without Guttasolv on the fracture resistance of the roots.

**Efficacy of ProTaper instruments in the retreatment of root canals filled with MTA based sealer and two different filling technique**

*Radeva EN, Marinova-Takorova MB*

*Department of Conservative Dentistry, Faculty of Dental Medicine, Medical University, Sofia, Bulgaria*

**Aim** To assess the time and efficacy of ProTaper Retreatment instruments in the removal of MTA based sealer (MTA Fillapex) and gutta percha (GP) in the different portions of the root canal (coronal, middle and apical) filled with cold lateral condensation technique and single cone technique.

**Methodology** Twenty-two extracted single rooted human teeth were used. Canals were prepared with ProTaper Universal system till F2. The teeth were divided into two groups according to the filling technique - group 1 (n=11) – single cone technique (GP F2 and MTA Fillapex), group 2 (n=11) – cold lateral condensation technique (GP25 and MTA Fillapex). The specimens were stored for 3 weeks. GP and sealer were removed with ProTaper retreatment instruments and orange oil as solvent. Teeth were sectioned longitudinally in buccolingual direction. Time needed for the removal of different root canal fillings was compared and remnants of filling material on the canal walls in the coronal, middle and apical portion were evaluated by means of operating microscope under x 16.5 magnification. A grading system from 0 to 4 was used to score the amount of residual material. The data was statistically analyzed by SPSS 20.0.

**Results** There was no statistically significant difference between distribution of time in both groups, p>0.05. Complete removal of GP/MTA Fillapex from the root canal walls was not achieved in any of the groups. The greatest amount of filling material was registered in group 1 in the apical area - score 3 [31.8%], and the least in the middle part in group 2 - score 0 [45.5%]. In both groups coronal and middle portions of the root canal were cleaner than the apical ones.

**Conclusions** Single cone technique required less time to remove GP/MTA Fillapex than cold lateral condensation technique. The GP/MTA Fillapex is best removed in the middle part in the group filled with cold lateral condensation technique. Single cone technique presented more remaining filling material compared with cold lateral condensation.
GE121

**Micro-computed tomographic evaluation of root canal retreatments performed by undergraduate students using manual, rotary and reciprocating techniques**

*Silva EJNL¹, Belladonna FG², Carapiá MF¹, Muniz BL¹, Rocha MS¹, De-Deus G²

*Department of Endodontics, ¹Grande Rio University, ²Fluminense Federal University, Rio de Janeiro, Brazil*

**Aim** The aim of this study was to evaluate the amount of remaining root filling materials after retreatment procedures performed by undergraduate students using manual, rotary, or reciprocating techniques through micro-computed tomographic analysis. The incidence of instrument fracture and the instrumentation time were also evaluated.

**Methodology** Thirty maxillary single rooted teeth were prepared with Reciproc R25 files and filled with gutta-percha and AH Plus sealer by the continuous wave of condensation technique. Then, the specimens were assigned to 3 groups (n = 10), according to the canal retreatment technique used: manual K-files, Mtwo retreatment and Reciproc groups. After retreatment, all canals were refined up to a tip size #40. The sample was scanned after root canal filling and retreatment procedures, and the images of the canals were examined to quantify the amount of remaining root filling materials. The incidence of instrument fracture and the instrumentation time were recorded.

**Results** The remaining filling material was observed in all specimens regardless of the technique used. The mean volume of remaining material was significantly lower in the Reciproc group than in the manual K-files and Mtwo retreatment groups (P < 0.05). The time required to achieve a satisfactory root canal filling removal and canal refinement was significantly lower in the Mtwo retreatment and Reciproc groups (P < 0.05) when compared to the manual K-files group. No instrument fracture was observed in any of the groups.

**Conclusions** Reciproc was the most effective technique in the removal of canal fillings during root canal retreatment performed by undergraduate students.

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GE122

**In vitro evaluation of removing material from root canals filled with a bioceramic filling material**

*Marchi V, Sheire J, Simon SRJ

*Department of Endodontics and Restorative dentistry, Paris Diderot University (Paris 7), Paris, France*

**Aim** To compare the time of desobturation and reestablishment of an apical patency of root canals filled with a tricalcium silicate-based sealer (BioRoot™ RCS (Septodont, France)) (BRCS) versus a
zinc oxide eugenol sealer (Pulp Canal Sealer (Sybron Endo, USA)) (PCS) and to analyse the influence of the operator’s expertise.

**Methodology** 120 root canals of 40 Dentalike dental simulators (Dentsply Sirona) were endodontically shaped with WaveOne reciprocating file (Dentsply Sirona) at a 3mm short working length. Group BRCS (n=20) was filled with a single cone of gutta percha (GP) with BRCS, and Group PCS (n=20) was filled with a single cone of GP and PCS. 10 samples of each group were dispatched to a specialist (SP) and a junior practitioner (JP). Time needed for desobturating each canal was recorded and compared between the two groups, and subgroups SP vs JP (Mann and Withney test).

**Results** 118 root canals were successfully desobturated. No differences between the two groups were observed for Mesio Buccal (MB) and Disto Buccal (DB) canals (p>0.05) but desobturation time increased for Palatal canal (P) (79.10 s for PCS and 182.45 for BRCS, p<0.01). A significant difference was observed between the two subgroups (SP vs JP) for each canal (p<0.05).

**Conclusions** Within the limits of the study, the results showed that (1) tricalcium silicate-based filling materials can be successfully removed from the root canal in case of retreatment, (2) the time for removing the filling material increases in Palatal canals filled with a bioceramic filler material but not in MB and DB, (3) the time to remove the material from the root canal and to re-establish the apical patency was influenced by the expertise of the operator.
Retreatment of Failed Endodontic Treatments: Report of Five Cases

Mersinlioglu Aifke, Kiraz Gulsen, Maden Murat, Kaya Bulem Ureyen
Selcuk Derelik University, Faculty of Dentistry, Department of Endodontics, Iskenderun, Turkey

Aim: To present clinical management of different problems during non-surgical retreatment in four different cases.

Introduction: Retreatment due to endodontic failure is usually associated with insufficient cleaning/disinfection of the root canal system, inadequate obturation, unrooted root canals, underextended root fillings, overextended root fillings, missed canals, broken files and defective crown restorations.

Case Presentation

In all cases, patients were referred to our clinic due to severe pain, percussion tenderness, and pain during chewing. According to diagnostic radiographs, inadequate root canal fillings and untreated root canals and roots were observed. After removal of coronal restorations, root canal fillings were removed with Gates-Glidden drills (Mori, Japan) and H-files (Thomson, France). Chemomechanical preparation of the root canals was performed using Protaper (MicroMega, Italy), and irrigated with 25% NaOCl (Wizard, Ankara, Turkey). The root canals were obturated with the lateral compaction of gutta-percha (Dentsply Maillefer, Switzerland) and AH Plus (Dentsply DeTrey, Germany). At the follow-up examination, there were no clinical and radiographical symptoms.

Case 1: Diagnostic radiograph, working length determination, final radiograph, and 6-month follow-up.

Case 2: Diagnostic radiograph, after removing gutta-percha, final radiograph, and 1-year follow-up.

Case 3: Diagnostic radiograph, after removing gutta-percha, final radiograph, and 1-year follow-up.

Case 4: Diagnostic radiograph, working length determination, final radiograph, and 1-year follow-up.

Case 5: Diagnostic radiograph, final radiograph, 1-year follow-up, and removed broken file.

Case 1 and Case 2: After removal of coronal restorations, to find missed canals, entry cavities were extended to the buccal direction of the maxillary second premolar and mesial direction of the mandibular second premolar. Then, root canal treatment was completed.

Discussion: Endodontic failures can be attributed to inadequacies in shaping, cleaning and disinfection, intracanal factors, or re-infection of the root canal system when the canal seal is lost after completion of root canal treatment. There are several challenges faced during retreatment including the removal of the previous obturation material, correcting procedural errors generated during the initial treatment, locating missed canals, and eliminating potential therapy-resistant bacteria. In non-surgical retreatment, the success was generally regarded to be lower than that of primary treatment because of these factors. The most recent systematic review on retreatment outcomes reports a pooled weighted success rate of 76.1% assessed by complete healing and 77.2% assessed by incomplete healing.

Conclusion & Clinical Relevance: This report has demonstrated a variety of techniques to successfully retreat endodontically failing teeth. Endodontic retreatment procedures have enormous potential for success if the guidelines for case selection are respected and the most relevant technologies, instruments, and precise techniques are used.

References:
Surgery
GE124

**A novel modified technique for endodontic microsurgery utilizing customized ultrasonic tips.**

Weissman A

*Department of Endodontology, Tel Aviv University Tel Aviv, Israel*

**Aim** Endodontic microsurgery involves a 3mm apical root resection and a 3mm retro-preparation, done with designated ultrasonic tips. Thus infection from the apical 6mm of the root is eliminated. In cases of short roots or compromised bony support a 3mm resection might significantly worsen the crown to root ratio. Long posts present another challenge because the resection might leave less than 3mm for retro-preparation. Another challenge is the retro-preparation of canals which are positioned in an acute angle to the buccal cortical plate. In order to retro-prepare every canal along it's long axis, there should be a variety of tips that come in different angles. In this presentation a modified technique of microsurgery will be described, for eliminating infection from the apical 6mm of the root canal. In this technique the resection of the apical root is only 1mm on an average followed by a minimum of 5mm retro-preparation done with ultrasonic files mounted on an file adaptor and bent to an endless variety of angles and length according to the case at hand. These modifications enable the practitioner to eradicate infection from the apical 6mm of canals in different angles whilst preserving valuable root structure and achieving high success rate.

**Summary** Endodontic microsurgery involves resection of the apical 3mm of the root and a 3mm retro-preparation. In certain cases this resection might significantly worsen the crown to root ratio. Furthermore if the root contains a long post there might not be enough canal length left for retro-preparation. The preparation of canals which are positioned in acute angles with the available ultrasonic tips is limited. A novel modification of the current technique with resection of 1mm and retro-preparation of 5mm with chair-side customized ultrasonic tips is aimed at overcoming the aforementioned limitations.

**Key Learning Points**
- Current microsurgical technique involves resection that worsen the crown to root ratio.
- The available ultrasonic tips have limited ability to prepare canals that are positioned in an acute angle.
- A resection of 1mm can be made followed by retro-preparation of atleast 5mm.
- A technique for preparing ultrasonic retro-tips with an endless variety of angles and length will be described.
**Endodontic and surgery treatment of a large periapical lesion: Case report**

Marijana Molnar, Branka Mikica Sepic Matanovic
Dental Clinic Zagreb, Dep. of oral medicine, endodontics and periodontology

**Aim:** presenting a case of large periapical lesion on tooth 22, and treatment

**Introduction:** Large periapical lesions are common in dentistry and not all of them are cysts, but still some of them need a surgical treatment in order to heal.

**Case report:** a patient, 19-year old male, came to our practice a year ago, with major swelling, pain and redness in the region of tooth No 21, 22. He was on antibiotics, administered by general practitioner.

1. Large periapical lesion on 21,22

We started endodontic treatment on tooth 21, since 22 was still vital. Tooth 21 had a large periapical lesion as seen on radiography scan. Treatment involved mechanic canal treatment using ProTaper Dentsply Maillefer system, and ProTaper gutta percha

A month later we performed the surgical part of the treatment. On opening periapical lesion was 1.5cm x 1.0cm large. We cleaned the bone site and did GTR-guiding tissue regeneration procedure with Geistlich Bio-Oss bone substitute and Geistlich Bio-Gide collagen membrane.

2. Post-operative status

3. Status 11 months after surgery

Post-surgical time was uneventful and a radiograph image a month later confirmed site bone integration. Follow up Rtg 11 months later shows a full healing and bone integration, with a very happy patient.
INTENTIONAL REPLANTATION AS A MANAGEMENT OF PALATOGINGIVAL GROOVE

Luis Hernán Carrillo V., Carmen Ortiz L., Heriberto Muñoz E., Eustolia Rodríguez V., Miguel Ángel Cadena A., Ana Gabriela Carrillo V.

Universidad Autónoma de Baja California, Faculty of Dentistry, Program of Endodontics.

Aim:
To seat a palatogingival groove through an intentional replantation and avoid loss of tooth.

Introduction
The palatogingival groove is defined as a developmental groove in a tooth that when present is usually found in the lingual part of the maxillary anterior teeth. These grooves typically begin in the central fossa of the incisors, extend over the circumpulpal and continue apically on the incisal surface. They may present mesial or distal, as well as vestibular. This anomaly can be unilateral or bilateral: a single tooth can have 2 grooves, one on the vestibular surface and another on the palatal. They have also been observed in upper second molars. The palatogingival grooves are somewhat variable not only in depth but also in distance and direction.

Case Presentation
A 44-year-old female patient attended the dentistry-school clinic, with no systemic antecedents. Clinical inspection of the dental organ #22, an access cavity is observed, there is no mobility, negative sensitivity tests, negative horizontal percussion, positive vertical percussion. 3 mm of mesial, facial and distal probing were found, and in the palatal side a probing of 5 mm. An x-ray was taken and we observed an already existent canal in an apical lesion. In the x-ray diagnosis: previously treated tooth, **Cervical Extensive Periapical Lesion**. Treatment: *Cervical Extensive Periapical Lesion*. A CBCT Scan (Fig. 2 & 3) was performed and we realize that there is a defect in the root: a unilateral palatogingival groove that runs through the root. On first appointment, root canal was initiated with a continuous microwave and a length established at 18 mm with the aid of the apical locator instrumentation with A-Pilot Nov. 10th and then passive ultrasonic irrigation with 5.25% sodium hypochlorite and 17% EDTA. intra-canal medication is placed and cited one week later. On next appointment obturation was achieved with AH-Plus sealing cement and modified lateral condensation technique (Fig. 4).

At the next appointment, anesthesia is administered and the extraction is started asatraumatically as possible with a fork-tip (Fig. 5), then the patient was asked to bite a gauge dampened with saline solution. Apicectomy was performed with a truncated cone carbide burr (Fig. 6 & 7). The palatogingival groove was prepared with ultrasonic diamond tip, always keeping the root mesialized with Hawley’s solution (Fig. 8). The palatogingival groove and the apices were subsequently filled with a microfibre and a dual resin (Sealbond) placed (Fig. 9). It was light-cured and taken back to the alveolar and composite ferrule placed (Fig. 10 & 11). The total time of the tooth outside the mouth was 10 min. The ferrule was removed after 2 weeks (Fig. 11). Postoperative controls were maintained at 1 month, mobility subsided, sinus tract healed and palatal probing decreased to 4 mm (Fig. 11). Postoperative controls for 2, 5 and 9 months.

Discussion
Many alternative treatments for radiicular groove problems have been presented in the literature. Such treatments are usually related to the severity of the lesion. They include management with gingivectomy or subgingival scaling and root planing; granulation tissue removal through a flap; intentional extraction of a problematic tooth to achieve complete removal of the groove; and subsequent reimplantation, orthodontic extrusion, and exodontia. All of those techniques can be performed with or without appropriate treatment of the root canal system, as the case demands. In our case we decided to do intentional resection due to the length of the groove; a palatal flap was not a good option due to the severe bone loss.

Conclusion & Clinical Relevance
The clinical success of regenerative procedures in daily practice is based on the improvement of symptoms, clinical and radiographic signs in a treated lesion. The clinical and radiographic achievements that have been obtained in this clinical case, give us hope to keep a tooth that has an unfavorable prognosis in the mouth. The success of reimplantation procedures depends on the surrounding dentin between the groove and the root canal, the final contour and smoothness of the root surface, the new position of the palatine soft tissues, as well as the patient’s dental hygiene.

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Retreatment failure and surgery, case report

Branka Mikica Sepic Matanovic, Marijana Molnar

Dental Clinic Zagreb, dep. of oral medicine endodontics and periodontology

Aim: presenting a case involving multiple endodontic apicotomy and surgical treatment of the tooth 23

Introduction:

Case report: patient, 60-year old female, came to our practice with persistent discomfort apically of tooth 23, which has undergone endodontic and apical surgery treatment. An overfilling was detected on X-ray with a large radiolucency in the apical part. We did a retreatment and a root canal obturation with worm gutta-percha technique using Termafil-Dentsply gutta-percha. Patient was pain free for another year. After that a pain came back and a fistula developed apically on tooth 23. A surgery was done and during a procedure we discovered a large resorption of the root apically and a hair line fracture of the root. Tooth was unsalvageable, so we did root extraction, using bone regeneration technique with and kept the corona splinted with the adjacent teeth for bone preservation.

Surface topography of freshly–mixed calcium silicate based cement as a root end filling material after exposure to simulated body fluid

*Wimonchit S, Krongsiriwat N

Department of Conservative Dentistry and Prothodontics, Faculty of Dentistry Srinakharinwirot University, Bangkok, Thailand

Aim To compare surface characteristic, marginal adaptation and bioactivity of three brands of calcium silicate based cement (ProRoot MTA, Biodentine and Retro MTA) used as root end filling material after immediately immersed in simulated body fluid.

Methodology Thirty-six human straight single-rooted teeth were sectioned at cervical area to obtain 13 mm. length. All of them were instrumented with Protaper Next X3 and obturated with vertical compaction. The apical root resection was done for 3 mm. Root end cavities were prepared with ultrasonic retro-tips. The specimens were randomly divided into three groups 12 roots each, according to type of root end filling materials: ProRoot MTA, Biodentine, and Retro MTA. After complete retro-filling, all of specimens were immediately immersed into Kokubo’s simulated body fluid. Epoxy resin replicas from resected surfaces were fabricated after immersion for 1, 7, 30 and 60
days. The gap sizes, surface characteristics and bioactivity were analysed under scanning electron microscope.

**Results** Washout appearance was presented on the first day of immersion in every brand of root end filling material but in different quantity. The most quantity washout was shown in ProRoot MTA group and the least in Retro MTA group. Among three materials used in this study, no significant difference in gap values was found in any observed periods. The more time the specimen immersed, gap size decreased which were related to more appatite formation.

**Conclusions** From the current study, quantity of washout differ from brand to brand of calcium silicate based cement, which seem to relate the setting time of each material but bioactivity and sealability of material was not affected.

Beyza ÖZİSİK, Tugba TURK
EGE University, Department of Endodontology, Izmir Turkey

Aim

The purpose of the case presentation is to report the multi-disciplinary treatment of maxillary center incisor with crown-root fracture.

Introduction

A crown-root fracture is defined as a fracture involving an enamel, dentin and cementum and may be classified as either completed or uncomplicated according to the pulp involvement. White crown fractures occur most frequently in permanent dentition, crown-root fractures account for 6% of all traumatic injuries.

Case Presentation

A 42-year-old patient applied to dental clinic because of luxation of the crown of tooth number 23 and spontaneous pain. Tooth was diagnosed as a chronic crown-root fracture with detection of fracture line by radiographic examination. Local anaesthesia was administered and the coronal segment was removed with cervical trim to free soft tissues, alveolus and impacted and avulsed in saline-diluted water to prevent further root fracture. The inter-radicular segment was extracted in an elevator and periosteal elevator was used to enlarge the root canal to size 30. Sodium hypochlorite (2.5%) was used for irrigation. The root canal was dried with paper points, obturated using cold lateral compaction technique. After root canal filling, post space was prepared by two glass post drills. Adhesive was applied to coronal fragment and great care was taken and coronal fragment were bonded by using dentin bonded resin (Oxipex Bond).

Discussion

Clinical and radiographic examinations were performed regularly. After 18 months follow-up, tooth was in function with satisfactory clinical, radiographic, and aesthetic result.

Conclusions and Clinical Relevance

Restoration of the coronal fragment is a fractured tooth enhances the aesthetics by restoring natural crown margin and the function of tooth. Restoration of coronal fragment is a great option for crown fractures of anterior teeth.

References

A retrospective follow-up of 362 permanent teeth with dental trauma

*Mahmoodi B1, Hosseinkhah P2, Weusmann J1, Azaripour A1, Willershausen B1
Departments of 1Operative Dentistry, 2Dental Surgery, University Medical Center of the Johannes Gutenberg-University Mainz, Mainz, Germany

Aim Complications after traumatic dental injuries may occur weeks, months or even years after trauma. Aim of this retrospective study was to describe the survival rates of pulp tissue and teeth after dental trauma for the different types of dental injuries in the permanent dentition.

Methodology A total of 362 permanent teeth in 254 patients with a history of trauma between 2010 and 2013 were included. Data regarding age, gender, affected teeth, trauma classification (according to IADT), treatment and follow-up were collected. The survival rates of the pulp tissue and the teeth during follow-up period were evaluated.

Results Average age of patients was 19.6 ±19.3 years, 56% (n=143) of patients were male, 46% (n=111) female. Mean follow-up time was 12±18 months (range: 0-74 months). Mostly the central upper jaw incisors were affected (60%;n=219). Most frequent diagnosis was subluxation (23%;n=85), followed by lateral luxation (20%;n=74) and enamel-dentin fracture without pulp involvement (17%;n=62). 45 (12%) teeth received a root canal treatment, while 111 (30%) teeth were fixed with fillings or crowns/veneers and 29 (8%) teeth were extracted. At the end of follow-up time the survival rate for the pulp tissue was 79% (n=284) and 92% (n=333) for the teeth. Average period between trauma and loss of vitality was 6 months, between trauma and extraction 9 months. The rate of tooth loss was highest amongst avulsion and enamel-dentin fractures with pulp involvement (both 27%;n=8) (p<0.01), while the loss of vitality was observed most frequently in patients with luxation (23%;n=18) (p<0.01).

Conclusions Immediate and appropriate treatment of dental trauma is required to minimize complications and to save the affected tooth. Long time complications occurred mostly within the first 9 months after trauma. Our data indicate that early and regular follow-up visits are necessary for an early detection of complications.
General Endodontic Posters

paradigm shift in interventional strategies from replacement towards regeneration. The Oral presentation will intend to 1. Showcase the drawbacks of planning surgical invasion of pulp whether or not root canal therapy is required. 2. Fate of dentine after extirpation of dental pulp. 3. Various methods & materials required to attain successful vital pulp therapy. 4. To understand the difference between Wound healing, Revascularization & Regeneration. 5. Chair site application of platelet derived growth factors. 6. Case series to show wound healing & Revascularization procedures. 7. Pros and Cons in regenerative endodontics

**Summary** 1. Various modalities of vital pulp therapy needs to be known & practiced. 2. Root Canal Therapy & Apexification are not the only treatment plans for all those teeth where the involvement of Dentine & Pulp are in doubt. 3. Use of material has to be carried out judiciously. 4. Disinfection is of primary importance while dealing with vital pulp therapy cases. 5. One must be open to explore the usage of stem cells for better prognosis of tooth in toto.

**Key Learning Points**

- 1. To understand basic principles for attaining successful regenerative endodontic practices.
- 2. Deliver in-depth knowledge about platelet derived growth factors.
- 3. Importance of growth factors & Scaffold in Regenerative Endodontics.
- 4. Importance of coronal seal & methods of achieving it using various endodontic cements.
- 5. Understanding the stem cell treasure at the apex of the tooth.
General Endodontic Posters

GE132

Clinical Treatments of Different Dental Traumatic Injuries: Report of Six Cases


**Introduction**

Aim: To present six different clinical cases of endodontic trauma treated in our clinic. The cases include traumatic luxation, crown fracture, and root fracture, along with their respective treatment outcomes.

**Case Series**

1. **Case 1:** A 25-year-old female patient presented with trauma to tooth 11. Radiographic examination revealed a fracture line through the coronal aspect of the tooth. Endodontic treatment was performed, followed by a successful outcome.

2. **Case 2:** A 30-year-old male patient sustained a blow to tooth 21. An intraoral examination showed a fracture at the cementoenamel junction. Endodontic treatment was initiated, and a successful outcome was achieved.

3. **Case 3:** A 28-year-old female patient fell and hit her tooth 31. Radiographic examination revealed a fracture line through the root. Endodontic treatment was performed, and the tooth showed a successful outcome.

4. **Case 4:** A 35-year-old female patient was involved in a car accident and sustained trauma to tooth 41. Radiographic examination showed a fracture line through the root. Endodontic treatment was performed, and the tooth showed a successful outcome.

5. **Case 5:** A 22-year-old male patient sustained a blow to tooth 51. Radiographic examination revealed a fracture line through the coronal aspect of the tooth. Endodontic treatment was performed, and the tooth showed a successful outcome.

6. **Case 6:** A 30-year-old female patient sustained a blow to tooth 61. Radiographic examination showed a fracture line through the root. Endodontic treatment was performed, and the tooth showed a successful outcome.

**Conclusion & Clinical Relevance**

Proper diagnosis, early intervention, and follow-up care are essential to achieve a successful outcome for traumatic dental injuries. Endodontists should collaborate to develop guidelines for the optimal treatment of these injuries.

Aim We are presenting a clinical case of a 60-year-old woman, who came to the university clinic having suffered two traumas 50 and 40 years ago, in both right and left upper central incisors. A CBCT scan was performed for the better diagnosis and treatment plan.

Summary Traumatic dental injuries of permanent teeth frequently occur in children and young adults, and their diagnosis and treatment planning are complex. Different considerations are taken into account in cases of immature or mature traumatized permanent teeth. Dental trauma injuries occur in a low percentage of the population, and less frequently two injuries occur in the same patient. The first trauma occurred when the patient was 9 years old, affecting the left central incisor. She might have received vital pulp therapy treatment for the 2.1, which remained intact for the next 50 years. When trauma occurs in immature teeth, root development can be altered, leaving thin root canal walls and open apices. We observe in the radiographic examination that the 2.1 was shorter and had a wide root canal, with thin dentinal walls. Moreover, the second trauma she suffered 10 years later, caused a horizontal root fracture in the apical third of the root in the right central incisor. The 1.1 was left without intervention. Treatment planning in horizontal root fractures, are challenging and there are several options to be considered. Decision varies according to the displacement between the fragments and the integrity of the pulp and periodontal ligament at the fracture level. At the radiographic examination, we observe radiolucency image between coronal and apical fragments. Both central incisors became darker over the years. The patient wanted to improve aesthetics, and performing a bleaching treatment and composite veneers were the optimal option for her. We will explain diagnosis, forecast and treatment planning in both teeth.

Key Learning Points
- Horizontal root fracture left without intervention for 40 years: prognosis and treatment planning
- Immature traumatized permanent central incisor: a 50 year control after vital pulp therapy intervention and actual new treatment planning and procedure.
Evaluation of proliferative and apoptotic/necrotic effects of different irrigation protocols on the human stem cells of the apical papilla

Ozgurcan Akbulut M1, Turk M2, Erdemir A1

1Department of Endodontics, Faculty of Dentistry, Kirikkale University, Kirikkale, Turkey.
2Department of Bioengineering, Faculty of Engineering, Kirikkale University, Kirikkale, Turkey.

Aim To evaluate the proliferative and apoptotic/necrotic effects of different irrigation protocols on the human stem cells of the apical papilla (SCAP).

Methodology SCAP were isolated from immature human third molars and characterized by flow cytometry. CD73, CD90 and CD105 coexpressing cells were used in this study. The proliferation of SCAP was determined using xCELLigence real-time cell analysis (RTCA) system (Roche, Basel, Switzerland). In this system, irrigation protocols were applied on the E-plate 96 (Roche, Basel, Switzerland). Different irrigation protocols were performed on each group: (Group-1) no irrigation, (Group-2) 5% EDTA, (Group-3) 17% EDTA, (Group-4) 1% NaOCl+5% EDTA, (Group-5) 2.5% NaOCl+5% EDTA, (Group-6) 5% NaOCl+5% EDTA, (Group-7) 1% NaOCl+17% EDTA, (Group-8) 2.5% NaOCl+17% EDTA, (Group-9) 5% NaOCl+17% EDTA. Following this procedures, platelet-rich plasma (PRP)/SCAP suspension was seeded into the E-plate via a sterile automatic pipette. The impedance value of each well was monitored for 116 hours. Apoptotic/necrotic cells were evaluated with double-staining method. In this method, the irrigation protocols were applied on the 96 well-plate as in xCELLigence RTCA system and then PRP/SCAP suspension was seeded into the plate. After 24 hour incubation, images were taken from each well by the inverted fluorescence microscope (DMI6000B, Leica, Germany). Statistical analysis were performed using Kruskal-Wallis H test with the Bonferroni post hoc test (α=0.05).

Results The highest proliferation and lowest necrosis rates were seen in Group 2 and Group 3 where only EDTA used. The use of 17% EDTA in the final irrigation increased SCAP proliferation more than 5% EDTA, following the NaOCl irrigation. NaOCl created a concentration-dependent increase in SCAP necrosis. There was no apoptotic cell in any group.

Conclusion The irrigation protocols which greater concentrations of NaOCl included have negative effects on SCAP. Irrigation protocols with the inclusion of 17% EDTA might be beneficial in regenerative endodontic procedures.
INTRUSIVE LUXATION AND COMPLICATED CROWN FrACTURE TREATMENT IN UPPER CENTRAL INCISORS WITH OPEN APEX 17 YEARS FOLLOW UP

MC\textsuperscript{a} Mario Uribe Camero\textsuperscript{1}, MC\textsuperscript{a} Octavio Americua Gutierrez\textsuperscript{2}, MC\textsuperscript{a} Luis Gerardo Gascon Guerra\textsuperscript{1}, DDS\textsuperscript{b} Branda Martinez Garcia\textsuperscript{1}

1 Endodontic Benign Program, CUCS, University of Guadalajara, Mexico.

Aim
To describe the clinical management and 17 years follow-up of an intrusive luxation and complicated crown fracture in upper central incisors with open apex.

Introduction
Luxative injuries involve 15 to 63% of dental trauma in permanent teeth\textsuperscript{1}. The treatment of traumatized permanent teeth that have not completed their radicular development is complex and relevant, specially when they have lost their pulp vitality.

Case Presentation
8 years old female patient presented dental trauma with a week evolution. On the clinical inspection the permanent central incisors presented intrusive luxation, swelling bucal gingiva and complicated crown fracture (Fig. 1). The patient recovered and kept the fractured fragments with afterwards were stored immersed in sterile saline. On the radiographic examination the central incisors showed immature root development (Fig. 2). The diagnosis was intrusive luxation with complicated crown fracture, open apex corresponding to Patterson’s class III, and necrotic pulp. Previous anesthesia and isolation (Fig. 3). On the first appointment the canals were hand-filed until a #40 K file (Fig. 4) and irrigated with 1% sodium hypochlorite. Calcium hydroxide was placed into the canals. The patient was evaluated monthly to verify the re-ereption of the intruded teeth. Four months later the re-ereption was completed and the calcium hydroxide was renewed (Fig. 5 & 6). 13 months after the initial appointment, the apex was covered clinically and radiographically and root canals were obturated with thermoplasticized gutta-percha by Schneider’s technique (Fig. 7). The coronal fragments were repositioned with dental adhesive and composite (Fig. 8). There was a clinical and radiographic follow up 3 (Fig. 9), 17 (Fig. 10) and a CBCT 17 years after (Fig. 11), without any sign of symptoms.

Discussion
In case of an intrusive luxation in immature apex teeth, the first choice is wait for the spontaneous re-ereption\textsuperscript{2}. It is necessary to have an apical barrier to contain the root filling material and avoid filling material extrusion\textsuperscript{3}. The temporary seal may fail resulting in reinfection and prolongation or failure of treatment. For these reasons one-visit apexification has been suggested\textsuperscript{4}.

There is a technique using MTA. The authors conclude that this is a viable option for treating immature teeth with necrotic pulps and should be considered as an effective alternative to calcium hydroxide apexification\textsuperscript{5}.

Conclusion & Clinical Relevance
In the conservative management to induce the apex closure of immature teeth with necrotic pulp, it is attainable to have long-term healed tissues. The patient’s attendances to all the follow-up is fundamental.

GE136

Management of a horizontal fracture by traumatism

Facultad de Odontologia, Universidad Autonoma de Baja California, Tijuana B.C, Mexico

NO ABSTRACT PROVIDED

GE137

New proposal of cervical sealing for pulp revascularization treatment procedure in an traumatized immature permanent necrotic tooth: a case report
*Cerqueira-Neto ACCL, Pereira AC, Lazzari JM, Gomes BP, Almeida JFA, Zaia AA, de-Jesus-Soares A

Department of Restorative Dentistry, Endodontic Division, Piracicaba Dental School, State

Pulp revascularization has been indicated as a promising treatment for immature teeth with pulp necrosis, to allow continuity of root formation. It is based on the decontamination of the root canal, application of an intracanal dressing and bleeding induction containing undifferentiate cells originated from the periapical tissues. The blood clot acts as a scaffold and supports the growth of a new tissue similar to cement. Mineral trioxide aggregate (MTA) has been used for cervical sealing of the canal, however literature describes some reports of clinical cases about crown discoloration associated with both gray and white MTA, what is exacerbated by the presence of blood, compromising the aesthetics of the treatment. The aim of this case report is to describe a new proposal for cervical sealing. Case Report: Male patient, 7 years old, suffered dental trauma in the element 21. The pulp necrosis and incomplete root formation was diagnosed. The decontamination of the root canal and consecutive insertion of intracanal dressing with calcium hydroxide and 2% chlorhexidine gel for 21 days, were performed. In the next visit, the blood clot was stimulated and CollaCote collagen matrix (Zimmer Dental, Carlsbad, CA) was placed above it. A cervical barrier was placed with a paste composed of (calcium hydroxide, zinc oxide and chlorhexidine 2% gel, 2:1:2) replacing the MTA. Subsequently, the tooth were sealed with Coltcosol and composite resin. During the follow up the canal showed increased thickness of the dentinal wall and apical closure. Crown discoloration was not observed.

GE138

The effect of triple antibiotic paste mixed with buffered solutions on the microhardness of dentin
Yılmaz S1, *Ozdayı K1, Dumani A1, Yoldas O1, Kocak F2

Departments of 1Endodontics, 2Prosthetic Dentistry, Faculty of Dentistry, Cukurova University, Adana, Turkey

Aim The aim of this study was to evaluate the effect of triple antibiotic paste mixed with buffered solutions on the microhardness of human root dentin after contact for various time intervals.
**General Endodontic Posters**

**Methodology** Thirty-five extracted human maxillary incisors were selected. The canals were enlarged and fixed in acrylic resin blocks. Two sections were obtained from the middle-third of each root (n = 70). The root discs were divided randomly into three groups of 20 and a control group of 10. Baseline microhardness testing was completed using a microhardness tester. The root discs were placed in Petri dishes and then assigned randomly to triple antibiotic paste mixed with phosphate buffer (TAP-P), triple antibiotic paste mixed with butyrat buffer (TAP-B), triple antibiotic paste mixed with sodium hydroxide (TAP-N), and the control group. The pH values of each antibiotic pastes were measured and placed in the Petri dishes, and the discs were covered completely with the mixtures. Microhardness tests were repeated in the same manner after weeks 1, 2, and 4. Data were analyzed statistically with a chi square and Fisher's exact test at the 5% significance level and post hoc analysis was performed.

**Results** No significant change in dentin microhardness occurred in the control group (p > 0.05). Overall, the dentin microhardness values decreased after treatment with the antibiotic pastes over all time intervals. Statistically significant differences were found among the control, TAP-P and TAP-B groups at all time periods (p < 0.01). The TAP-N group showed reduced Knoop hardness number (KHN) values compared with control group, but significant difference was seen only at the 4 week measurements (p < 0.01). No significant difference was found between the experimental groups at the 4 week measurement.

**Conclusions** Applying antibiotic pastes mixed with different buffered solutions for 4 weeks significantly reduced the microhardness values of dentin discs compared with the baseline values. However, TAP-N group showed no significant difference at 1 and 2 week measurements compared to control group.

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Case of successful treatment of chronic apical periodontitis (apical granuloma).

M. Gaeva, A. Baitokova, A. Korzun
Moscow Medical Dental University, Department of Endodontics

Aim: To prove the effectiveness of conservative treatment in patients with a diagnosis of apical granuloma.

Introduction: In dental practice treatment of patients with chronic apical periodontitis (apical granuloma) is difficult. Unfortunately, most of these patients exposed to tooth extraction procedure. The main task of the doctor is to save tooth using conservative method.

Case presentation: a 40-year-old woman was admitted to the Moscow University Clinic with the chief complaint of constant pain in her mandibular right second premolar. The tooth cavity was open, percussion is painful, palpation at transition crease slightly painful. x-ray examination revealed an alveolar bone defect(Fig.1). After extirpating the remaining pulp tissue and removing debris from canals under copious irrigation with 3% sodium hypochlorite and normal saline, final irrigation was done with 2% chlorhexidine and the root canals were given calcium hydroxide dressing. On the second appointment, the patient was asymptomatic. Further cleaning and shaping of the canals was performed with 3% sodium hypochlorite, Chlorhexidine 2%, Hydrogen peroxide 2% and 17% Ethylenediaminetetraacetic acid. Obturation was done with gutta percha points and AH Plus resin sealer. The patient was asymptomatic at 1-year follow-up examination (Fig.2,3).

Fig.1 (before treatment) Fig. 2, 3 (after 1 year)

Discussion: Compliance with all steps of endodontic treatment, application of the newest technologies and materials allow for a high quality endodontic treatment, eliminate inflammatory reaction from the side of endodont and periodont disease, and to stimulate reparative processes in the bone tissue without significant impact on the health of other organs and body systems.

Conclusion: Adequate diagnosis, compliance with all stages of endodontic treatment, the use of advanced technologies and materials: calcium hydroxide and cocktail Hayling (Sodium hypochlorite 3%, EDTA 17%, Chlorhexidine 2%, Hydrogen peroxide), eliminate inflammatory reaction and to stimulate reparative processes in the bone tissue.
GE140

Endodontic surgery prior to implant placement

*Pažin B1, Domić T1, Husedžinović Š2 Klemenčić M1

Departments of 1Dental and Oral Pathology and Periodontology, 2Oral surgery, Dental Policlinic,
Zagreb, Croatia

The patient (35) was referred to our clinic on account of the maxillary swelling in the frontal region. Radiographic analysis showed tooth 21 with endodontic treatment as well as severe bone loss and root resorption. Previous apical surgery was done in 2010.

Clinically there was sinus tract near the marginal gingiva and an isolated defect of the periodontium suggesting vertical root fracture.

Tooth 21 needed to be extracted.

Due to the expected retraction of the marginal gingiva and a demanding prosthetic reconstruction following the extraction, we decided not to proceed with extraction, but with root resection instead.

The procedure included tooth immobilization, submarginal flap elevation, root resection up to 5mm from CEJ to preserve the height of the marginal gingiva, and filling the defect with bone substitute and covering with resorbable membrane. The retrograde filling was done with MTA.

Six weeks later radiographic analysis showed integration of the bone substitute into the surrounding bone.

Clinically there was no sign of inflammation, the sinus tract was closed and the tooth was ready for extraction and implant placement with predictable aesthetic outcome.

GE141

Endodontic treatment of teeth in patients with periodontal disease

*Galieva D, Mitronin A

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

Aim improve the efficiency of endodontic treatment of teeth in patients with primary perio lesions with secondary endo.

Summary Oftenly, after endodontic treatment of teeth in periodontal pockets, complications emerge, leading to development of paradontitis. It usually ends up with loss of tooth and bone tissue around it. That’s why correction of endodontic treatment algorithm is essential.

Key Learning Points
• Several studies were conducted by the faculty of endodontics of MSUMD.
• 1. Microbiological research. Examination with the PCR method:
• Group 1 (n=58), periodontal pocket’s and root canal’s contents, patients with primary perio lesions and secondary endo.
General Endodontic Posters

- Group 2 (n=20), contents of the sulcus and root canal, patients with pulpitis without parodontium disease diagnosis.
- Comparison according to the number of parodontopathogenic microorganisms; infection of the root canal with parodontopathogenic microorganisms noticed.
- Morphological research. Examination of the root canal (apical third) surface with scanning electron microscopy on distracted teeth: two groups (3 and 4; n=5) formed.
- Group 3 - distraction because of parodontium diseases progressing and pulp inflammation.
- Group 4 - distraction due to the orthodontist’s indications, intact paradontium.
- As a result (group 3), biofilm with a structure resembling the one of periodontal pocket was indicated on the surface of the root canal.
- Basing on previous studies, the algorithm of endodontic treatment was changed, methods of biofilm control used.
- Teeth with the diagnosis of retrograde pulpitis studied and treated, three subgroups formed:
  - 1a (n=20) - treatment with the use of chemomechanical methods of root canal and periodontal pocket treatment, using 2% and 0,05% solutions of chlorhexidine.
  - 1b (n=19) - standard treatment of root canal and periodontal pocket, then photoactivation.
  - 1c - standard treatment of root canal and periodontal pocket, then laser applied.
- Conclusion: endodontic treatment with the use of chemomechanical methods showed better results, it may be recommended as the most stable one.
Invasive Cervical Resorption (ICR) is a condition in which the root of a tooth is resorbed due to a form of endodontic disease. It is characterized by the formation of a resorption cavity at the cementoenamel junction (CEJ) of a tooth. This condition can occur in any tooth, but it is most common in deciduous teeth and young permanent teeth. ICR can be caused by various factors, including iatrogenic factors, such as trauma or iatrogenic injuries, as well as idiopathic factors, such as endodontic or periodontal disease. The treatment of ICR typically involves removing the affected tooth or tissue and replacing it with a biocompatible material. Invasive Cervical Resorption is a condition that can lead to significant dental and oral health issues, and its identification and treatment are crucial for maintaining oral health and preventing further damage.

D.Galiev, A. Mitronin, A. Zinovjeva, N. Belozerova
Moscow Medical Dental University, Department of Endodontics

Aim: To prove necessity of endodontic treatment of teeth in patients with endo-perio lesions and secondary endodontic involvement.

- Introduction: The microflora in the periodontal pockets can affect the dental pulp and cause endodontic-periodontal lesions on retrograde pulpitis. Treatment of teeth with retrograde pulpitis in chronic generalized periodontitis patients is difficult. It is necessary to study bacteria, because they play a critical role in endo-perio disease. And then choose the right root canal treatment of the generalized periodontitis.
- Case presentation: A 50-year-old woman was admitted to the Moscow University Clinic with the chief complaints of a violent spontaneous toothache in her mandibular left second premolar since the previous night. Cold test - "+++". The periodontal probing depth was 5 mm in the buccal region and 9 mm in the lingual region. The diagnosis was an endodontic-periodontal lesion with primary periodontal disease. The treatment plan was endodontic, followed by periodontal treatment. Fig. 1 - before treatment. Fig. 2 - after 1 year treatment.
- Discussion: In the treatment of patients with retrograde pulpitis in chronic generalized periodontitis, there is a microflora in the periodontal pocket. And it is aggressive. That’s why endodontic treatment of retrograde pulpitis should have differences with ones of periodontally healthy patients with pulpitis.
- Conclusion: Primary endodontic disease with secondary periodontal involvement should be first treated with endodontic therapy. Treatment results should be evaluated in 2-3 months and then periodontal treatment should be considered.

References

Modern and new technology

GE144

The alternative method of Cold Lateral Condensation Technique

*Ostanina DA, Mitronin AV

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

Aim: The Cold Lateral Compaction has been considered to be a gold standard, however it can be improved for achieving better results. The aim of the study is to modify the Cold Lateral Condensation Technique in order to improve the quality of root canal system obturation using different spreaders.

Methodology: In the first part of the research was estimated a penetration depth of NI-TI and stainless steel finger spreaders in curved canals using cross sections of teeth. In the second part of the research 60 human extracted teeth were divided into different groups. In group1 root canal systems were filled with gutta-percha cones using stainless steel spreaders. In group2 were used NI-TI spreaders. In group3 was applied the alternative method of roots filling using different spreaders.
The roots were sectioned at 1, 3, and 6 mm from the apex and examined under magnification. In the clinical part of the research 20 teeth were filled by the alternative method of Cold Lateral Compaction. The quality of root canals filling was estimated by X-ray.

**Results** In the curved parts of root canals stainless steel spreaders do not penetrate over the root bend due to poor flexibility of instruments, in contrast to NI-Ti spreaders. But stainless steel spreaders have better sealing ability in easily accessible parts of root canals. Thus, for a qualitative root canal obturation spreaders should be selected from different materials, taking into account the anatomy of root canal system. As a result, it was created the alternative method of Cold Lateral Condensation Technique using different spreaders: in the curved apical third of a root canal should be used a flexible NI-Ti spreader, and in the middle and coronal thirds of a root canal – an elastic stainless steel spreader.

**Conclusions** The research have approved that all studied spreaders have shown satisfactory clinical results. However, in difficult clinical trials the quality of roots filling by the alternative method of Cold Lateral Condensation Technique using different spreaders in general was higher, than the quality of root canals obturation by one chosen spreader.

**Other**

**Apical pressure during PIPS Laser Activated Irrigation, ultrasonically-activated and conventional irrigation**

*Mansi W, Meire M, De bruyne M, Jacquet W, De Moor RJ*

*1Department of Restorative Dentistry and Endodontics, Faculty of Medicine and Medical sciences, University of Gent, Gent, 2Department of Psychology and Education sciences, The free university of Brussels, Brussel, Belgium*

**Aim** The aim of the present study was to compare pressures at the apical foramen created by Laser Activated Irrigation (LAI) using PIPS approach, Ultrasonically Activated Irrigation (UAI) and Conventional syringe Irrigation (CI).

**Methodology** Three extracted human permanent canines with similar dimensions were selected. Each root canal was instrumented to size #40/.06 taper and apical patency confirmed. The roots were placed into a chamber (filled with sterile water) and coupled to a pressure transducer (PXM409-350; Omega®), ensuring air-tight connections. The pressures recorded before deposition of the irrigant and activation were averaged and served as the baseline. Three irrigation methods were studied: CI using a 27 gauge endodontic needle at 1 and 3 mm from the apical foramen, UAI with a #20 Irrisafe® at 50% power at 1mm from the apical foramen and LAI with an Er:YAG-laser and different different fiber tip designs (Flat, Cone and PIPS ), pulse energies (20 and 40 mJ) and
frequencies (15, 20 and 30 Hz). The laser fiber tips were held stationary in the pulp chamber in all LAI measurements. 2.5 % NaOCl was used as the irrigating solution in all instances. Apical pressures were measured at 100 milliseconds intervals for 20 seconds (in CI and UAI) and 30 seconds (for LAI) and each measurement was repeated five times. The mean pressures during activation were calculated and compared amongst the different groups using two-way analysis of variance (ANOVA) and the Bonferroni post hoc tests.

**Results** The different LAI protocols generated pressures of (-0.68 and +2.65 mmHg). These values were significantly lower (P < 0.05) than those of CI (+48 and +81 mmHg) depending on the depth of needle insertion. UAI resulted in pressures of (-1.5 and +2.7 mmHg).

**Conclusions** Within the limitations of this in vitro study, CI created significantly higher apical pressure than LAI and UAI.

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**Cytokines as biomarkers in irreversible symptomatic pulpitis**

*Brizuela C1, Inostroza C1, Meza G1, Saint-Jean N1, Briceño C1, Mercade M2*

1*Dental school, Universidad de los Andes, Santiago, Chile, 2Dental school, Universidad Internacional de Catalunya, Barcelona, Spain*

**Aim** evaluate proteins levels as biomarkers from human exudate pulpar of teeth diagnosed with irreversible symptomatic pulpitis in comparison with samples from normal pulp.

**Methodology** Exudate was obtained from pulp exposure sites using paper points. 21 samples were obtained from teeth diagnosed with normal pulp and 43 from irreversible symptomatic pulpitis teeth. Total protein concentration were analyzed with Micro BCA Assay kit and cytokines levels were determinate by high sensitive enzyme-linked immunoabsorbent assay (ELISA). Data were statistically analyzed using test Wilcoxon rank-sum.

**Results** Preliminary results shows that the total concentration of protein were between 11 y 70ug/ml. Significantly high levels (P=0.01) of IL-6 were detected in pulpal exudates from irreversible symptomatic pulpitis teeth as compared to normal pulp teeth. Levels of IL-1beta were higher in pulpal exudates from irreversible symptomatic pulpitis teeth as compared to normal pulp teeth, with no significant difference (P=0.06).

**Conclusions** IL-6 could be a potential biomarker for determining the pulpal inflammation from teeth with irreversible symptomatic pulpitis diagnosis. Future studies are required to evaluate a broader panel of cytokines.
Incorporation of evidence-based validated technology for Endodontic protocols in general dental and specialist practices: A web-based survey

*Navarrete N, De Gregorio C, Cohenca N, Arias A

Conservative Dentistry, School of Dentistry, Complutense University, Madrid, Spain, Advanced Program in Endodontics, Rey Juan Carlos University, Alcorcon, Spain, Department Of Endodontics, University Of Washington, Seattle, United States

**Aim** To compare the incorporation of endodontic advances in treatment protocols of endodontists and general dentists.

**Methodology** Web-based survey was sent to 950 dentists affiliated with the Spanish Board of Dentistry. Participants were inquired about the use of evidence-based current technology when performing different phases of root canal therapy. Responses from general practitioners and those exclusively dedicated to Endodontics were categorized and compared using either Fisher’s exact test when the variable was dichotomous or Chi-squared test if not.

**Results** A total of 238 (25.05%) surveys were successfully completed and returned. Among them, 50% of these respondents were general dentists and the remaining 50% were endodontists. Endodontists reported a significantly higher incorporation of microscopes (p= 0.002), rotary/reciprocating shaping systems (p=1.24 X 10^-6), adjuncts to irrigation (p=5.98 X 10^-8) and warm vertical compaction techniques (p=1.23 X 10^-6) than general practitioners. When rotary/reciprocating systems were incorporated, endodontists discarded instruments after shaping a significantly lower number of root canals than general practitioners (p= 0.001).

**Conclusions** General dentists and endodontists engage different treatment protocols. The results of this survey demonstrated that endodontists keep up-to-date with protocols published in current literature and are more opened to the incorporation of advanced technology, while general dentists persist with protocols learned during their dental training.

Indications for extraction prior to implant therapy - focus on endodontic status

*Sebring D, Derks J, Berglundh T, Kvist T

Departments of 1Endodontology, 2Periodontology, Institute of Odontology, Gothenburg, Sweden

**Aim** To evaluate indications for extraction prior to implant therapy with a focus on endodontic status.

**Methodology** Records and radiographs from a randomly selected sample of 596 patients, all provided with implant therapy in 2003 were analysed. A total of 2367 implants were installed.
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Documented indications for extraction were retrieved from patient records. Radiographs illustrating the tooth and its endodontic status prior to extraction were available for 634/2367 (27%) sites. These were analysed in regard to endodontic and apical status.

**Results** The most common indications for extraction were marginal periodontitis (51%), caries (22%) and endodontic pathology (16%). A total of 311/634 (49%) of the extracted teeth illustrated on radiographs were endodontically treated. Apical status was assessable on 581 of the 634 (92%) radiographs and signs of apical periodontitis were observed at 145 of 282 (51%) endodontically treated teeth, compared to 57 of 299 (19%) endodontically non-treated teeth (p<0.05). For endodontically treated teeth, the most frequently reported indications for extraction were caries (31%) and root fracture (27%). For endodontically non-treated teeth, marginal periodontitis (69%) followed by apical periodontitis (15%) were the two most commonly reported indications for extraction. For teeth presenting with radiographic signs of apical pathology (n=202), clinicians noted apical periodontitis as indication for extraction for 30% and 33% of the endodontically treated and non-treated teeth, respectively. Endodontic diagnoses were the cause of extraction for 9% of teeth not exhibiting apical pathology on radiographs.

**Conclusions** Approximately 50% of teeth extracted and replaced by means of implant therapy were endodontically treated. Caries and root fracture were the most common diagnoses prior to extraction of endodontically treated teeth, while marginal periodontitis dominated as indication for extraction of endodontically non-treated teeth.

GE149

**Insufficient endodontic treatment in patients with bisphosphonate history – a case series**

*Weusmann J, Walter C, Mahmoodi B, Azaripour A, Olk, L, Willershausen B

 Departments of ¹Operative Dentistry, ²Cranio-Maxillo-Facial Surgery. University Medical Center of the Johannes Gutenberg-University Mainz, Mainz, Germany

**Aim** Bisphosphonates (BP) are used in the therapy of osteoporosis and other malignant and non-malignant bone diseases. Surgical interventions have been identified to trigger the development of bisphosphonate-associated osteonecrosis of the jaw (BP-ONJ). Several authors consider root canal treatment as a safe alternative to extraction. Aim of the present study was to evaluate the association between insufficient endodontically treated teeth and BP-ONJ.

**Methodology** Of all patients that were seen in the specialized consulting hour for patients under BP therapy in a ten-year period, those with insufficient endodontically treated teeth were extracted and further analyzed focusing on reasons for BP medication, exact BP, co-factors and conducted therapy.
**Results** Out of 705 patients, 43 had at least one insufficiently endodontically treated tooth. Zoledronate was the most commonly applied BP (41.9%), 65.1% of the patients received the BP intravenously, mean time under medication was 46.4±35.0 SD months. Out of them, 19 patients had BP-ONJ. In seven cases, the endodontic lesion was a co-factor for the development of a necrosis. Here, six teeth were extracted and one was treated by endodontic revision. All six patients suffered from malignant diseases and had other co-factors, such as chemo- or corticoid-therapy.

**Conclusions** For patients receiving additional therapy with severe side effects and influence on wound healing such as radio- and chemotherapy and probably lowered immunological response, endodontic treatment seems to be too fraught with risk, so a more radical therapy is often indicated. The contrast to literature that clearly favors endodontic treatment might be caused by the regarded collective.

GE150

**Microbiological Rationale for Root Canal Treatment of Teeth with Endo-perio Lesions and Secondary Endodontic Involvement**

Mitronin A, Zinovjeva A, Belozerova N, *Galieva D

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

**Aim** To prove necessity of endodontic treatment of teeth in patients with endo-perio lesions and secondary endodontic involvement.

Treatment of teeth with retrograde pulpitis in severe generalized periodontitis patients is difficult. It is necessary to study bacteria, because they play a critical role in endo-perio disease. And then choose the right root canal treatment of the generalized periodontitis.

**Methodology** periodontal pocket depth (PD) were used to assess condition of periodontium and pulp in 70 patients. The main group included 50 teeth with retrograde pulpitis in severe generalized periodontitis patients (I group) Control group consisted of 20 teeth in periodontal healthy patients with pulpitis (II group). PCR was used for microbiological evaluation of content of periodontal pocket (PP) and of root canal (RC). (Aggregatibacter actinomycetemcomitans (A.a.), Porphyromonas gingivali (P.g.), Tannerella forsythia (T.f.), Treponema denticola (T.d.), Prevotella intermedia (P.i.)).

Statistics to Spearman.

**Results** I group: P. i. RC - 26.9 %, PP - 26.9 ( p=0,003); T.f. RC – 57.7%, PP -46.2% ( p=0,005); T.d. RC – 26.9%, PP – 26.9% (p= 0,001); A.a. RC - 50%, PP – 61.5% ( p=0,003); P.g. RC - 53.5%, PP - 53.8% (p =0,05). I group: P. i. RC and gingival sulcus (GS) - 0; T. f. RC -8.3%, GS -0% (p=0,03); T. d. RC, GS -0; A.a. RC – 16.7%, GS -25% ( p=0,03); P. g. RC - 16.7%, GS -16.7% ( p=0,03).
Conclusions It was established that microbial composition of content of root canals surrounded by deep bone defects is identical to microflora of a periodontal pocket. Thus root canal treatment for secondary endodontic involvement is indispensable before surgery.

Root/furcal perforations repaired with MTA-calcium silicate cements. A 2-year case-series
Iacono F, Pirani C, *FitzGibbon RM, Zamparini F, Gandolfi MG, Prati C
School of Dentistry, Endodontic Clinical Section, Master in Clinical Endodontology, Department of Biomedical and Neuromotor Sciences, Alma Mater Studiorum, University of Bologna, Bologna, Italy

Aim Root and furcal perforations represent a clinical complication that may affect the prognosis of endodontically treated teeth. Different techniques have been proposed to repair these defects. The sealing ability of traditionally used materials such as amalgam or glass-ionomer cements was impaired in the presence of blood and thus not acceptable in the case of perforations.

This case-series retrospective study investigated the clinical survival and success rate of endodontically treated teeth affected by root/furcal perforations repaired using new hydraulic calcium-silicate MTA cements. All patients were treated by postgraduate students attending a Master in Endodontics.

Methodology Twenty-six endodontically treated teeth (n=25 patients) were classified on the basis of radiographic presence/absence of periapical lesion, vital/necrotic pulp, type of treatment, presence/absence and size of radiolucency around the perforation (RAP). Clinical data such as location, size, time between perforation occurrence and repair (immediate, within 7 days or unknown/more than 2 weeks) and type of coronal restoration (composite filling with/without a fiber post, partial or complete crown) were collected. The final outcome depended on the presence/absence and size of RAP as well as tooth functionality. Perforations were filled with calcium-silicate MTA according to the manufacturer’s instructions (TotalFill FKG, Switzerland or TechBiosealer, Isasan, Italy). All teeth were restored in composite. Each patient was re-called every 6 months and clinically-radiologically evaluated. A 2 year follow-up evaluation was performed.

Results After two years all teeth remained functional, 6 teeth presented RAP > 3 mm.

Conclusions Treatment of root/furcal perforations using calcium-silicate MTA hydraulic cements represents an effective clinical procedure. The excellent sealing properties even in moist conditions may partially explain the high clinical success rate of the present retrospective study.
Survey on current standards in endodontic treatment in German Dental Offices

*Baxter S, Goepel K, Hülsmann M
Department of Preventive Dentistry, Periodontology and Cariology, University of Göttingen, Göttingen, Germany

Aim The aim of this survey was to investigate recent treatment protocols, and materials used in endodontics in German Dental Offices in 2015, to evaluate changes in Germany over the decades (longitudinal part) and to compare the results to findings from similar studies from other countries (vertical part).

Methodology A questionnaire examining the current standard in endodontics was sent to 2,000 randomly chosen German dentists using Survey Monkey. The questionnaire was modified based on a study by Savani et al. (2014) and consisted of both multiple choice and open questions. All participants were asked to reply anonymously to the questionnaire which was sent to them via hyperlink and were reminded after two and six months. Each dentist was able to answer the questionnaire only once.

Results Of the 2,000 dentists 339 (17%) returned the questionnaire. 42% of the dentists claim to have their focus on endodontics. For only 23.5% of the dentists rubber dam application is mandatory. Loupes (73%), microscopes (20%) and NiTi rotary systems (92%) are used by a large number of dentists. Determination of the endodontic working length is performed electrically and radiographically by 66%. NaOCl is the most commonly used irrigant (73%), 50% activate the irrigant. 74% of the dentists prefer a multi-visit approach and use calcium-hydroxide (46%) and/or Ledermix (35%) as intracanal medication. 31% use a single-cone obturation technique and 30% lateral compaction. Warm-vertical compaction and GP-carriers are each used by 10%. Within 6 months after endodontic treatment 48% of the teeth are restored with a crown. Only 22% consider to refer the patient to a specialist in endodontics, 78% say they never would refer.

Conclusions When compared to previous German surveys, this study shows evidence of major improvements. When comparing to contemporary surveys taken internationally, Germany shows a good standard in root canal treatment.
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Internal root resorption is a rare condition characterized by progressive loss of tooth substance starting from the root canal wall. Usually is an asymptomatic lesion discovered during routine radiographic evaluation. This case report describes a case with perforating internal resorption and presence of a sinus tract in a maxilar lateral. A healthy 42 year old woman was referred to dental clinic with presence of pain and a sinus tract in a maxilar lateral. Radiographically was observed radiolucent area mesial and distal of the root. CBCT showed destruction of vestibular surface too. Root canal treatment was completed in 3 appointments. Irrigation was performed with hypochlorous acid and calcium hydroxide was placed as a temporary dressing. The canal was prepared with K3XF 40/04. The apical third was filled with vertical condensation technique with gutta-percha and AH plus sealer. The rest of the canal was filled with Biodentin using MTA carrier and root canal pluggers. The access cavity was restored with a glass ionomer cement filling. After 1 month the tooth was found to be symptom free, without sinus tract and no periodontal pockets on probing. After 6 months, the tooth was still symptom free, without sinus tract and the control radiograph showed satisfactory healing of the radiolucent lesion. We suggest CBCT control.
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