



## Abstracts

Oral Presentations on freely chosen subjects



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\* denotes the presenter

## THURSDAY, SEPTEMBER 17th

### HALL 5

**Time:** 9:48 - 10:08

#### **Does root canal treatment in non-vital or retreatment cases require anesthesia? An in vivo clinical study**

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**Aim** Local anesthesia is commonly applied during endodontic treatment in both vital and non-vital cases. While being essential in vital teeth, its application in non-vital cases may be questionable. The study reported here examined whether local anesthesia is required for painless treatment of non-vital teeth (NVT) and retreatment cases (RC)

**Summary:** Root canal treatment was performed in NVT and in RC, without the administration of local anesthesia. The study protocol, approved by the Ethics Committee, ensured that if pain or discomfort were encountered, local anesthesia will be applied. Sixty two canals were included in the study. Two length measurements were performed in each: one at which the scale of the RootZX electronic apex locator read "0.5", which was defined as "electronic length" (EL); the second was the length at which the patient first reported that a #15 file was touching the periapical tissues, defined as "periodontal length" (PL). The difference between these two measurements ( $\Delta = PL - EL$ ) was the parameter studied. It was found that EL was shorter than PL in 92% of the cases. The mean difference between the measurements was 0.73 ( $\pm 0.17$ ) mm in the NVT group and 0.51 ( $\pm 0.18$ ) mm in the RC group, which did not differ from each other. The mean difference between the two measurements was 0.61 ( $\pm 0.12$ ) mm ( $p < 0.001$ ) when the two groups were pooled together. Working length (WL) was defined in this study as 0.5 mm short of the EL. Therefore, the resulting distance between the WL and PL was 1.11 mm ( $0.61 + 0.5$  mm). In all these cases subsequent root canal treatment was performed with no pain or discomfort experienced by the patients. The biologic basis of post-operative pain and flareups will be discussed. It may explain why avoiding local anesthesia may help to avoid such

#### **Key Learning Points:**

- The use of electronic apex locator allowed to established the length of the canal before the patient felt any sensation in most (92%) of the cases.
- Local anesthesia may not always be required when endodontic treatment is performed in non-vital teeth.
- Avoiding un-necessary local anesthesia may reduce the incidence of post-operative pain and flare-ups when treating non-vital or

**Time:** 10:10 - 10:30

#### **Pain levels and typical symptoms of acute endodontic infections**

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**Aim** It was the aim of this prospective study to investigate pain levels and associated symptoms in individuals who pursue emergency treatment in a dental hospital because of painful endodontic infections.

**Summary:** Acute dental pain is most frequently of endodontic origin. A tooth can – but does not have to – hurt thrice. First, when the dental pulp becomes infected, then again when the inflammatory process reaches the periodontium, and finally when it affects the periosteum. These

conditions are termed symptomatic irreversible pulpitis (SIP), symptomatic apical periodontitis (SAP), and acute apical abscess (AAA), respectively. Despite the high occurrence of these conditions, detailed information is sparse. It is not known how painful SIP, SAP, and AAA are. While the diagnosis of AAA is not challenging, specific symptoms have not been identified to reliably differentiate between SIP and SAP. However, emergency treatment of both conditions can differ. In the current investigation it was attempted to close this gap in knowledge. Questionnaires were issued to 222 emergency patients diagnosed with acute pain of endodontic origin. Pain levels were recorded using a verbal numerical rating scale (NRS-11), and specific questions were issued regarding the presence or absence of 11 key symptoms. Subsequently, the painful tooth was diagnosed employing clinical diagnostic tests and periapical radiographs. Logistic regression was used to evaluate the questionnaire regarding its differentiation between SIP (N = 70) and SAP (N = 103). Moreover, a decision tree was constructed to identify a hierarchy in differentiating symptoms.

**Key Learning Points:**

- Symptomatic endodontic infections are extremely painful conditions
- There was no significant difference in pain levels between acute teeth diagnosed with SIP, SAP, or AAA.
- Pain to cold stimuli appears to be the main differentiator between SIP and SAP
- The information presented in this talk can be useful for endodontic diagnostics and questionnaire-based studies.

**Time:** 11:00 - 11:20

**The Influence of Brushing Motion on the Cutting Behavior of Three Reciprocating Files in Oval-shaped Canals**

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**Aim** The purpose of this study was to compare the cutting efficiency of three reciprocating single-file systems, used with brushing motion, in oval-shaped canals.

**Summary:** Sixty premolars with single oval canals were selected and randomly assigned to 3 groups according to the file used in canal instrumentation; R25 Reciproc®, Primary WaveOne® and a novel prototype instrument; Ufile®. Instrumentation was performed in four consecutive steps; according to manufacturers' instructions, 5 brushing strokes against the buccal wall with a non-working instrument followed by another 5 and 15 brushing strokes with working file. Cone Beam Computed Tomography (CBCT) scans were taken following each step of preparation. Pre- and post-instrumentation images were superimposed; at apical and midroot levels, and then evaluated in terms of changes in maximum buccolingual ( $\Delta$ BL) and mesiodistal dimensions ( $\Delta$ MD). Instrumentation with brushing motion resulted in the following findings. At apical levels, no significant difference was found in  $\Delta$ BL for the three groups (-p-value > 0.05). However,  $\Delta$ MD was significantly less for Reciproc (-p-value = 0.006) and Prototype Ufile (-p-value = 0.03) groups. At midroot levels, Prototype Ufile group showed the highest significance in terms of  $\Delta$ BL(-p-value < 0.0001) but the lowest in terms of  $\Delta$ MD(-p-value = 0.003).  $\Delta$ MD was significantly the highest for WaveOne group at midroot levels (-p-value = 0.05). The prototype file was more efficient than other files at midroot levels while all systems acted the same at apical levels. The increase in number of brushing strokes resulted in more dentinal cutting at that direction.

**Key Learning Points:**

- We compared the cutting efficiency of three reciprocating single-file systems when used in brushing motion in oval-shaped canals.
- We examined changes in root canal dimensions using CBCT axial sections.

- All three reciprocating files were efficient when used with lateral brushing motion with statistical differences at different levels of the root canal.
- Multiplying the number of brushing strokes will lead to significant cutting of the canal wall, in all directions.

**Time:** 11:22 - 11:42

#### **How calcium hydroxide and culturing influence *Enterococcus faecalis* in mixed biofilms**

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**Aim** To evaluate the fate of *Enterococcus faecalis* in dual-species and multi-species biofilms after a calcium hydroxide treatment (Ca(OH)<sub>2</sub>).

**Summary:** Biofilms were cultured from *E. faecalis* and *Pseudomonas aeruginosa* or from isolates from primary root canal infections. Subsequently, the biofilms were treated with Ca(OH)<sub>2</sub>. The proportion of *E. faecalis* and *P. aeruginosa* as well as their susceptibility to disinfection were evaluated in a viability assay. In the mixed-species assay, the presence and proportion of *E. faecalis* before and after Ca(OH)<sub>2</sub> was evaluated with a quantitative polymerase-chain-reaction assay. Groups were compared with Kruskal-Wallis and Man Whitney-U-tests and  $\alpha < 0.05$  was considered statistically significant. In the dualspecies assay after Ca(OH)<sub>2</sub>, the proportion of *E. faecalis* in the biofilms had increased ( $P < 0.001$ ). Also, *E. faecalis* was equally susceptible to disinfection whereas *P. aeruginosa* had become more susceptible. The root canal isolates did not contain detectable amounts of *E. faecalis*. After Ca(OH)<sub>2</sub> and a 16-h recovery phase, the total number of bacteria was still reduced ( $P < 0.001$ ). Calcium hydroxide favours the population of *E. faecalis* in a dualspecies biofilm. By culturing of multispecies endodontic isolates, *E. faecalis* becomes detectable. *E. faecalis* was often present in primary endodontic infections albeit in low numbers.

#### **Key Learning Points:**

- After a treatment with Ca(OH)<sub>2</sub> *E. faecalis* appeared more resilient than *P. aeruginosa* which enabled the population of *E. faecalis* to increase.
- In isolates of primary infections, *E. faecalis* is most likely present in low numbers. Culturing of these isolates is necessary to increase *E. faecalis* to detectable numbers.

**Time:** 11:44 - 12:04

#### **Stress distribution in endodontic instruments during preparation of the root canal. A finite elements analysis**

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**Aim** This study aimed to compare the stress distribution for NiTi instruments with similar design (Mtwo® and Reciproc®, VDW, Munich, Germany) used in either rotary or reciprocating movement in order to identify the benefits and limitations of each movement type regarding the fracture resistance of the instrument during preparation of the root canal.

**Summary:** Whilst NiTi instruments were introduced to facilitate instrumentation of curved canals, a major concern exists regarding the fracture susceptibility of the NiTi-alloy during the shaping procedures. The majority of NiTi instruments are used in a rotary motion type, newly developed instruments are used in a reciprocating movement in order to present a better fracture resistance. NiTi instruments have different cross sectional or longitudinal designs. Choosing two instrument systems with similar cross-sectional and longitudinal designs, the present study investigates the stress distribution during rotary or reciprocating movement of the endodontic instruments using a

computational model. The simulated instrument - either rotary or reciprocating - was used according to the manufacturers indications in root canals with variable curvature degrees. The influence of the parameter motion type and canal curvature were registered and the combined bending and torsion load during instrumentation were subjected to the FE analysis.

**Key Learning Points:**

- With the inherent limitations of this study, it can be concluded that the reciprocating movement type can lead to a better stress behaviour of the NiTi instruments compared to the rotary movement.
- This presentation will give an overview of the advantages and disadvantages of each instrument movement type during root canal preparation.
- The latest results on this topic will be discussed and a review of the relevant literature will be given.
- To conclude, the movement type is an important factor for the stress distribution or the fracture resistance of root canal instruments with similar design.

**Time:** 12:06 - 12:26

**Nickel-titanium versus stainless steel instruments for orthograde endodontic therapy: a systematic review and meta-analysis**

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**Aim** The aim of this systematic review was to evaluate the available literature regarding the effectiveness of Ni-Ti instruments as compared to Stainless Steel ones in order to find if there is evidence of a superiority of one versus the other instrument type for the main outcomes related to the endodontic treatment success.

**Summary:** An electronic search was performed on Medline, EMBASE and Scopus using a specific search strategy, to find comparative studies evaluating Nickel-Titanium vs. Stainless Steel instruments. An additional hand searching was performed. When feasible, meta-analysis based on a random-effects model was performed for relevant outcomes. Articles were divided according to study type (vivo or vitro studies) and according to the outcome variables: a) removal of existing filling material during retreatment; b) cleansing ability after treatment; c) apical extrusion of debris; and d) transportation and centering ability. Inclusion criteria In vivo studies:

- Only Comparative studies between manual stainless steel and engine driven Ni-Ti files.
- Clinical studies (prospective or retrospective or randomized or non-randomized study).
- Written in the English language. *In vitro* studies: i) Only randomized comparative studies between manual stainless steel and engine driven Ni-Ti files. ii) Experiments done using only extracted human teeth iii) Written in the English language

**Key Learning Points:**

- The preparation of the root canal using new generation rotary NiTi files can be regarded as predictable and the choice of a specific type of files for daily use requires consideration of the combined evaluation of all described parameters, since any type of instrument has its specific advantages and limitations, meaning that NiTi and manual stainless steel files systems are not completely inter-changeable.
- Achieving the success in dental procedures mainly depends on the dentist skill and experience and secondly comes from the instruments and material. The combination of the use of contemporary available modern devices and files with a solid base of anatomic and biologic knowledge will lead to a predictable higher quality of root canal treatment on a broader basis, thus helping to preserve more teeth for more years

**Time:** 12:28 - 12:48

**A comparative study of six rotatory NiTi instruments in preserving canal curvature according to the file system and the number of uses with CBCT.**

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**Aim** Compare the deformation of the root canal according to the files system used and the number of uses of each file from 6 instrumentation system: protaper, protaper next, wave one, hyflex, mtwo and k3.

**Summary:** 144 simulated resin root canal were prepared divided in 6 groups of 24. New files were used for each 6 simulated canals following the complete sequence as determined by the manufacturer up to apical diameter #25. Irrigation protocol was with saline and was prepared by the same operator. Then we made a cone-beam to obtained a 3D image and the possibility of measuring angles specific program. At the first use (which we named 0) significant statistical differences were found between Mtwo, WaveOne, k3 and Hyflex, being wave one the one that produced the most deformation and k3 the one that produced the least. At the second use (named 1) no statistical differences were found. At the third use (named 2) we found statistical differences between universal Protaper and Mtwo, being Protaper the one that produced the least deformation. At the forth use (named 3) we found statistical differences between universal Protaper and Mtwo, Hyflex, k3 and Protaper next, being k3 the one that produced the least deformation. At the fifth use (named 4) we found statistically differences between Protaper, Hyflex, K3, Mtwo and ProtaperNext and between WaveOne and mtwo. At the sixth use (named 5) we found statistical differences between Protaper next, Mtwo, Hyflex and the rest of the systems. These three systems produced most deformation.

**Key Learning Points:**

- According to the number of uses, the biggest difference obtained was in the 5th use, with significant differences between Mtwo and the rest of the systems, except for Hyflex and Protaper except for ProtaperNext.
- Mtwo, hyflex, and ProtaperNext increased the angle of the root canal because they shaped more the curvature wall, while Protaper, Wave one and k3 systems don't increase the angle because they shaped more the anticurvature wall so the most rigid systems tend to straighten the canal root
- Further study with different angles of curvature of the initial root canal can be followed in order to complete this study.

**Time:** 12:50 - 13:10

**Single file systems for root canal preparation: Fact or Fiction**

\*Saber S

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**Aim** The aim of this oral presentation is to critically evaluate sound studies conducted to evaluate the performance of existing single file systems, and to answer the key question: Do single file systems satisfy our cleaning and shaping objectives?

**Summary:** Shaping of the root canal is one of the most important steps in root canal treatment. It is essential for the efficacy of all subsequent procedures, including chemical disinfection and root canal filling. However, the complex anatomy of the root canal system and the inherent limitations of instruments pose several challenges that can affect treatment outcome. The introduction of rotary nickel-titanium instruments has revolutionized root canal preparation. Despite these advantages, unexpected instrument fracture is not uncommon. Such a mishap might complicate and compromise the outcome of endodontic treatment. Another recent concern is the possibility of cross-contamination associated with the inability to adequately clean and sterilize endodontic instruments. Therefore, the single use of endodontic instruments has been recommended to reduce

instrument fatigue and possible cross-contamination. There are several single file systems in the market that vary in their metallurgy, design and mode of operation. Nevertheless, using a single instrument with sharp cutting edges to complete the preparation might result in canal aberrations and will subject it to a great deal of stresses. Also, there are serious concerns for their cleaning potential.

**Key Learning Points:**

- Challenges during root canal preparation
- Rationale for single file systems
- Current single file systems
- Review of current literature (JOE/IEJ search)

**Time:** 15:00 - 15:20

**OTR Movement (Optimum Torque Reverse) in root canal shaping: research and Clinical applications.**

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**Aim** to show pre-clinical researches and Clinical application of the new OTR device.

**Summary:** J Morita (Tokio –Japan) has recently proposed the OTR module used together with the Root ZX II Apex Locator. This new device permits to shape the root canal system using both continuous rotation and reciprocating movement, reducing the fracture risk of NiTi rotary instruments. Whenever the set torque value is exceeded, the rotating movement will immediately be replaced with the reciprocating one (90° CCW/90° CW). This will work until the torque values go below the preset ones again. The Speaker will describe the preclinical research performed using both new and used NiTi instruments comparing continuous rotation, OTR movement and Reciprocating movement (150° CCW/ 30° CW). He will also report clinical cases showing the use of this new device in daily practice.

**Key Learning Points:**

- the cyclic fatigue can be reduced, preventing instruments fracture
- the new OTR device permits either reciprocating or continuous rotation, according to the root canal characteristics

**Time:** 15:22 - 15:42

**Volumetric 3D mapping of dentinal cracks after intracanal procedures**

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**Aim** To present a microCT reconstruction method to volumetrically map the dentinal cracks present at various phases of root canal preparation and filling and verify the correlation of these dentinal defects generation/propagation with intra canal procedures.

**Summary:** The formation/propagation of intracanal procedures-induced dentinal cracks have been largely demonstrated with the use of methodological approaches that are both destructive for the sample (cross-sectioning) and solely provide 2D images of the affected area. Therefore longitudinal evaluation of the defects and its volume variation along canal preparation cannot be estimated. MicroCT allows the 3D reconstruction of root canal structures with the advantage of being non-destructive which permits a longitudinal tracking of dentinal consequences of intracanal procedures. A type II configuration mandibular molar was instrumented to the working length using a reciprocating system and profuse irrigation with 2,5% NaOCl. Further, the canals were filled with



gutta-percha and endodontic sealer using lateral compaction technique. Three high-resolution scans were accomplished per each tooth: (S1) prior to treatment, (S2) after root canal preparation, and (S4) after root canal filling. Images were reconstructed using NRecon v.1.6.3 (Bruker-microCT) with a beam hardening correction and an automatic segmentation threshold was used to separate dentin and root canal space from the dentinal defects, using CTAn v.1.12 software (Bruker-microCT). Colour-coded models (blue, black and pink indicate the original root canal anatomy, the dentinal defect, and obturation materials, respectively) enabled surface area and volumetric comparison of cracks generation and propagation pattern during the different stages of intracanal procedures using CTVol v.2.2.1 software (Bruker-microCT).

**Key Learning Points:**

- MicroCT reconstruction allows the 3D mapping of dentinal defects which enables the longitudinal calculation and comparison of surface areas, volume and propagation pattern of dentinal defects
- Dentinal defects were present before intracanal procedures and appears not to be generated nor propagated by the intracanal procedures performed.

**Time:** 15:44 - 16:04

**Impact on root dentine after identification and instrumentation of complex root canal anatomy ex-vivo**

\*Paque F

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**Aim** The aim of this presentation is to show and to discuss the identification and instrumentation of complex root canal anatomy ex vivo using micro-computed tomography (micro-CT). In particular, the so-called middle mesial root canal of mandibular molars and the preparation with different tapered instruments will be in the main focus.

**Summary:** Root canal anatomy is very complex and variations of number and arrangement of root canals are significant in particular molar teeth. This presentation will focus on the identification and instrumentation of middle mesial root canals. The amount of the surrounding dentine in these canals is often less than in the main root canals. Instrumentation and preparation of these canals can weaken the root considerably. New data analysed by micro-CT studies show the impact of different tapered instruments on the residual dentine thickness in mandibular molars. The effect of the preparation with these instruments will be discussed.

**Key Learning Points:**

- To detail the possible anatomical variations in human molars.
- To describe the impact of complex root canal anatomy on shaping procedures.
- To describe the effect of different tapered instruments on the residual dentine thickness in 'additional' root canals.

**Time:** 16:06 - 16:26

**Effect of ethylenediaminetetraacetic acid gel on the incidence of dentinal cracks caused by three novel nickel-titanium systems**

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**Aim** To evaluate the incidence of crack formation while using Reciproc, WaveOne and Twisted File Adaptive with and without ethylenediaminetetraacetic acid (EDTA) gel.

**Summary:** Methodology: Seventy extracted mandibular premolars were included. The teeth were decoronated until roots of 16 mm were obtained. Samples were distributed into seven groups: group 1, no canal preparation (control); other groups were instrumented so; group 2, Reciproc; group 3, Reciproc + EDTA; group 4, WaveOne; group 5, WaveOne + EDTA; group 6, Twisted File Adaptive; group 7, Twisted File Adaptive + EDTA. Roots were horizontally sectioned from 3, 6 and 9

mm from apex and observed under stereomicroscope with a magnification of 20×, and digital pictures were obtained with a digital camera attached to the microscope. The number and the incidence of cracks were recorded and statistically analysed with chi-squared and Kruskal–Wallis tests. No cracks were found in the control group. Among the experimental groups, no statistically significant differences were determined ( $P > 0.05$ ). Three novel engine-driven Ni-Ti instruments resulted in the same degree of crack formation. Despite its lubricant effect, EDTA gel did not reduce the crack initiation of this instrument.

**Time:** 17:00 - 17:20

**Comparative evaluation of the shaping ability of six different nickel-titanium file systems produced by different manufacturing methods.**

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**Aim** Many improvements have been proposed by manufacturers to enhance the clinical performance of nickel-titanium (NiTi) instruments. The newly developed NiTi instruments made from controlled memory (CM) wire, M-Wire (Dentsply Tulsa Dental Specialties, Tulsa, OK) or R-phase wire are result of this improvements. The aim of this study was to compare and evaluate the shaping ability of six NiTi file systems made out of CM-wire, M-Wire and R-phase wire in simulated L-shaped canals.

**Summary:** Ninety L-shaped canals in resin blocks with a canal curvature of 45° were divided into six group of 15 canals and prepared by using M-Wire NiTi instruments (Reciproc, ProtaperNext, Profile Vortex), R-phase wire NiTi instruments [Twisted File Adaptive (TFa), K3XF] and CM-wire NiTi instruments (HyflexCM) systems. Pre- and post-instrumentation digital images were taken by stereomicroscope and superimposed. Ten measuring point (MP) were defined on the each canal. Material removal and canal transportation were measured at each MP with a computer image analysis program. Canal aberrations, files failures and preparation times were also recorded. These data were analysed statistically by using ANOVA and post-hoc (LSD) test. During preparation no file fractured. Instrumentation with Reciproc system was significantly faster than with all other instrument systems ( $P < 0.05$ ). Canal transportation and material removal values were the highest statistically with reciproc in the apical third and no significant difference was found between the other 5 group. The TFa system and HyflexCM were found to have less canal transportation in the apical third ( $p < .0001$ ). The TFa system and HyflexCM system showed superior shaping ability in preparation of simulated canals. The use of reciproc system resulted in increased apical transportation and material removal.

**Time:** 17:22 - 17:42

**Assessment of Different Carrier-based Obturation Systems: Micro-Ct Comparison with Warm Vertical Compaction.**

\*Carla Zogheib CZ

*Department of Endodontics, Saint Joseph University, Beirut, Lebanon*

**Aim** To evaluate the percentage volume of filling materials and voids in the apical third of root canals obturated with 4 different carrier-based systems using micro-computed tomography.

**Summary:** 60 single-rooted teeth were selected, root canals prepared, and assigned to 5 groups ( $n=12$ ), according to the filling technique: Thermafil, Real Seal1, Gutta Core, Gutta Fusion and Warm Vertical Compaction technique. Each specimen was scanned using a micro-CT device. Percentage of gaps and voids was calculated. All results were statistically analyzed using ANOVA test, with a significance level of 5%. No significant difference was found within the five obturation methods at 1mm ( $-p\text{-value} > 0.05$ ), 3mm ( $-p\text{-value} > 0.05$ ) and 5 mm ( $-p\text{-value} > 0.05$ ). No root fillings were void-free. No significant difference was found between the WVC technique, the GC technique and the GF

technique concerning percentage of apical voids regardless of canal level. All techniques gave good sealing making them appropriate to use in our daily practice.

**Key Learning Points:**

- Root canal obturation techniques evaluation
- New cross-linked carrier based obturators techniques
- Micro CT evaluation of root canal obturation
- Comparison with SCHILDER'S warm vertical compaction
- Clinical relevance: there isn't any obturation technique superior to another

**Time:** 17:44 - 18:04

**Moulding ability of endodontic gutta-percha**

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**Aim** To achieve an hermetic gutta-percha adaptation against the root canal system morphology, heat should be applied during vertical condensation. Endodontic gutta-percha plasticizes at 68-70°C. Thus, the aim of this research was to determine the potential of gutta-percha to absorb and transmit heat.

**Summary:** Heat was applied at room temperature (28/±2°C) by means of a heat-plugger size .10 (M) (SybronEndo, Orange CA, USA) to gutta-percha points (n=15) sizes 30/.06 and .04 (Roeko/Coltène/Whaledent, Langenau, Germany) during 2s (±0.5s). The maximum temperature (°C) of the heat-pluggers and gutta-percha points were measured at 5 and 1mm from their respective “apical” tips by means of a ThermoCAM SC640 infrared camera (Flir Systems/Frankfurt, Germany). The results were statistically analyzed. the mean temperatures applied and reached by the gutta-percha were:

- Level 1mm from the “apical ” tip  
.06 plugger 360.76° (±49.21°); gutta-percha 133.32° (±41.15°) and  
.04 plugger 288.26° (±91.04°); gutta-percha 169.56° (±48.38°).
- Level 5mm from the “apical ” tip  
.06 plugger 302.62° (±32.05°); gutta-percha 156.02° (±17.14°)  
.04 plugger 266.51° (±32.64°); gutta-percha 136.16° (±26.47°).
- Plugger at Level 5 and gutta-percha 1mm “apically” from the 5mm measuring level  
.06 plugger 302.62° (±32.05°); gutta-percha 75.38° (±3.59°) and  
.04 plugger 266.51° (±32.64°); gutta-percha 47.38° (±8.10°).

Conclusions: the statistical analysis of the results demonstrated that gutta-percha has an extremely low heat transportation potential; thus, care should be taken to apply the heat at the level where gutta-percha should plasticize in order to be able to allow gutta-percha to fill all confines of the root canal morphology.

**Key Learning Points:**

- Evaluate the thermal conduction potential of gutta-percha.
- Recognize the thermal capabilities of the device employed.
- Identify the fidelity of the three-dimensional filling produced.

**Time:** 18:06 - 18:26

**A micro-CT evaluation of the obturation after immediate and delayed post preparation**

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<sup>1</sup>Department of Endodontics, UNIPAR, Cascavel, <sup>2</sup>Department of Endodontics, PUCPR, Curitiba, Brazil

**Aim** To evaluate *in vitro* the percentage of root canal obturation and voids, in immediate and delayed post preparation, performed in teeth filled with different sealers and obturation techniques.

**Summary:** Seventy-two single-rooted extracted premolars divided into 12 groups (n = 6), were prepared up to a F4 rotary ProTaper. The teeth were filled with gutta-percha associated to AH Plus or Fillapex MTA, using different obturation techniques (single cone, System B, lateral condensation). Immediate preparation was performed in 3 groups with heated instruments. All teeth were kept 4 weeks (37°C 100% humidity) and then delayed preparation was performed in the remaining teeth using Gates-Glidden drills. Teeth underwent computed microtomography. The three-dimensional digital reconstructions were analyzed to obtain the percentage of filling material and voids inside the main root canal. The data were statistically analyzed at a 5% significance level (ANOVA, t test). There was no significant difference when comparing filling percentage in the apical third obtained before and after the delayed post preparations. Delayed and immediate post preparation presented similar apical percentage of voids. The percentage of filling was similar among the obturation techniques, but it was significantly higher for AH Plus fillings compared to MTA Fillapex (p=0,0024).

**Key Learning Points:**

- Immediate and delayed post preparations resulted in a similar amount of remaining filling in the apical third.
- The percentage of root canal obturation in the apical third was not affected by the tested obturation techniques.
- The partial removal of the root canal filling had not increased the percentage of voids in the apical third of the obturations.
- MTA Fillapex obturations presented higher percentage of voids compared to AH Plus.

## FRIDAY, SEPTEMBER 18th

### HALL 4

**Time:** 9:00 - 9:20

**The Isthmus: an area difficult to manage**

\*Al-Huwaizi HF

*Conservative dentistry, College of dentistry, University of Baghdad, Baghdad, Iraq*

**Aim** The lecture aims to highlight on the different procedures to clean and obturate the isthmus area and the degree of their clinical significance.

**Summary:** Root canal anatomy shows great variations and from these anatomical complexes is the isthmus. It is a narrow connection between two or more root canals. Many improvements occurred in instrumentation techniques, irrigation protocols and systems and thermoplasticized obturation systems that limited the untouched areas in the isthmus. Micro CT analysis, histopathological and tooth clearing examinations proved reliable ways to predictably analysis isthmus cleaning and obturation. It is still a difficult area to tackle and treat completely.

**Key Learning Points:**

- The isthmus should be understood as an area essential to be treated.
- The use of rotary instrumentation techniques without an effective irrigation protocol produce smear layer that fills the isthmus rather than gutta percha.
- Irrigation using sonic vibrations or affecting surface tension improve isthmus debridement.
- There should be a focus on procedures and materials that improve obturation to the isthmus by use of low viscosity materials.

**Time:** 9:22 - 9:42

**Micro-CT Root Canal Configuration and Main Foramina Number Investigation of 302 Maxillary Molars**

\*Wolf TG<sup>1</sup>, Paqué F<sup>2</sup>, Willershausen B<sup>2</sup>, Briseño Marroquín B<sup>2</sup>

<sup>1</sup>*Department of Operative Dentistry, University Medical Center Mainz, Mainz, Germany,* <sup>2</sup>*Division of Endodontology, University of Zurich Dental School, Zurich, Switzerland*

**Aim** The root canal configuration (RCC) and main foramina number (MFN) of 179 first and 123 second maxillary molars was investigated by means of micro computed tomography.

**Summary:** Successful root canal treatment is enhanced through accurate knowledge of the morphology of the root canal system. The RCC and MFN (4th numerical) were numerically described in the coronal, middle and apical thirds by means of micro computed tomography. The data was statistically analyzed. The results of the first molar roots showed that the apical RCC and MFN mostly corresponded or that the MFN was seldom lower (mb=16.9%; db=1.2%; p=0.6%). The most common RCC/MFN observed in the mesio-buccal root were 1-1-1-1 (45.8%), 2-2-2-2 (25.1%), 2-2-1-1 (10.1%) and 2-1-1-1 (3.9%); 1-1-1-1 (97.2%) in the disto-buccal root and 1-1-1-1 (98.9%) in the palatal root. The second molar roots results showed that the apical RCC and MFN mostly also corresponded or that the MFN was slightly lower (mb= 27.6%; db=0.8% db and p=0.0%). The most common RCC/MFN observed in the mesio-buccal root were 2-2-2-2 (19.5%), 2-2-1-1 (14.6%) and 2-1-1-1 (13.0%); 1-1-1-1 (93.5%) in the disto-buccal and 1-1-1-1 (96.7%) in the palatal root. The RCC of maxillary molars is quite varied. The mesio-buccal root of first maxillary molars has in 53.7, 42.2 and 4.1% one, two and three root canal entrances respectively. Second maxillary molars have predominantly two root canal entrances. 61.0% and 28.4% of the first second molars, respectively, have only one main foramina. The apical RCC/MFN morphology is 2-2 in 33.0% (first) and 39.8% (second) in the mesio-buccal roots.

**Time:** 9:44 - 10:04

## **Cone-Beam Computed Tomography study of root and canal morphology of mandibular first and second molars in a spanish population**

\*Mora Christian J, Abella Sans F, Nuñez Avellaneda A, Roig C M

*Department of Endodontics, Universitat Internacional de Catalunya, Barcelona, Spain*

**Aim** The aims of this report was to study the root and canal morphology of mandibular first and second molars in a Spanish population by using CBCT.

**Summary:** Recognition of variations in root canal anatomy is an essential prerequisite for successful endodontic diagnosis and treatment. The complexities of internal anatomy are often masked by the external surfaces, which have a relatively simple and uniform anatomy. Internal complexities of the root canal are genetically determined and have definitive importance in anthropology, thereby necessitating the identification of root canal morphologies of different ethnic populations.

The methods used in analyzing root canal morphology are canal staining and tooth clearing, conventional radiographs, digital radiographic techniques, radiographic assessment enhanced with contrast media, and more recently, computed tomography (CT) techniques and modified canal staining and clearing. An ideal technique would be one that is accurate, simple, nondestructive, and most importantly, feasible in the in vivo scenario. Recently, cone-beam computed tomography (CBCT) images have been found to be useful and accurate in detecting periapical lesions and assessing root canal morphology. CBCT has also been used to estimate the inter-orifice distances of root canals in three-rooted mandibular molars in Taiwanese individuals. As an emerging technology in endodontics, CBCT, with its lower radiation and higher resolution than traditional CT scans, has produced valid root and canal details in three dimensions for diagnosis and prognosis in the context of endodontic therapy. Amongst Caucasians, the DL root is rare (3.4–4.2%) and is considered to be unusual or dysmorphic root morphology. Several case reports have been reported recently on the treatment of three-rooted mandibular first molars in patients of European origin. However, there are few studies carried out in European populations.

### **Key Learning Points:**

- Classify the root morphology of the mandibular first and second molars of a spanish population.
- Classify the root canal morphology of the mandibular first and second molars of a spanish population.
- Determine the prevalence of the disto lingual root in mandibular first molars in a spanish population.
- Determine the prevalence of C-Shaped canals of mandibular second molars in a spanish population.

**Time:** 10:06 - 10:26

## **Accuracy of an Electronic Apex Locator in the Retreatment of Teeth Obturated with Plastic or Cross-linked Gutta-percha Carrier-based Materials: An Ex Vivo Study**

\*Palopoli P, Mancini M, Conte G, Iorio L, Cianconi L

*Department of Endodontics, Tor Vergata University, Rome, Italy*

**Aim** The purpose of this evaluation was to assess the accuracy of the electronic apex locator (EAL) Root ZX during the retreatment of canals obturated with ProTaper Obturator and GuttaCore and to evaluate whether these materials influenced its accuracy differently.

**Summary:** A few studies evaluated the accuracy of different Electronic Apex Locators (EALs) during retreatments. To date, this is the only study evaluating EAL accuracy during retreatment of canals obturated with carrier-based gutta-percha. Fifty extracted single-rooted human teeth with sound apices were selected. We measured canals with the direct visual technique using a #10 K-file and shaped them with ProTaper Universal up to this length. After instrumentation, we determined the length again using the visual technique (direct length [DL]). This value was considered the “reference point”. Specimens were then placed in a tooth holder, and the length was electronically measured

(electronic length 1 [EL1]). Specimens were then obturated with ProTaper Obturators (group-1, n=25) and GuttaCore (group-2, n=25). Seven days later, a new electronic length was determined (electronic length 2 [EL2]) during retreatment in the presence of the obturating material. EL1 and EL2 values were compared with DL using the Bland and Altman method. The different influences of the tested materials on the accuracy of the EAL were calculated with repeated measures analysis of variance. RESULTS EL1 and EL2 values provided a statistically significant overestimation of the actual canal length (DL [ $P<.05$ ]), with the EL2 values higher from DL. The 2 different materials did not influence the accuracy of the EAL differently ( $P=.486$ ). The measurements obtained with the EAL tested during orthograde retreatments can lead clinicians to overinstrumentation and consequent overfilling of the endodontic space. To prevent this, clinicians should subtract at least 1 mm from the WL measurement on the APEX mark before shaping and sealing the root canal system. However it is suggested to recalculate the root canal length after the complete removal of endodontics material.

#### **Key Learning Points:**

- An accurate working length (WL) is a crucial aspect in endodontic orthograde retreatments.
- Electronic apex locators (EALs) are useful in determining the WL.
- Carrier-based obturating material could affect EALs' accuracy.

**Time:** 11:00 - 11:20

#### **Evaluation of the effect of calcium hydroxide removed from root canal with different techniques on bonding strength of root canal sealers**

\*Eymirli A, Uyanik O, Calt Tarhan S

*Department of Endodontics, Health science, Ankara, Turkey*

**Aim** The aim of this study was to evaluate the effect of calcium hydroxide residues on push-out bond strength of different sealers.

**Summary:** In this study, 104 single rooted human teeth were used. After removal of crowns, 8 of 104 teeth served as control groups, remaining 96 teeth were divided into two groups and root canals were filled with Calasept and Surepaste (n=48). After 7 days, calcium hydroxide was removed with %17 EDTA+Protaper F3 rotary file, %17 EDTA+Protaper F3 hand file and %17 EDTA (n=16). Then root canals were filled with AH Plus jet, Apexit Plus and Protaper F3 gutta percha (n=8) followed by bond strength was tested with push-out bond strength test. Data was analysed by One Way ANOVA. Results showed that, AH Plus jet control group showed highest whilst Surepaste-%17 EDTA-AH Plus jet showed lowest bond strength ( $p<0,05$ ). Among other groups no differences was found ( $p>0,05$ ). In this study, the effect of calcium hydroxide vehicles and removal techniques on bond strength of different root canal sealers was evaluated. Results showed that vehicles, techniques and sealers affect bond strength. Highest bond strength was seen in AH Plus group while the lowest in SurePaste/EDTA/AH Plus group.

**Time:** 11:22 - 11:42

#### **A prospective comparative study of root canal treatment using Thermafil and Cold lateral compaction in teeth with periapical lesions**

\*Kandemir Demirci GÖZDE, Çalışkan MKEMAL

*Department of Endodontology, Ege University, İzmir, Turkey*

**Aim** To investigate and compare clinical and radiological outcome of root canal treatments(RCT) with using Thermafil (TF) and cold lateral compaction (CLC) methods with standardized clinical protocols, the time required for treatment, extrusion of root canal filling rates and postoperative pain levels between the groups.

**Summary:** It was a prospective randomized clinical trial involving 120 teeth in 100 patients aged between 18–65 years. This study involved patients who required primary, nonsurgical RCT with either TF or CLC by one endodontist with a standard treatment protocol. A total of 56 teeth were

filled with CLC and 56 teeth with TF. The time used in the entire of obturation was recorded. In a blind evaluation, the treated teeth radiographs were examined according to Orstavik et al. (1986) by two examiners who did not know their group assignment and each apical root canal filling level was examined according to Sjögren's et al. (1990). Post-treatment disease with clinical symptoms and/or radiographic radiolucency was observed in one tooth (1,8%) of the LC group and in two teeth (3,6%) in the TF group. There was no statistically significant difference ( $P>0.05$ ) between two groups. When obturation of root canals using TF, the extension of gutta-percha was more uncontrollable than CLC group. There was statistical significance between TF and CLC groups ( $p=0.027$ ). The result of the present study demonstrates that, at 24 hours and 48 hours, mean pain level was higher in the TF group. The difference between the groups and the patient's age and gender on postoperative pain were not statistically significant ( $p>0.05$ ).

#### **Key Learning Points:**

- Root filling with TF did not result in a different treatment outcome compared with cold LC of GP after 24 months of observation period.
- The study also found that root canal treatment using with TF required significantly less time than LC.
- Favorable results of the present study showed that the good sealing ability of both techniques making them appropriate to use in endodontic obturation procedure.

**Time:** 11:44 - 12:04

#### **Quaternary ammonium polyethyleneimine enriched sealer supports post treatment infection control**

\*Abramovitz I<sup>1</sup>, Weisblach D<sup>1</sup>, Zaltsman N<sup>2</sup>, Weiss EI<sup>3</sup>, Beyth N<sup>2</sup>

<sup>1</sup>Department of Endodontics, Hebrew University-Hadassah School of Dental Medicine, Jerusalem,

<sup>2</sup>Department of Prosthodontics, Hebrew University-Hadassah School of Dental Medicine, Jerusalem,

<sup>3</sup>Tel Aviv University, Goldschleger School of Dental Medicine, Tel Aviv, Israel

**Aim** The aim of the present study was to evaluate the intra tubular antibacterial effect of an epoxy resin sealer incorporating 1% QPEI against *E. faecalis* in a human dentin model.

**Summary:** Infected dentinal tubules are a potential resource of continuing or recurring endodontic disease. Antiseptic rinsing as well as anti-bacterial dressing and root canal sealers have a limited antibacterial effect that exhaust a few days following root canal preparation and obturation leaving the remaining bacteria unchallenged by any active antibacterial mechanism. Such scenario calls for a development of better sealers that will possess long term antibacterial properties. Epoxy-amine resin endodontic sealer incorporating quaternary ammonium polyethyleneimine (QPEI) has been proven to possess long lasting antibacterial activity against gram positive and negative bacteria and is chemically stable, non-soluble and biocompatible. Ten root canals of extracted teeth were sterilized and then inoculated with *Enterococcus faecalis* for 7 days prior to standard endodontic treatment. Scanning laser confocal microscopy was used to evaluate the antibacterial effect of an epoxy-amine resin endodontic sealer at concentrations of 0% or 1% (wt/wt) of added QPEI nanoparticles. The obturated root canals with the conventional sealer (no QPEI) showed a higher percentage of bacterial live cells ( $77\% \pm 15\%$ ) than in the test group incorporating QPEI nanoparticles ( $45\% \pm 13\%$ ) ( $p<0.01$ ).

#### **Key Learning Points:**

- Infected dentinal tubules may be involved in perpetuation of endodontic disease.
- Root canal preparation and obturation materials have a short term limited antibacterial effect.
- Incorporation of QPEI nanoparticles into endodontic sealers may enhance and prolong the antibacterial activity of the sealers.

**Time:** 12:06 - 12:26

#### **New generation intracanal pastes: antibiotics vs glycoproteins**



\*Öztürk A

*Department of Endodontics, Marmara University, İstanbul, Turkey*

**Aim** The aim of this presentation is to evaluate and compare the use of new generation antibiotic combinations and glycoproteins as intracanal medicaments.

**Summary:** The main aim of root-canal treatment is the elimination of bacteria from the infected root-canal and prevention of subsequent reinfection. Microorganisms and their byproducts are the major aetiological factors in dentinal, pulpal and periapical pathosis. For the elimination of these factors, effective chemomechanical preparation and intracanal medicament usage are necessary. In order to eliminate the bacteria from the infected root-canal, several antibiotic pastes have been used as intracanal medicaments since the introduction of Grossman's PBSC paste. Single antibiotic usage is not adequate for disinfection of polymicrobial infections in root-canals. In early 90's, lesion sterilization and tissue repair therapy, consisting of the use of antibacterial drug combinations, have been suggested for the disinfection of pulpal and periapical pathologies. Besides their favourable effects, antibiotic combinations have several disadvantages such as difficulties in removal from the root-canal, uncertainty about the ratio of the mixture, and tooth discoloration. These undesired consequences led researchers to develop new medicaments. A glycoprotein, which is present in saliva, secretory fluids of mammals, gingival cervical fluid, and human milk, has a functional role including iron hemostasis, regulation of immune response, antibacterial, antifungal, antiviral, anti-inflammatory effects. It has been used in several incidences in dental practice. However, scientific research about this glycoprotein in endodontics is scarce.

**Key Learning Points:**

- What is the importance of chosen vehicle in the antimicrobial effect of the medicament?
- May this functional glycoprotein be used as an intracanal medicament?
- What are the disadvantages of antibiotic combinations and this glycoprotein?
- What is the duration of intracanal dressing of these medicaments?
- In which cases is the use of these new generation medicaments recommended?

**Time:** 12:28 - 12:48

Evaluation of a technique/materials

**Pastinject: Is it a novel instrument for root canal irrigation?**

Kayahan MB<sup>1</sup>, Pamukçu Güven E<sup>2</sup>, Türk T<sup>3</sup>, \*Çiftçioğlu E<sup>1</sup>, Küçükay I<sup>1</sup>

<sup>1</sup>Department of Endodontics, Okan University, Faculty of Dentistry, İstanbul, <sup>2</sup>Private Practice, İstanbul, <sup>3</sup>Department of Endodontics, Ege University, Faculty of Dentistry, İzmir, Turkey

**Aim** To test the effectiveness of a novel lentulo irrigation technique on the removal of artificially placed dentine debris from the root canals and to compare it with various irrigation regimes.

**Summary:** Sixty single-rooted human incisors were prepared to a size 30 (Protaper Next X3). After shaping procedure, teeth were embedded into orthodontic acrylic and the roots were split longitudinally into two halves. On the one half of each root canal three holes each 0.5 mm deep and 0.5 mm in diameter were created to simulate uninstrumented canal parts 2, 4 and 6 mm from the apex. The holes were filled with artificial debris which was created by mixing 2% sodium hypochlorite (NaOCl). Then two halves of each root were reconnected using a wire and teeth were divided into 5 subgroups (n=12). All root canals were irrigated respectively with 10 ml of 5% NaOCl using a syringe, pumping gutta-percha, sonic irrigation, ultrasonic and a novel irrigation technique with pastinject lentulo. Following the irrigation, separated root halves were observed under stereomicroscope. Two experienced endodontists evaluated the amount of remaining debris in the holes by using a scoring system between 0–3: the higher the score, the more the debris. Data were analyzed with Kruskal-Wallis and Mann-Whitney U tests. Significance level was set at  $p < 0.005$ . At the apical hole the amount of debris in the syringe irrigation was found to be significantly superior than pastinject lentulo and ultrasonic irrigation ( $p < 0.005$ ). No statistically significant difference was

detected between the techniques in the middle and coronal holes ( $p>0.005$ ). Within the limitations of this study, almost all irrigation methods exerted achievement in the debris removal effectiveness. However, pastinject lentulo and ultrasonic irrigation techniques might provide better debris removal capacity from the apical third compared to other irrigation techniques.

**Key Learning Points:**

- root canal irrigation, a novel instrument, pastinject lentulo

**Time:** 12:50 - 13:10

**Advances and New Approaches in Endodontic Irrigation Procedures**

\*İriboz E

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

**Aim** The aim of this presentation is to discuss how the endodontists can increase the effectiveness of irrigation procedure during endodontic treatments.

**Summary:** The success of endodontic treatment depends on the elimination of microorganisms from the root-canal system and the prevention of reinfection. Irrigants, which are routinely used in order to eliminate these microorganisms, have traditionally been delivered into the root-canal space using syringes and needles of different sizes and tip designs. However, clinical experiences and research have shown that this classical approach typically results in ineffective irrigation, particularly in peripheral areas such as anastomoses between canals and the most apical part of the main root-canal. Therefore, most of the compounds used for irrigation have been chemically modified and several mechanical devices have been developed to improve the penetration of the irrigant and effectiveness of the irrigation procedure. Currently, PIPS, PAD, Endo-Vac, Ozone-treated irrigation and PUI are widely used irrigation procedures in scientific research. On the other hand, the effectiveness of these procedures in removing all the debris and intracanal medicaments from the root-canal walls is questionable. This presentation summarizes the chemistry, biology, and procedures for safe and efficient irrigation and provides cutting-edge information on the most recent developments.

**Key Learning Points:**

- Effectiveness of irrigation may be enhanced by using new equipment and devices that match biological concepts with clinical practice.
- Irrigation is a key point not only for disinfection of the root-canal but also for the removal of the intracanal medicament from the root-canal.
- With the new techniques and devices, removal of the intracanal medicament from the root-canal can be accomplished more successfully.
- The advanced irrigation procedures should be taken into account for both improved disinfection and accurate intracanal medicament removal.

**Time:** 15:00 - 15:20

**Novel method for rapid detection of remnant live bacteria in the root canal space using fluorescence amplification**

\*Herzog D<sup>1</sup>, Niazi S<sup>2</sup>, Hirvonen L<sup>3</sup>, Cook R<sup>1</sup>, Koller G<sup>1</sup>, Foschi F<sup>4</sup>, Mannocci F<sup>4</sup>, Festy F<sup>1</sup>

<sup>1</sup>Tissue Engineering & Biophotonics, <sup>2</sup>Department of Microbiology, <sup>3</sup>Department of Physics,

<sup>4</sup>Department of Restorative Dentistry, King's College London, London, United Kingdom

**Aim** Development of a method to detect vital bacteria remnant in the root canal space post root canal treatment using paper point sampling and fluorescence spectroscopy combined with vital cell stains. Successful detection of remnant bacteria may lead to a reduction of persistent and secondary infections, decreasing the number of re-treatments necessary.

**Summary:** Here we demonstrate the detection of remnant bacteria during and post treatment of the root canal space, using paper point sampling. We have evaluated calcein AM as a fast acting vital

cell stain, suitable for rapid staining of stressed and mature biofilms. This was achieved using both an established *in vitro* nutrient-stressed endodontic multispecies biofilm model and *in vivo* sampled biofilms during root canal treatments. We further use *in vitro* studies to demonstrate the link of measured fluorescence to the amount of vital bacteria as well as the ability to detect toxicity stressed bacteria with impaired abilities to form colony forming units. *In vivo* sampling has revealed the sensitivity of this method to be accurate enough to detect small amounts of vital bacteria remnant in the apex following root canal treatments performed to high standards. Rapid detection is achieved by combining fluorescent staining and imaging with micro spectroscopy, using software for fast and unbiased spectral analysis. Making use of a prototype setup, with a spectrometer coupled to a wide field fluorescence microscope, we show the successful detection of vital bacteria within the root canal space after just 5 minutes of incubation in a suitable fluorescent stain. This highlights the potential of this method to be utilised in dental clinics for the detection of remnant bacteria with the goal of minimising the need for re-intervention.

**Key Learning Points:**

- Vital cells in biofilms are successfully and rapidly stained with calcein AM.
- The fluorescence intensity is linked to the amount of vital cells present.
- Vital cells in nutritionally and toxicity stressed biofilms can be detected.
- Spectral analysis allows to detect the fluorescent signal from live cells on paper points used for sampling.
- Vital cells are shown to be detected during and at the end of root canal treatments.

**Time:** 15:22 - 15:42

**Laser-activated irrigation using pulsed erbium lasers: principles and physical basis**

\*Meire MA<sup>1</sup>, Poelman D<sup>2</sup>, Verschraege A<sup>2</sup>, De Moor RJ<sup>1</sup>

<sup>1</sup>Department of Restorative Dentistry and Endodontology, <sup>2</sup>LumiLab, Department of Solid State Sciences, Ghent University, Gent, Belgium

**Aim** To discuss the fundamentals and physical principles of laser-activated irrigation using pulsed erbium lasers.

**Summary:** In recent years, the use of pulsed erbium lasers to activate root canal irrigants within the root canal system has witnessed increased attention. Promising *in vitro* results in terms of disinfection and removal of intracanal debris and smear layer underlie this interest. Operating such pulsed erbium lasers however is not always straightforward, since the laser allows many parameters to be adjusted, all of which affect the interaction between the beam and the irradiated target. When pulsed erbium lasers are operating within aqueous liquids, different physical phenomena occur around the fibre tip. First, there is the formation of vapour bubbles (cavitation) due to superheating and boiling of the liquid surrounding the fibre tip upon absorption of the laser energy. These bubbles vary considerably in size, shape, location and life span, depending on the fibre tip geometry (flat versus conical fibre tips) and pulse parameters such as pulse length and energy. A second phenomenon is the occurrence of shock waves upon implosion of the vapour bubbles, where the potential energy of the bubble is converted into acoustic energy. Third, secondary cavitation bubbles can be seen long after the laser pulse has terminated.

These phenomena are explained and related to physical laws in light of its endodontic application.

**Key Learning Points:**

- pulsed erbium lasers produce vapour bubbles, shock waves and secondary cavitation when emitting in aqueous liquids
- these explain the cleaning action within the root canal
- bubble shape and dynamics are influenced by fibre tip geometry and pulse parameters

**Time:** 15:44 - 16:04

**Laser-activated irrigation using pulsed erbium lasers: value added cleaning and disinfection**

\*De Moor RJG, Meire MA

*Department of Restorative Dentistry and Endodontology, Ghent Dental Laser Centre, Ghent University, Ghent, Belgium*

**Aim** To evaluate the effect of fibre position on root canal cleaning and disinfection during laser activated irrigation (LAI)

**Summary:** Laser and fibre technology for root canal debridement and disinfection have evolved enormously during the last two decades. Whereas ultrasonically activated irrigation (UAI) induces acoustic microstreaming and to a lesser extent cavitation in the irrigant, laser-activated irrigation in the root canal leads primarily to cavitation followed by the generation of shockwaves and microstreaming. Today, two LAI approaches can be discerned. In conventional LAI (C-LAI), the fibre tip is introduced into the apical portion of the root canal. In the second approach, the fibre tip is held at the root canal entrance or above the orificium during activation (O-LAI). C-LAI relies on pulse energies between 40 and 100 mJ and pulse durations between 130 and 250 µsec, whereas lower energy i.e. 10 to 20 mJ and shorter pulse durations of 50 µsec are used for O-LAI (PIPS approach – Photon-Induced Photoacoustic Streaming). The latter results in higher peak power creating vigorous agitation of the irrigant. It appears that both approaches are equally effective for removal of debris and smear layer, though C-LAI is being thought to be more effective in removal of dens locally compacted debris. Attention has to be paid to intracanal pressure during C-LAI in light of irrigant extrusion. Regarding antimicrobial efficacy, LAI compared with UAI yields contradictory results. LAI in general, however, generated more negative samples.

**Key Learning Points:**

- LAI is at least as effective as UAI for removal of intracanal debris.
- Both are also effective for root canal disinfection, though LAI seems to generate more negative samples.
- There are two LAI approaches: the use of the fibre in the canal (C-LAI) and the use of the fibre in the region of the orifice (O-LAI). C-LAI is chosen for the removal of densely compacted dentine, whereas O-LAI (PIPS approach) is advocated for general cleaning and disinfection.
- C-LAI and O-LAI can be used in a safe way considering the creation of pressure during the activation period when appropriate settings are used.

**Time:** 16:06 - 16:26

**Laser-Assisted Endodontic treatments: A paradigm-shift**

\*Martins MR<sup>1</sup>, Martins MA<sup>2</sup>, Gutknecht N<sup>3</sup>

<sup>1</sup>Aachen Dental Laser Center, RWTH Aachen University, Aachen, Germany, <sup>2</sup>Endodontic Department, Universidade Católica Portuguesa, Viseu, Portugal, <sup>3</sup>Department of Conservative Dentistry, RWTH Aachen University, Aachen, Germany

**Aim** The aim of this presentation is to provide a comprehensive and evidence-based rational to encourage the adoption of new (laser) technologies in contemporary Endodontics.

**Summary:** Endodontic research has long been focusing to find the best protocols to render root canal systems free of smear layer and bacterial infection. However, as regards to long-term outcomes, there is still to be found a superior, evidence-based clinical protocol. With special attention to Sodium Hypochlorite (NaOCl), Chlorohexidine (CHX), Calcium Hydroxide (CaOH) and chelating agents such as EDTA or Citric Acid, no individual irrigant or their combination can be pointed as the clinical gold-standard in Endodontics. In fact, latest reports have been raising rather conflicting arguments concerning not only the inability of chemical irrigants to achieve their task, but also regarding their hazardous effects to teeth structural components, or to their surrounding structures. Hence, alternative chemical compounds have been subjected to several basic/in-vitro research but still failed to provide consistent evidences of any superiority. Lasers have long been reported as effective tools to assist endodontic treatments effectively but only in the past few

years the adoption of lasers have increased their popularity. Apart of other wavelengths, the Er,Cr:YSGG laser in Endodontics has been found to both remove smear layer and effectively achieve deep disinfection of radicular dentine. Moreover, the introduction of Radial Firing Tips have definitely confirmed this wavelength potential to assist endodontic treatments, overcoming the limitations of traditional laser fibers.

**Key Learning Points:**

- Despite decades of research, chemical irrigants such as NaOCl, CHX, CaOH or EDTA have been failing to provide consistent evidences of superior clinical efficacy.
- Laser technology has been successfully incorporated in several fields of medicine and should represent an option to overcome the limitations and hazardous effects of traditional irrigant solutions.
- The development of Radial Firing Tips has expanded the spectrum and effectiveness of laser applications in endodontics.
- A paradigm-shift towards the adoption of lasers in endodontics should be spreaded within endodontic societies.

**Time:** 17:00 - 17:20

**An ex-vivo study to demonstrate the effect of direct current on the efficacy of 1% sodium hypochlorite**

\*Logani A, Chahar M, Shah N

*Department of Conservative Dentistry and Endodontics, Center for Dental Education and Research , All India Institute Of Medical Sciences, New Delhi, India*

**Aim** To investigate the effect of direct current (DC) produced by an indigenously engineered micro-generator on the antibacterial and tissue dissolving efficacy of 1% of sodium hypochlorite (NaOCl).

**Summary:** To test the antibacterial efficacy, sixty four single rooted mandibular premolar teeth were inoculated with E.faecalis (ACTCC29212).Based on the irrigation protocol they were divided into groupI-5%NaOCl (positive control, n=10), groupII-normal saline (negative control, n=10), groupIII- 1% NaOCl (n=14) & group IV (1 % NaOCl+ 900  $\mu$ A DC, n=20). Ten teeth were used for counting the CFU's of the initial inoculums. A contact period of five minute was established. Post irrigation samples were streaked on Muller Hilton Agar plates. Total colony forming units were observed by semi quantitative analysis. To demonstrate the pulp tissue dissolution, bovine pulp tissue were divided into forty fragments of 25mg each and placed in propylene tubes. Based on the irrigation protocol as described above they were divided in four group i.e. (group I, II, III.IV n=10). % of tissue weight loss was calculated. Data was subjected to one way ANOVA.Antibacterial efficacy of 1% NaOCl with 900  $\mu$ A DC was similar to 5% NaOCl (P= 0.598).Pulp tissue dissolution of 1% NaOCl with 900  $\mu$ A DC was superior to 1% NaOCl (P<0.001)

**Key Learning Points:**

- DC enhanced the antibacterial and tissue dissolving efficacy of 1% NaOCl
- It can be an alternate modality to heat to improve the efficacy of NaOCl
- A clinical device can be engineered for this purpose

**Time:** 17:22 - 17:42

**A new alternative for intracanal negative pressure irrigation: The iNP needle. Characteristics and suggestion for the protocol of clinical use**

\*Adorno CG

*Department of Endodontics and Research Methods, Facultad de Odontología, Universidad Nacional de Asunción, Asunción, Paraguay*

**Aim** To discuss the characteristics and suggest a protocol for the clinical use of a new apical negative pressure needle.

**Summary:** Effective debridement of the apical root canal is important for successful root canal treatment. Efficient renewal of the irrigant at the most apical regions would allow a greater volume of fresh irrigant to help remove debris from within the root canal. Additionally, greater irrigant volume can be also achieved by increasing flow rate. A new negative pressure irrigating needle (iNP needle, Mukuni Kogyo Co. Ltd., Nagano, Japan) was recently introduced. The needle's features will be described, along with its strengths and weaknesses. For example, despite being used 2 to 3 mm short of the working length, the irrigant can reach the working length in most cases. A novel method of in vivo monitoring of the apical limit of the root canal irrigant, namely sodium hypochlorite, by using the iNP and an electronic apex locator during final irrigation will be suggested as a protocol of clinical use.

**Key Learning Points:**

- Identify a few desired characteristics of root canal irrigation
- Discuss the features of the iNP needle
- Describe a new method of in vivo monitoring of the apical limit of irrigation

**Time:** 17:44 - 18:04

**Evaluation of the antibacterial and antifungal activity of benzydamine hydrochloride and conventional antimicrobial agents: an *in vitro* study**

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<sup>1</sup>Department of Endodontology, School of Dentistry, <sup>2</sup>Department of Pharmaceutical Microbiology, Faculty of Pharmacy, <sup>3</sup>Department of Oral and Maxillofacial Radiology, School of Dentistry, Ege University, Izmir, Turkey

**Aim** To evaluate the antibacterial and antifungal activity of benzydamine hydrochloride (BNZ), chlorhexidine (CHX) (gel and liquid form) and sodium hypochlorite (NaOCl).

**Summary:** Enterococcus faecalis 29212 and Candida albicans 90028 standard strains were used for the activity test. Fresh cultures of the strains were adjusted 0.5 McFarland turbidity. Enterococcus faecalis suspensions were inoculated to Mueller Hinton Agar plates and Candida albicans suspensions were inoculated to Sabouraud Dextrose Agar plates. Wells (5 mm in depth, 6 mm in diameter) were cut in the cultivated agar plates and filled with the test materials. The plates were incubated aerobically at 35°C for 24-48 hours. The diameters of microbial inhibition zones around each well were measured and recorded in millimeters. Fluconazole (25ug/disc-Oxoid) and ampicillin (10ug/disc-Oxoid) discs were used as control agents. Data were analysed using one-way ANOVA followed by Holm-Sidak multi-comparison test (p=0.05). Antimicrobial activity of the tested materials against Enterococcus faecalis were as follows: CHX gel (29.6±1.1mm) ≈ CHX liquid (29.0±1.4mm) > BNZ (21±1.4mm) ≈ NaOCl (19.3±1.2 mm). When antifungal activity was considered, BNZ (17.8±0.8mm) presented significantly lower activity on Candida albicans when compared to CHX (gel and liquid form) and NaOCl groups (p< 0.05).

**Key Learning Points:**

- CHX formulations had the highest activity against both Enterococcus faecalis and Candida albicans in the present study. BNZ had similar antimicrobial activity with NaOCl on Enterococcus faecalis, but it presented the weakest antifungal activity on Candida albicans. Therefore, CHX can be suggested as the most active antimicrobial and antifungal material among the tested materials.

**Time:** 18:06 - 18:26

**New perspective for endodontic irrigation: nanodroplets**

\*Alovisi MA<sup>1</sup>, Pasqualini D<sup>1</sup>, Cavalli R<sup>2</sup>, Cuffini AM<sup>3</sup>, Mandras N<sup>3</sup>, Scotti N<sup>1</sup>, Berutti E<sup>1</sup>

<sup>1</sup>Department of Surgical Sciences, Dental School, Endodontics, <sup>2</sup>Dipartimento di Scienza e Tecnologia del Farmaco, <sup>3</sup>Department of Public Health and Microbiology, University of Turin, Turin, Italy

**Aim** Experimental nanodroplets (NDs) with a chitosan shell have been recently proposed. Besides antimicrobial properties of chitosan NDs, a drug loaded nanopharmaceutical is desirable for the delivery and the extended releasing of drugs in dental mineralized tissues. The objective of this study is to estimate the bactericidal efficacy of a solution of NDs loaded with Benzalkonium Chloride (BAK) against endodontic pathogens and its ability to extend action deeper into dentinal tubules.

**Summary:** ninety-two human single-root teeth with fully-formed apex were used. Cylindrical root dentin blocks were longitudinally sectioned and enlarged to a size of Gates Glidden drill #3. In the first phase of the study, 20 specimens were analyzed with confocal laser scanning microscopy (CLSM) after exposure to a solution of NDs loaded with BAK and marked with 6-coumarin and rhodamine to evaluate penetration depth and patterns into dentinal tubules. In the second phase, remaining specimens were infected with *Enterococcus faecalis* and randomly assigned to 3 different groups (n=20) plus positive (n=6) and negative (n=6) controls to assess antimicrobial efficacy of NDs-BAK solution. In group NDs-BAK irrigation was performed with 2mL of NDs solution loaded with BAK for 3 minutes, in groups NaOCl-3 with 2 mL of 5% NaOCl for 3 minutes, in group CHX-3 with 2 mL of 2% chlorhexidine (CHX) for 3 minutes. Confocal laser scanning microscopy (CLSM) and viability staining (Live/Dead BacLight Viability Stain - Molecular Probes, Eugene, OR) were used to quantitatively analyze the proportions of dead and live bacteria and results were analyzed with Kruskal-Wallis and post-hoc Dunn's test ( $p < 0.05$ ). Moreover the mean penetration depth of efficacy was recorded and differences were analyzed with one-way ANOVA and post-hoc Bonferroni's test ( $p < 0.05$ ). In NDs-BAK, NaClO-3 and CHX-3 groups the ratio of red to green-and-red fluorescence was 60.5%, 64.2% and 40.1% respectively ( $p < 0.05$ ). The mean depth of efficacy was respectively: NDs-BAK  $630 \mu\text{m} \pm 30$ , NaOCl  $460 \mu\text{m} \pm 60$  and CHX  $420 \mu\text{m} \pm 60$  ( $p < 0.05$ ).

**Key Learning Points:**

- NDs structure and potentiality as nanocarriers of antimicrobial agents.
- Experimental NDs-BAK solution composition and use.
- NDs-BAK solution showed effective antibacterial action deep into dentin tubules.

## HALL 5

**Time:** 9:00 - 9:20

### **Mta vs gutta-percha in big apical lesion, a randomized control trial**

\*Krokidis AK

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

**Aim** Apical periodontitis (AP) is an inflammatory disorder of periapical tissues caused by persistent microbial infection of the root canal system of the affected tooth creating periapical lesions, which sometimes can be large with diameters bigger than 5mm. In these cases conventional treatment presents low percentages of success, and the healing rate is slow. In this randomized clinical study we examined the ability of two different endodontic filling materials (MTA vs. gutta-percha) of sealing and healing (five years examination) teeth with big apical lesions (diameter>5mm).

**Summary:** Eighty teeth with big apical active lesions were selected (n=40) (PAI=5). Diagnosis was performed radiographically and clinically. All volunteer patients had to fulfill inclusion criteria. Patients were informed and agreed on receiving conventional retreatment instead on surgery.

Randomization was insured through sortage. Root canal treatments (RCT) were carried out by using Race rotary files, irrigation with NaOCL 6% and one medication with CaOH for 10 days. The filling material was sorted from a box with forty black and forty white backgammon pieces. White corresponded to MTA and black to, hot gutta-percha vertical technique. All teeth were evaluated radiographically and clinically at six months, two years and five years. Percussion pain, enlarged periradicular bone bucal or lingual, increase of bone absorption and PAI index (XRay), presence of fistula and tooth mobility were monitored for each case, when at least two of these topics of the check list were found poorer, the case was programmed for endodontic surgery. Healing was evaluated clinically and radiographically (PAI reduction to at least 2 units).

#### **Key Learning Points:**

- Seventy-six teeth were recalled at five years. (95% attendance), thirty-nine from the MTA group, and thirty-seven from gutta-percha group. The MTA group presented no losses, since all 38 teeth were healed or healing, presenting reduced PAI index and no symptoms. From the gutta-percha group seven teeth presented symptoms and had to be treated through endodontic surgery.

**Time:** 9:22 - 9:42

### **Colour alteration of MTA: literature review and discussion of actualities**

\*Marciano MA, Guimarães BM, Andrade FB, Duarte MAH

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

**Aim** The literature related to colour alteration of MTA is reviewed. The hypotheses tested are discussed associating them with each other.

**Summary:** Mineral trioxide aggregate is one of the consecrated materials in Endodontics. Its adequate biological properties allow its use for several purposes including apical surgery, pulp capping, repair of perforation and apexification. Once aesthetic areas are involved, the colour stability of MTA is a critical property to be considered. Dental discolouration has been reported with application of MTA in contact with tooth structures. Different factors have been tested as possible inductors of colour alteration. De-stabilization of radiopacifier bismuth oxide, presence of light, oxygen-free environment, interaction with collagen of dentine and interaction with blood are some factors tested as possible inductors of colour alteration. Despite the several tests conducted, even now the process of discolouration remains unclear. Investigations are required to demonstrate why and how the discolouration occurs and the exact chemical interactions and molecular alterations.

#### **Key Learning Points:**



- Colour stability of MTA
- Literature evidences
- Hypotheses for discoloration of MTA

**Time:** 9:44 - 10:04

### **Non-surgical treatment of perforating internal root resorption with mineral trioxide aggregate**

\*Kasikci Bilgi I, Turk T, Caliskan K

*Department of Endodontology, Ege University School of Dentistry, IZMIR, Turkey*

**Aim** To describe and discuss the non-surgical treatment of perforating internal root resorption orthograde Mineral Trioxide Aggregate (MTA) application along with cases

**Summary:** Clinical and radiographical examination of all cases were indicated that perforating internal root resorption at different root levels. Root canals were biomechanically cleaned using stainless steel instruments and irrigated with 1% sodium hypochlorite. EDTA was used for final irrigation. All root canals were filled with calcium hydroxide for 3-4 weeks. After medication period, orthograde MTA was placed to the resorption area with MTA carriers. In cases when the perforating resorption area was in the apical third MTA was placed like an apical plug. When the perforating resorption area was at the middle or coronal third; the apical and/or middle third of the root canals were obturated with gutta percha and then MTA was placed to the perforation area. The coronal restoration was finished with resin composite. Clinical and radiological examinations were performed regularly in each case. Cases were followed up regularly for at least three-year period

#### **Key Learning Points:**

- Surgical treatment is not a mandatory approach for cases with perforating internal root resorption. The non-surgical endodontic treatment has some advantages like avoiding periodontal tissue loss due to flap operation and shorter treatment time.
- After 3 years follow up, teeth were in function with satisfactory clinical and radiographic results.
- Favourable results after long term period revealed that MTA is a suitable material for non-surgical endodontic treatment of perforating internal root resorption.

**Time:** 10:06 - 10:26

### **Effects of ProRoot MTA and Micromega MTA on odontoblastic differentiation in human dental pulp stem cells**

\*Onay EO<sup>1</sup>, Yurtcu E<sup>2</sup>, Terzi YK<sup>3</sup>, Ungor M<sup>1</sup>, Yazici AC<sup>1</sup>, Oguz Y<sup>4</sup>, Sahin FI<sup>2</sup>

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**Aim** To evaluate the effects of newly developed Micromega MTA (MM-MTA) and ProRoot MTA (MTA) on odontogenic differentiation of primary human dental pulp stem cells (hDPSCs).

**Summary:** Normal human impacted third molars were collected from 6 donors aged 18-25 years with informed consent under a protocol approved by the Institutional Review Board. Then hDPSCs were isolated from dental pulps and the effects of MM-MTA and MTA on hDPSCs were evaluated in culture conditions at 1, 7 and 14 days. Untreated cells were used as control. Odontoblastic differentiation was assessed by alkaline phosphatase (ALP) activity. Runx-related transcription factor 2 (RUNX2), alkaline phosphatase liver/bone/kidney (ALPL), bone morphogenetic protein 2 (BMP2), dentin sialophosphoprotein (DSPP), Distal-less homeobox 3 (DLX3) as odontoblastic/osteoblastic expression markers were evaluated by semi quantitative reverse-transcription polymerase chain reaction analysis. Calcium levels of media were also determined. Distributions of variables were assessed by Shapiro-Wilk's test, homogeneity of variances was determined by Levene's test and

comparisons of group means were performed with the Repeated Measures Analysis of Variance. A  $p < 0.05$  was considered statistically significant. ALP activity of hDPSCs and calcium levels of culture media were not statistically significant between MM-MTA and MTA groups for all time periods ( $p > 0.05$ ). Messenger RNA expression levels of RUNX2, BMP2, DLX3 were similar in all groups ( $p > 0.05$ ). ALPL and DSPP mRNA expressions were up regulated both in MM-MTA and MTA groups only at 14 days ( $p < 0.05$ ). However, when MM-MTA group is compared with MTA group, ALPL and DSPP mRNA expressions were not statistically significant for this time period ( $p > 0.05$ ).

**Key Learning Points:** • MM-MTA and MTA have similar odontogenic effects in hDPSCs.

• MM-MTA may be useful for pulp-capping applications based on its abilities to promote hDPSC differentiation.

**Time:** 11:00 - 11:20

***In vitro* investigation of the diffusion of calcium and hydroxyl ions through dentinal tubules to the root surface from MTA and BioAggregate**

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**Aim** The aim of this study was to compare the effects of MTA, BioAggregate and calcium hydroxide on calcium and hydroxyl ion diffusion through dentinal tubules to the root surfaces without cementum in various root levels.

**Summary:** Diffusion of calcium and hydroxyl ions from intracanal calcium hydroxide through dentin is used to arrest external inflammatory root resorption. However, long-term calcium hydroxide placement has been associated with an increased risk of root fracture. MTA and BioAggregate might provide an alternative to calcium hydroxide as a source of calcium and hydroxyl ions. This *in vitro* study compared the effects of MTA, BioAggregate and calcium hydroxide on calcium and hydroxyl ion diffusion through dentinal tubules to the root surfaces without cementum in various root levels. 120 previously extracted human permanent single-rooted teeth were used in this study. The teeth were decoronated and instrumented using crown-down technique with Protaper rotary files. To simulate external root resorption, artificial defects were created using cylindrical diamond bur in cervical-middle-apical thirds of root surfaces. The teeth were divided into four main groups: Control (1), calcium hydroxide (2), MTA (3) and BioAggregate (4). Main groups then divided into three sub-groups according to location of the simulated defects: Cervical (a), middle (b) and apical (c). In control group, root canals of specimens left empty. Other root canals of specimens filled with calcium hydroxide, MTA or BioAggregate. The entire root surfaces, except the simulated defects, were isolated. Each specimen was immersed in a vial containing 10 ml distilled water. Calcium concentrations and pH of the immersion media was measured at 1, 3, 7, 14, 21 and 28 days. Statistical analysis was accomplished by Kruskal–Wallis H and Mann–Whitney U tests with Bonferroni correction. This study indicated that intracanal placement of both calcium hydroxide, MTA and BioAggregate resulted in the diffusion of calcium and hydroxyl ions across dentine. The results showed greater calcium and hydroxyl ions released by calcium hydroxide groups than MTA and BioAggregate groups. MTA and BioAggregate groups showed similar properties and there were no differences between these groups in whole study period.

**Key Learning Points:**

• MTA BioAggregate calcium hydroxide external inflammatory root resorption ion diffusion.

**Time:** 11:22 - 11:42

**One-session apexification – how to decide the best material to use in each particular case?**

\*Santos JM, Ramos JC, Palma PJ

Department of Dentistry, Faculty of Medicine - University of Coimbra, Coimbra, Portugal

**Aim** The goal is to present the actual calcium silicate-based materials options to treat open apex teeth and discuss advantages and disadvantages of each approach.

**Summary:** Pulp necrosis of immature permanent teeth represents a significant challenge for clinical management as root development ceases and apices remain with open. The aetiology of pulp inflammation and necrosis in immature permanent teeth can include caries, trauma or the presence of developmental abnormalities, as dens invaginatus and dens evaginatus. The challenge of Endodontic treatment in those cases is a result of the thin dentinal root walls and the lack of apical closure, with concomitant increased risk of cervical root fracture, which will affect the long-term prognosis of those teeth. Treatment approach for those cases has evolved a lot during the last two decades, moving from traditional multi-visit apexification procedures, to one-session using an apical plug of MTA and now the paradigm shift towards application of regenerative endodontic procedures. One-session apexification using an apical plug is considered a predictable treatment associated with very good outcome. Strong and extensive scientific evidence supports the use of ProRoot MTA, the first generation bioceramic material on the market, in this clinical indication. Nevertheless, it has the potential to discolor teeth and has a long setting time, requiring presence of moisture in the setting environment to reach the desired sealing and biocompatible properties. Recently, new bioceramic materials have entered the market claiming better biological and handling characteristics.

**Key Learning Points:**

- One-session apexification with ProRoot MTA is a predictable treatment for open apex teeth.
- Preventing tooth discoloration after ProRoot MTA apexification is still a challenging issue.
- New bioceramic materials have potential to overpass some of ProRoot MTA disadvantages.
- We need stronger scientific evidence to support long-term advantages of new bioceramic materials over classical MTA.

**Time:** 11:44 - 12:04

**Clinical outcome of direct pulp capping with MTA and an adhesive system: a retrospective analysis**

\*Ramos JC, Vinagre A, Malva S, Costa AL, Messias A  
*Dentistry, Faculty of Medicine, Coimbra, Portugal*

**Aim** This work aimed at the determination of the success rate of direct pulp-capped permanent teeth with either two-step single-bottle etch-and-rinse dental adhesive or with a inorganic cement (Mineral Trioxide Aggregate) by the clinical and radiological evaluation of the teeth over a period of clinical service ranging from 1 to 12 years.

**Summary:** Thirty-two cases of direct pulp capping performed by two experienced operators in healthy patients with good oral hygiene were selected from a total of 104 cases according to the material used for pulp capping (two-step single-bottle etch-and-rinse dental adhesive or MTA). Criteria for the execution of the procedure included absence of irreversible pulpitis at the time of exposure, adequate bleeding control to perform both capping and restorative procedures. Study inclusion criteria also included a minimum follow-up of 12 months (mean period of clinical service of 94 months), well-documented technical data from the procedures and patient written informed consent. Clinical evaluation of pulp-capped teeth was performed based on the FDI World Dental Federation criteria and complemented with additional specifications. The study was approved the Faculty Ethical Committee. The global survival rate of pulp capping was 94.4%, 88.2% and 70.2% determined for the 12th, 60th and 120th month respectively. Unfavourable outcomes registered a mean survival time of  $63.8 \pm 47.9$  months. Concerning the Kaplan Meier survival function, MTA showed a statistically significant better performance than the adhesive system ( $p=0.011$ ). Data regarding aetiology of the exposure, age of the patient, preoperative symptoms, use of rubber dam isolation, contamination, and pulpal bleeding were analysed for failure and none seemed to influence the outcome of the treatment ( $p>0.05$  for all features). According the results, direct pulp

capping with MTA proven to be a successful long-term therapy. Mineral trioxide aggregate seems to have higher efficacy than adhesive systems as a pulp-capping material.

**Key Learning Points:**

- Introduction and literature review
- Actual clinical procedures and materials
- Retrospective study
- Key clinical cases
- New perspectives

**Time:** 12:06 - 12:26

**Dentine extracellular matrix components liberated by calcium silicate cements and their potential role in wound healing of the dental pulp**

\*Tomson PL, Lumley PJ, Smith AJ, Cooper PR

*Oral Biology, College of Medical and Dental Sciences, University of Birmingham, Birmingham, United Kingdom*

**Aim** To discuss the ability of calcium silicate cements (CSCs) to liberate potent growth factors from dentine and to demonstrate their subsequent potential role in wound healing of the injured pulp.

**Summary:** Although the regenerative capacity of the dentine-pulp complex induced by pulp capping agents is well established, the molecular processes by which this occurs are poorly understood. CSCs have been demonstrated to significantly enhance wound healing in the pulp, but the mechanism that induces such favourable healing is yet to be determined. The work presented here will show the potential of CSCs (white MTA, grey MTA and Biodentine) to liberate dentine extracellular matrix (dECM) components from human teeth and describes the broad cocktail of growth factors released. This study also demonstrates the functional role of dECM components released by CSCs in the wound healing processes of pulp cell proliferation and chemotaxis. In this study, dECM were released from human dentine using solutions of EDTA, white MTA, grey MTA and Biodentine. Proteomic analysis using multiplex ELISA demonstrated the presence of a broad range of growth factors, which were differentially released, indicating that each agent had differing capacities to liberate such molecules. A number of growth factors previously not detected in dentine were shown to be released by these therapeutic materials; they were identified as belonging to the neurotrophic, colony stimulating and insulin-like growth factor families. *In vitro* analysis of pulp cells exposed to dECM components released by white and grey MTA, demonstrated increased capacity for cell proliferation and chemotaxis compared to control. Growth factors liberated from dentine by the soluble components of CSCs may regulate reparative events leading to pulp wound healing in the clinical setting.

**Key Learning Points:**

- A cocktail of growth factors which are sequestered in dentine can be solubilised by CSCs.
- Previously undetected cytokines which can be categorised in the neurotrophic, colony stimulating and insulin-like growth factor families were shown to be differentially liberated by CSCs.
- dECM components released by white and grey MTA demonstrated increased capacity for cell proliferation and chemotaxis compared to control which are key processes in wound healing of the pulp.

**Time:** 12:28 - 12:48

**Replacement resorption or dentoalveolar ankylosis: Different treatment options. A review**

\*Ruiz XF, Mercadé M, Durán-Sindreu F, Roig M

*Department of Endodontics, Universitat Internacional de Catalunya, Barcelona, Spain*

**Aim** To describe the replacement resorption and to evaluate the different therapeutic option treatment depending on the age of the patients.

**Summary:** When replanting a tooth after traumatic injuries (especially in intrusive luxation and avulsion, with extended dry time) an extensive necrosis of the periodontal ligament (PDL) is produced with the subsequent formation of bone onto a denuded area of the root surface. This phenomenon is called replacement resorption (RR) or dentoalveolar ankylosis (DA). Osteoclasts are the cells that initiate the inflammatory reaction in direct contact with the mineralized dentin in the exposed root surface but the process could be reverted if less than 20% of the root surface is involved. Clinically, the main complication following RR is the infra-occlusion of the tooth that represents a great severe problem in growing patients. To date, there is no clear predictable treatment to arrest the inflammatory response that stimulates the bone turnover and clastic cells to produce resorption. In this review, new different treatment options and clinical management of RR will be defined and illustrated especially focusing on the age of the patient. These will include intracanal dressing with corticosteroids (directed towards to maintain the PDL of the tooth), autotransplant technique and decoronation with ridge preservation, between others.

**Key Learning Points:**

- Replacement resorption or dental ankylosis is an entity characterized by the fusion of bone and the root surface of a tooth that would represent a severe problem of infra-alveolar position specially in growing patients.
- Treatment planning options in replacement resorption should vary depending on the growing age of the patient.
- Intracanal dressing with corticosteroids, autotransplant and decoronation are different treatment options that might be taken into consideration during clinical management of RR and dentoalveolar ankylosis.

**Time:** 12:50 - 13:10

**Intra-alveolar root fracture associated to an alveolar cortical bone fracture. Thirty year follow up: clinical, periapical and CBCT findings**

\*Zabalegui Borja BORJA<sup>1</sup>, Zabalegui Gonzaga GZ<sup>2</sup>, Paula Zabalegui PZ<sup>1</sup>

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**Aim** Alveolar bone fracture are frequently associated with intra-alveolar root fractures. Surgical Endodontic Flap might be needed for Initial Reposition Treatment. Pulp vital therapy when pulp is vital, makes the prognosis predictable. 30 years follow up, shows repair and no sign of pathosis when pulp is vital. CBCT sagittal view shows pattern of this horizontal fractures, periapical status and cortical bone condition.

**Summary:** Emergency trauma case, year 1984. Female patient, 19 years of age, presented injury to an upper central incisor. Examination, showed occlusal and lingual displacement of the crown and gingival sulcus signs of bleeding. Periapical radiographic revealed Intra-alveolar root fracture . Pulpal sensitivity test elicited a positive response. Initial reposition treatment attempts failed. A lateral periapical radiograph, reveals radicular coronal fragment impactation to the vestibular cortical bone bone. A full-thickness flap was raised to access the external alveolar bone. Osteotomy was made at the site of coronal root impactation. This procedure enabled the repositioning of the coronal fragment. Tooth splinted for 4 weeks. Follow up periods every three months during the first year elicited a positive response. Thirty years Follow up (2014). The patient reported complete absence of symptoms. Periapical radiography revealed tissue repair at the level of the fractured fragment, and no periapical pathology. Sensibility testing elicited a positive response.

**Key Learning Points:**

- Intra-alveolar root fracture associated with alveolar cortical bone is a rather frequent pathology
- Traditional periapical radiographs cannot show this alveolar bone fractures.
- Vital pulp therapy is the endodontic treatment of choice when tooth is vital.
- Preservation of tooth is predictable when tooth is vital and restorable.

- CBCT, sagittal view shows, horizontal root fracture irregular line, periapical and cortical alveolar bone condition.

**Time:** 15:00 - 15:20

**Enhancing clinical diagnosis in endodontics using Cone Beam Computerized Tomography: Clinical cases.**

\*Tena G, Talim J

*Department of Endodontics, Ostrow School of Dentistry, University of Southern California (USC), Los Angeles, United States*

**Aim** The aim of this clinical presentation is to compare between conventional radiography and Cone Beam Computerized Tomography (CBCT) in their efficiency to detect periapical pathology, radicular anatomical variations and tooth fractures.

**Summary:** In the last few years, CBCT has become increasingly popular as a diagnostic aid in endodontics. Periapical granuloma and cyst is essentially a histologic diagnosis. Although conventional radiograph and CBCT cannot differentiate between a granuloma and a cyst, a calculated differential diagnosis can be made based on certain factors. Anatomical structures such as the mental foramen, Stafne's bone cyst (anterior and posterior) in the mandible and incisive/nasopalatine canal and Canalis sinuosus in the maxilla can mimic periapical lesions of endodontic origin in periapical radiography. On the other hand, tooth fractures coronal or radicular or both are difficult to diagnose on conventional radiograph and on CBCT unless there is a significant separation of the fractured segments. In this presentation, an updated literature review and clinical cases of lesions of endodontic origin such as, anatomical variations like canalis sinuosus, mental foramen and Stafne's bone cyst as well as root fractures will be presented.

**Key Learning Points:**

- To review the current knowledge on CBCT applications in endodontic practice.
- To understand the differences between conventional radiography and CBCT for endodontic diagnosis.
- To know when to apply each technology in clinical situations.

**Time:** 15:22 - 15:42

**Influence of cone-beam computed tomography in clinical decision-making among different specialists in Endodontics**

\*Rodriguez Millan G, Abella Sans F, Roig C M, Bueno M R

*Department of Endodontics, Universitat Internacional de Catalunya, Barcelona, Spain*

**Aim** The aim of this oral communication present study was to determine the influence of CBCT on clinical decision-making choices of undergraduate and postgraduate dental students when presented with patient scenarios with varying degrees of endodontic involvement and complexity.

**Summary:** Diagnostic tests are vital for proper treatment plan. In the field of Endodontics, have traditionally used different tests as palpation, percussion, susceptibility testing pulpal and periapical radiographs (PR). Until now these PR have been indispensable for complement endodontic treatment and to determine the success of such treatment. However, it is known that PR have certain limitations as the anatomical noise, 2-dimensional vision and geometric distortion. Occasionally, those detected PR periapical lesions found in cancellous bone. That is, the images obtained by PR only provide data mesial-distal dimension, making it difficult to detect information as important as the root anatomy, the presence of root disorders, bone loss, different types of resorption, root fractures or even planning an apical surgery. To overcome these limitations, we should use the cone beam computed tomography (CBCT). By CBCT overlays, anatomical structures are removed and, periapical lesions can be detected and can make a differential diagnosis with a noninvasive and highly effective technique. The study was conducted in different groups: students of

the endodontic program, oral rehabilitation, implantology, periodontology and dental undergraduates. 30 different clinical cases (Periapical Radiography, photography and initial clinical diagnosis) were presented. Observers had one minute per case, to answer a test that indicated one of the following options: 1) No treatment, 2) Waiting 12 months and reassess, 3) endodontics, 4) nonsurgical retreatment, 5) apical surgery, 6) nonsurgical retreatment plus apical surgery and 7) tooth extraction. In another session, the same cases were presented randomly and adding a previous CBCT of each case. Observers reassess the previously chosen treatment plan taking in consideration the additional radiographic information in three dimensions. Results will be presented at the biennial congress

#### **Key Learning Points:**

- The use of CBCT as a diagnostic tool facilitates clinical decision making
- 3-dimensional radiography allows for a more clear view of periapical defects
- CBCT eliminates anatomical structures that impare a proper visualization of the tooth

**Time:** 15:44 - 16:04

#### **Role of age and gender in relation to position of inferior alveolar nerve in indian population using CBCT**

\*Jaju S<sup>1</sup>, Jaju P<sup>2</sup>, Garcha V<sup>3</sup>

<sup>1</sup>Conservative Dentistry and Endodontics, Rishiraj College of Dental Sciences and Research Centre, Bhopal, <sup>2</sup>Oral Medicine and Radiology, Rishiraj College of Dental Sciences and Research Centre, Bhopal, <sup>3</sup>Public Health Dentistry, Sinhgad Dental College, Pune, India

**Aim** To evaluate whether differences in patient gender or age are predictive of differences in the relative location of the inferior alveolar nerve (IAN) compared with the roots of the mandibular first molar

**Summary:** The study included 200 patients (Males 105 ; Females: 95) that met the following inclusion criteria: (1) age between 25–65 years; (2) Cone Beam Computed tomography (CBCT) scans containing the mandibular first molar and IAN. Exclusion criteria consisted of any pathosis that might alter the position of the IAN. Also lack of cortication around the IAN were excluded from the study. 6 measurements were done, mainly measuring the distance of root apices to the superior border of mandibular canal, distance of buccal and lingual cortical plates from root surfaces and mandibular canal, and distance of inferior border of mandibular canal with inferior border of mandible. CBCT images were observed and anatomic measurements were made by 2 observers (Endodontist & oral maxillofacial radiologist) with mutual agreement of any discordant measures. Measurements were made (in millimeters) were taken at the level of the IAN and mesial and distal root apices. Data were analyzed by 2-way (age, sex) analysis of variance and Mann Whitney test at  $P < 0.05$ . Regardless of age, females had significantly shorter vertical distances from the IAN to the mesial ( $P < 0.05$ ) and distal apices ( $P < 0.05$ ) and shorter vertical distance from inferior border of mandibular canal to inferior border of mandible. With respect to age and side of jaw there was no significant difference between the overall measurements.

#### **Key Learning Points:**

- The IAN is a critical anatomic structure whose location can often influence the surgical planning of root-end surgery on mandibular molars.
- It is critical for endodontists to understand the anatomy of the IAN and its relationship to the roots of mandibular molars.
- Awareness of the relationships between the mean average distance of the mandibular roots to the IAN and with variations among age and gender is essential to minimize risks.
- This study found that the distance between the IAN and the root apices of mandibular first molars is significantly shorter in females than in males.

**Time:** 16:06 - 16:26

## **Highlighting the weakest link in Endodontics Cross-infection control: Propionibacterium acnes and the nosocomial endodontic infections**

\*Niazi SA, Al Kharusi HS, Vincer L, Beighton D, Foschi F, Mannocci F

*Department of Restorative Dentistry, King's College London Dental Institute at Guy's, King's and St Thomas' Hospital, London, United Kingdom*

**Aim** The opportunistic *Propionibacterium acnes* contributes to the endodontic pathology and might be the result of nosocomial infections occurring at the time of root canal treatment (RCT). The aim of the study was to identify the *P. acnes* phlotypes predominating within the primary endodontic infections and to investigate if gloves can be the potential source of these nosocomial infections.

**Summary:** The cultivable microbiota of 15 primary endodontic infection [without (n=7) and with (n=8) open communication with the oral cavity] was identified using partial 16S rRNA gene sequencing and by interrogating the Human Oral Microbiome Database (<http://www.homd.org/>). Phylogenetic analysis by recA gene sequencing (using PAR1 and PAR2 primers) of 47 *P. acnes* isolates was done. The cultivable microbiota of gloves (n=5) worn during RCT at 4 time points (T1-start of treatment, T2-before x-ray, T3-after x-ray, T4-end of session) were identified using partial 16S rRNA gene sequencing. *P. acnes* isolates (n=46) were typed by recA gene sequence comparison. The phylogenetic relationship were determined using MEGA 4.1 (<http://www.megasoftware.net/fixedbugs.html>). Data distributions were compared using  $\chi^2$ -tests, means were compared using the Mann-Whitney U test in SPSSPC (Version 21. IBM, USA). *P. acnes* was the most prevalent isolate recovered from primary endodontic infections with oral communication. No contamination of samples was identified, as control cultures were sterile. The richness of the bacterial taxa distributed in different phyla identified from primary endodontic infections with and without communications were significantly different ( $p<0.05$ ). 36 cultivable bacterial taxa were identified from the gloves. The quantitative viable counts at T4 [(aerobically  $2.97\pm0.68$ ), anaerobically ( $3.43\pm0.52$ )] were significantly greater ( $P<0.05$ ) than at T1 [(aerobically  $0.4\pm0.59$ ), anaerobically ( $0.14\pm0.31$ )] and T2 [(aerobically  $1.88\pm0.70$ ), anaerobically ( $2.47\pm0.70$ )]. *P. acnes* was the predominant taxa identified at T2, T3 and T4. recA gene sequencing revealed 2 phylogenetic lineages of *P. acnes* with type I (further split into type IA and type IB) associated with primary endodontic infections and type II and IB prevalent on gloves.

### **Key Learning Points:**

- The *P. acnes* in primary endodontic infections with communications is an opportunistic pathogen.
- The microbial load of the gloves can lead to the nosocomial infections at the time of root canal treatment.

**Time:** 17:00 - 17:20

## **How endodontists are influenced by paradigm change in restorative dentistry.**

\*Cerny D

*Institute of Dentistry and Oral Sciences, Faculty of Medicine and Dentistry / Palacky University Olomouc, Olomouc, Czech Republic*

**Aim** To inform endodontists about critical importance of understanding current concepts of dentine-bonding technology and how to use it during their clinical work.

**Summary:** Division of dentistry into clinical specialties like endodontics and prosthodontics brings in the important step of drawing the division line. With the introduction of new procedures and technology, we need to reconsider where this line is drawn. Paradigm change in restorative dentistry must be completed within endodontics. There are two main fields which represent this problem. 1. Endodontists are sometimes asked to perform "safety" root canal treatment in order to avoid potential pulp vitality loss during crown preparation. Unlike any other specialty, endodontists are trained and comfortable working in situations near vital pulps. Endodontists should be encouraged to maintain vitality of teeth using modern adhesive protocols and their knowledge of pulp biology



rather than perform perfect but unnecessary root canal therapy. 2. Intracanal postendodontic restoration has traditionally been performed by prosthodontist rather than endodontist. However with almost general implementation of microscopes to clinical endodontics, unnecessary tissue reduction is being avoided whenever possible. Thus creating quite a challenge to following specialty to restore the defect. However there is nobody better informed about morphology and tissue quality within pulp chamber and root canals than endodontist. In both of the clinical situations presented, the endodontist is required to have thorough knowledge of dentinal adhesion. Author presents state-of-the-art treatment model based on clinical experience from private office setup where endodontists are responsible for the treatment to the phase of build-up followed by prosthodontists focusing on prosthetic preparation only.

**Key Learning Points:**

- Restorative dentistry paradigm shift should be transformed into the clinical practice reorganising the workflow.
- Endodontist should use their knowledge of pulp biology to maintain pulp vitality whenever possible.
- No endodontic procedure should be called completed without proper adhesive intracanal restoration performed by endodontist.
- Endodontists should incorporate thorough knowledge of dentinal adhesion into their clinical practice.

**Time:** 17:22 - 17:42

**"Fill and Drill Technique" to leakage control in open-flap operative field isolation of tooth with external cervical resorption: case report.**

\*Cardinali F

*Private Practice, Ancona, Italy*

**Aim** To describe a very effective and easy technique for leakage control in cases of field isolation in endodontics and / or conservative open-flap procedures.

**Summary:** Operative field isolation should be considered the standard of care for endodontics and restorative dentistry.

Rubber dam application is to obtain an operative field stable and free of infiltration: the presence of a leakage during endodontic and restorative treatment is recognized to be an unfavorable prognostic factor for therapy outcome. The rubber dam has to be constantly applied to guarantee total control of infiltration even in more complex cases such as combined endodontics and restorative open-flap procedures. In this case report, the Author describes a simple and effective way to leakage control called "fill and drill technique", easy to apply even in cases like this, where the isolation had been obtained after opening a surgical flap in order to adequately fill an external cervical resorption in tooth abutment of Maryland bridge. In order to have a greater chance of success, the therapeutic choice has been to maintain the vitality of the tooth. Provided an ideal surgical field a rubber dam was applied to attempt a restorative adhesive technique, an indispensable condition to prevent the restoration's leakage. Complying with the request of the patient to not remove the Maryland bridge, rubber dam application and leakage control are found to be the most difficult phases of treatment.

**Time:** 17:44 - 18:04

**Cold atmospheric plasma biooxidative therapy or ozone therapy: theoretical basics, mistakes and clinical application**

Pavelic B, Šegović S, Katunarić M, Galić N, Anić I

*Department of Endodontics and Restorative Dentistry, School of Dental Medicine, University of Zagreb, Zagreb, Croatia*

**Aim** To present a basic theory and successful use of cold plasma biooxidative therapy in difficult clinical treatment.

**Summary:** Plasma is an ionized gas consisting of free electrons, ions, radicals, neutral and/or excited atoms and molecules. Plasma can be created by providing energy to a neutral gas. The source of energy can be thermal, electric energy and electromagnetic radiations. Depending on the type and amount of energy transferred to the plasma, the plasma properties are changed due to the density of electrons and their temperature. The high frequency generator Ozonyx (Biozonix, München, Germany), produces a high frequency electrical plasma field (resonant frequency 30-50kHz, impuls frequency 470 - 1050Hz, trigger voltage 3-18kV, current 100  $\mu$ A) and with its set glass probes is offering a wide range of application in dentistry. Inside the glass probe, which is formed by a double glass camera, is a noble gas that is conducting and emitting electromagnetic energy. When probe gets in contact with the body it emits energy around the treated area and creates a plasma field. The plasma treatment can be used as an antimicrobial agent for treating diseases of the hard and soft tissues of the oral cavity. In cold atmospheric plasma, low doses of intensity of the plasma fields stimulate cells that grow in the cell culture to proliferate, while high doses are subject to the process of apoptosis or necrosis.

**Key Learning Points:**

- Cold atmospheric plasma therapy can be utilized as a primary therapy or as a support to other types of therapies.
- Activated plasma field can be adjusted in different levels via current strength and can be integrated into routine dental care.
- The good first clinical results need further clinical *in vitro* investigations and comparisons with other clinical studies

**Time:** 18:06 - 18:26

**Competencies self-assessment in preclinical endodontic courses**

\*Abiad R

*Division of Endodontics, Department of Restorative Sciences, Faculty of Dentistry, Beirut Arab University, Beirut, Lebanon*

**Aim** The aim of this presentation is to show how self-assessment helped students of the preclinical endodontic courses in Beirut Arab University improve their practical competencies.

**Summary:** Students were introduced to a new rubric system in an attempt to enhance their self-assessment skills. Instructors were calibrated before the start of the semester. After the instructors' induction period and beginning of the course, students were taught on how to assess their work according to the distributed rubrics in an independent seminar. Later with the beginning of each practical session, a relevant short video demo was used according to the type of lab activity scheduled after which the students were given the green light to start their work. The work could only be delivered after the self-assessment had been completed. Subsequently, the instructors would assess the work using the same rubric system. A bonus mark was allocated to each student who had managed to successfully provide an accurate mark to his own work. Retrospective comparison of marks showed that students who used the rubric system scored better than those of the previous courses. In addition, reports from the instructors showed that the students' self-assessment became more accurate successively as the course proceeded. Finally, the questionnaires showed that the student became more confident about their practical skills feeling more prepared to start their clinical courses.

**Key Learning Points:**

- Practical Competencies
- Self- Assessment
- Rubrics

## SATURDAY, SEPTEMBER 19th

### HALL 4

**Time:** 9:00 - 9:20

**The overall assessment in periapical surgery using cone beam computed tomography and operating microscope**

\*Beltes CH, Tsompanides G

*Department of endodontology, aristotle university of thessaloniki, thessaloniki, Greece*

**Aim** This presentation intends to display indicative periapical surgery cases, illustrating the parameters to be considered in order to select the appropriate treatment plan, following an accurate preoperative evaluation comparing conventional radiograph and cone beam computed tomography (CBCT). The radiographic findings were taken under consideration and reassessed, intraoperatively, through examination under dental operating microscope, in order to investigate all the reasons of failure in the non-surgical endodontic treatment.

**Summary:** CBCT is available to provide small field of view images at low dose with sufficient spatial resolution for applications in endodontic diagnosis and treatment guidance and especially for pre-surgical case planning, in order to determine the exact location of root apex/apices and overall morphology, the detection of periapical pathology, to evaluate the proximity of adjacent anatomical structures, to assess overextended root canal obturation materials, separated endodontic instruments, calcified canal identification, and localization of perforations and internal / external resorptions. The application of dental operating microscope in surgical endodontics is associated with the improvement of clinical and radiographic outcomes, in relevance with the pre- and intraoperative findings.

**Key Learning Points:**

- The exact identification and management of endodontic failure can be achieved through accurate three-dimensional representations and microscopic inspection during surgery.
- CBCT is helpful for diagnosis and treatment planning in most of cases for endodontic surgery.
- The combination of both CBCT and operating microscope in endodontic surgery, when they are essential, can provide all the benefits to be performed with an accuracy and predictability of results that were not possible to reach 10 - 15 years ago.

**Time:** 9:22 - 9:42

**Comparison of the degree of cleansing of surgical root-end cavities in teeth treated with plastic carrier obturators or guttapercha crosslinked core.**

\*Rigolone M

*Department of Surgical Sciences - Dental School, Endodontics and Operative Dentistry, University of Turin, Turin, Italy*

**Aim** Evaluation of the degree of cleansing after surgical root-end cavity preparations in teeth filled with Thermafil® (Dentsply, Maillefer), GuttaCore® (Dentsply, Maillefer) and GuttaPink carrier-based filling systems.

**Summary:** Introduction: New cross-linked gutta-percha carriers have been introduced in order to simplify their removal during the surgical root-end cavity preparation and to improve the degree of cleansing. Materials and Methods: thirty extracted human single-root teeth with fully formed apex and equal canal curvature and morphology were used. Each specimen was sectioned to obtain a residual root length of 16 mm. Each canal was preflared using K-Flexofiles up to #20 and then shaped using ProTaper Universal® S1-S2-F1-F2 (Dentsply, Maillefer) at working length. Irrigation was performed with 33ml 5% NaOCl and 10ml 10%E.D.T.A. for 10 minutes per specimen. Samples were randomly assigned to three different groups: in group A canals were filled with Thermafil® #30, in

group B with GuttaCore® #30 and in group C with Guttapink #30. Three expert blinded operators underwent root apical resection (2mm) and a 3mm root-end cavity ultrasonic preparation. ProUltra® Surgical Endo Tips (SURG2) (Dentsply, Maillefer) were used. All samples were radiographed to evaluate the amount of residual guttapercha on root canal walls. Five different endodontic expert blinded operators analyzed root-end cavities degree of cleanliness with radiographs and optical microscope observation (50X). Cleanliness score was recorded basing on an assessment grid: 1. >75%: bad, 2. 50 to 75%: poor, 3. 25 to 50%: medium, 4. <25%: good, 5. minimal residual: excellent. The preparation time was also recorded (sec.). Differences among groups were analyzed with Kruskal Wallis and post-hoc Dunn's test ( $p < 0.05$ ). Results: The mean root-end cavity preparation time was 22,41s for Thermafil group, 16,50s for GuttaCore and 15,1s for GuttaPink group. The degree of root canal cleansing was significantly less when plastic carriers were used: 34.6% for Thermafil and 50% for the other two obturators ( $p = 0.045$ ). Conclusions: An higher degree of root canal cleansing was observed when crosslinked guttapercha carriers were used.

#### **Key Learning Points:**

- Plastic carrier appeared more difficult to removed
- Lower root end cavity preparation time in GuttaCore® and GuttaPink groups
- All groups demonstrated the presence of residual gutta-percha on retro-cavity walls

**Time:** 9:44 - 10:04

#### **Conventional endodontic therapy combined or not combined with surgical decompression in the treatment of extensive radicular cyst**

\*Melian A1, Melian G2, Antohi C<sup>1</sup>, Salceanu M<sup>1</sup>

<sup>1</sup>Department of Endodontics, University of Medicine and Pharmacy, <sup>2</sup>Maxillo-Facial Surgery, Faculty of Dental Medicine, University of Medicine and Pharmacy "Gr.T.Popa" Iasi, Romania

**Aim** The aim of this study is to demonstrate that both common and very large radicular cysts of endodontic origin can be treated by conventional endodontic therapy, combined or not with an additional treatment – surgical decompression.

**Summary:** The study followed eight patients over two years. Each case was diagnosed with large radicular cysts but the surgical treatment (cyst enucleation) damaged the adjacent teeth and bone. To avoid this situation, a conventional endodontic therapy was performed which gave positive results (healing). Only two of those cases required cyst surgical decompression, an additional therapy. The protocol we respected was: biomechanical preparation, ultrasonic irrigation of roots canals, using sodium hypochlorite 3.5% and calcium hydroxide intracanal dressings. The surgical decompression has been carried out with latex tubing in place, irrigation with physiologic saline solution and chlorhexidine gluconate 0.2%. Healing of periapical lesion was achieved in all cases in a period of four months to a year, depending on the size of the cyst. Healing was further confirmed in two years by radiological and clinical tests. The results are satisfactory even if the treatment did not lead to overall healing as important dimensional reduction of the lesion periapical surgery would involve addressing strict affected tooth, no neighbors or adjacent bone and teeth.

#### **Key Learning Points:**

- The importance of conventional endodontic treatment of radicular cysts of endodontic origin
- The role of ultrasound irrigation in biomechanical treatment of the root.
- Advantages of surgical decompression of radicular cyst versus surgical enucleation.

**Time:** 10:06 - 10:26

#### **Differential diagnosis and treatment of lateral lesions of endodontic origin**

\*Weissman A

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

**Aim** Periapical lesions next to the main apical foramen, usually allow for a straightforward diagnosis and treatment. On the other hand, those which appear on the lateral aspect of the root often present a diagnostic and treatment challenge. The differential diagnosis of lateral lesions will be discussed, focusing on lateral lesions of endodontic origin. Cases of lateral lesions will be presented and discussed, including horizontal and vertical root fractures, perforations and lateral canals. Identification and treatment of lateral canals is especially difficult when root canal treatment is done through conventional access. The endodontic micro-surgical approach may serve as an alternative treatment modality in such cases. A modification in retro-preparation will be presented in which lateral canals are prepared using ultrasonic files, commonly used for intracanal applications. Those files are customized by bending them to accommodate the specific location of the lateral canal in the case at hand. This method allows for treatment of a large variety of cases with a minimal ultrasonic tip armamentarium. This simple chair-side method for preparing an endless variety of apical ultrasonic tips will be demonstrated. A variety of cases treated with such tips will be presented and discussed, including lateral canals at different challenging locations.

**Summary:** In treating lateral lesions of endodontic origin, the clinician faces both a diagnostic and a treatment challenge. A differential diagnosis of lateral lesions will be reviewed and a versatile technique for the surgical treatment of lateral canals will be presented.

**Key Learning Points:**

- Lateral lesions can be of odontogenic or non odontogenic origin.
- Communication between the pulp and the PDL can be either physiological or pathological in nature.
- There are several hints that help diagnose the existence of lateral canals.
- Surgical treatment of lateral canals using customized ultrasonic tips can be efficient in a variety of clinical situations.

**Time:** 11:00 - 11:20

**Comparative study on apical leakage within different dental cements in retrograde filling techniques following apical surgical resection: MTA Proroot, MTA Angelus or Aureoseal cement vs cold burnish.**

\*Gallini G<sup>1</sup>, Tolosa Such A<sup>2</sup>

<sup>1</sup>Endodontics, Studio dentistico Guido Gallini, Varese, Italy, <sup>2</sup>Endodontics, universidad catolica de Valencia, Valencia, Spain

**Aim** The purpose of this in-vitro study was to compare the root-end sealing capacity of several apical cements using a dye leakage system.

**Summary:** Sixty-four extracted single-rooted human teeth were endodontically treated in this study using Protaper Universal file system up to F3, lubricating with 17% EDTA and irrigating with 0,2% Chlorhexidine. Dentsply's Topseal cement was used with lateral condensation filling-technique. After cement setting, the 4mm apical portion has been resected with steel counter-angle disc. At this point the samples have been subdivided in a randomized form into four groups (n=15) before shaping a retro-cavity with handpiece bur; group 1 was retro filled with MTA Proroot(Dentsply), group 2 with MTA(Angelus) and group 3 with sterile Aureoseal's Portland cement. A fourth group have been chosen for the burnish in cold of gutta-percha technique without the retro-cavity. In addition two teeth were dedicated to the positive and another two to the negative control. The apical portion of every piece of the study was vertically immersed in 3 ml of Chino ink for three days in cylindrical containers reaching 4 mm of depth, renewing the mentioned dye every 24 hours. 256 cylindrical cuts of 1 mm thick from apical to coronal were realized and singularly examined under optical microscope to detect the coloured leakage produced in every study group. Percentages of microleakage: MTA Proroot®: 33% MTA Angelus®: 0% Aureoseal : 0% Burnished in cold: 26% This study demonstrated that MTA Angelus presented statistically significant differences in the sealed apex after apical resection compared with MTA Proroot, Aureoseal cement and cold burnishing. For

the statistical analysis we used GraphPad Prism program applying Mann Whitney's test which indicated a pvalue <0,05. In conclusion the apical sealing after resection is more predictable realizing the retrograde obturation with a sealer cement than the simple cold burnish. The apical sealer capacity is verified in 100% of cases using MTA Angelus and Aureoseal cement. Sealer capacity statistically significant of the MTA Angelus and Aureoseal cement in comparison to the other cements of this study.

**Time:** 11:22 - 11:42

**Efficacy of Reciproc and ProFile files at removing GuttaMaster from curved root canals**

\*Marfisi Nava K<sup>1</sup>, Plotino G<sup>2</sup>, Varela Dominguez P<sup>1</sup>, Clavel Diaz T<sup>1</sup>, Roig M<sup>1</sup>

<sup>1</sup>Department of Endodontics, Universitat Internacional de Catalunya, Barcelona, Spain, <sup>2</sup>Department of Endodontics, 'Sapienza' University of Rome, Rome, Italy

**Aim** Aim. To compare efficacy of Reciproc® (VDW GmbH, Munich, Germany) and ProFile® (Dentsply Maillefer) instruments at removing gutta-percha from straight and curved root canals ex vivo filled using cold lateral condensation and GuttaMaster® (VDW GmbH) techniques.

**Summary:** A total of 160 teeth, forty mesial mandibular molar roots with two curved canals and 80 single-rooted teeth with straight root canals, were randomly assigned to eight groups (canals per group = 20) according to filling technique, retreatment instrument and root canal curvature as follows: Group 1, cold lateral condensation/ProFile®/straight; Group 2, cold lateral condensation/ProFile®/curved; Group 3, cold lateral condensation/Reciproc®/straight; Group 4, cold lateral condensation/Reciproc®/curved; Group 5, GuttaMaster®/ProFile®/straight; Group 6, GuttaMaster®/ProFile®/curved; Group 7, GuttaMaster®/Reciproc®/straight; and Group 8, GuttaMaster®/Reciproc®/curved. Procedural errors and retreatment duration data were recorded, digital radiographs in the mesio-distal projection measured canal wall cleanliness and the images were analysed with AutoCAD 2009. Means and standard deviations were calculated and analysed using the Kruskal–Wallis test, one-way analysis of variance and Tukey's test ( $P < 0.05$ ). One Reciproc® R25 instrument and one size 20, 0.06 ProFile® instrument fractured during GuttaMaster® retreatment procedures in curved root canals. No perforations, blockages or ledges were recorded in any group. Reciproc® instruments were significantly faster than ProFile® instruments at removing GuttaMaster® from both straight ( $P = 0.0001$ ) and curved ( $P = 0.0003$ ) root canals. Reciproc® instruments were statistically more effective than ProFile® instruments at removing GuttaMaster® from straight root canals ( $P = 0.021$ ). Regardless of filling technique or retreatment instrument, gutta-percha was removed more rapidly from curved roots than from straight root canals ( $P = 0.0001$ ). Neither system completely removed filling material from the root canals. Reciproc® instruments removed GuttaMaster® filling material from straight and curved root canals more rapidly than ProFile® instruments.

**Key Learning Points:**

- Compare retreatment in straight and curved root canals.
- Efficacy of Reciproc® and ProFile® instruments at removing filling material.
- Compare retreatment efficacy of two different filling techniques.

**Time:** 11:44 - 12:04

**Microsonic removal of separated endodontic instruments: success rate, influencing factors and the quality of root canal filling**

\*Tordai B, Lempel E, Krajczár K

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**Aim** Fracture of endodontic instruments during root canal treatment can jeopardize further treatment and might even cause failure. Several techniques had been described to remove broken fragment from root canals. The aim of this study was to evaluate the success rate of the microsonic technique for removing broken instruments located in root canals and to identify its influencing factors. We assessed the quality of root canal filling after successful removal using different quality parameters and investigated whether the removal procedure has any impact on the quality.

**Summary:** Our retrospective study analyzed patient's records, preoperative and postoperative radiographs. Success of the removal and quality of the obturation were assessed according to the type of tooth and root canal, angle of curvature, length and type of fragment, site of fragment in root canal. In cases of successful removal taper, homogeneity and length of obturation were evaluated and classified as ideal or altered. Effect of altered taper on length and homogeneity were investigated. Data were analyzed using Pearson's chi-squared test and Fischer's exact test at the 0.05 level of significance. 97 instrument removals from 89 teeth and 94 root canals were investigated. 75 fragments were removed successfully (77.3%). Site of fragment relative to canal curvature and angle of curvature had significantly influenced the removal ( $p<0.01$  and  $p<0.05$ ). 45 of the evaluated 73 obturations showed altered taper (61.6%) in which cases length and homogeneity of the obturations proved significantly lower quality ( $p<0.05$ ).

**Key Learning Points:**

- Microsonic removal proved to be a successful method to retrieve broken files.
- Success could be compromised in those cases where fragments located beyond the curvature especially in severely angled canal.
- Care should be taken to avoid preparation errors because in the cases of altered taper, quality of the obturation might be reduced which could jeopardize the success of the treatment.

**Time:** 12:06 - 12:26

**A retrospective study of the healing process in periapical lesions - seven years follow-up**

\*Gusiyska AZ

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

**Aim** Periapical lesions are generally accompanied by periapical bone destruction which is radiographically observed as periapical radiolucency around the apex. The initial diagnosis and the difficulties associated with treatment are related to the complex dynamic clinical characteristics of the apical lesions. The aim of this study was to present results from the retrospective monitoring of the healing process in periapical lesions.

**Summary:** An endodontic retreatment was done by one endodontist on a total of 287 teeth ( $n=287$ ) for a period of seven years followed-up with reference to the dental records. For statistical purposes results are grouped into three main groups according to the initial periapical index - group I (teeth with PAI II and III), group II (teeth with PAI IV) and group III (teeth with PAI V). According to the follow-up period of the above cases results are grouped into three subgroups - subgroup I (2 years follow-up), subgroup II (4 years follow-up) and subgroup III (7 years follow-up). The analysis and assessment of results by parallel radiographs showed that in clinical cases followed-up to the 2nd year a successful periapical healing process were observed in 96.39% (group I) and failure was observed in 3.61%. Successful healing clinical cases followed-up to the 4rd year were observed in 95.1% (group II) and 89.2% for group III. Of the monitored 287 cases treated from 2003 to 2010 incl., a prevalence of CAP with PAI3 - 44.2% was established. No statistically significant difference was found comparing group I with group II, but compared with group III a statistically significant difference was found ( $p=0.05$ ). The healing process depends on the initial PAI. The satisfactory results of treatment vary from 89.2 % to 96.39% while respecting the rules of contemporary endodontic science.

**Time:** 12:28 - 12:48

### **Biological behaviour of periodontal ligament fibroblasts on novel root repair materials**

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<sup>1</sup>*Department of Endodontics, Faculty of Dentistry, University of Necmettin Erbakan,* <sup>2</sup>*Department of Biotechnology, Faculty of Science, University of Selcuk,* <sup>3</sup>*Department of Endodontics, Faculty of Dentistry, University of Selcuk, Konya, Turkey*

**Aim** The aim of this *in vitro* study was to evaluate biological behaviour of periodontal ligament fibroblasts (PDL) on newly proposed root repair materials; Biodentine (Septodont, France), MM-MTA (MicroMega, France), polymethylmethacrylate (PMMA) bone cement (AF cement, Laboratorios, Argentina), SDR (Dentsply, Germany) in comparison with contemporary root repair materials; IRM (Dentsply, USA), Dyract Compomer (Dentsply, Germany), ProRoot MTA (PMTA) (Dentsply, Switzerland), Vitrebond (3M ESPE, Germany).

**Summary:** Five discs from each material were fabricated in sterile Teflon molds and specimens were aged and prewetted in cell culture media for 96h. Three material discs were used for scanning electron microscope (SEM) to evaluate attachment, density and morphological changes of PDL cells whereas two samples were used for energy dispersive X-ray spectroscopy (SEM-EDX) to determine elemental composition of materials. Human periodontal ligament fibroblasts were plated at a density of 10.000/well onto materials and incubated for 3-days. Only cell culture media were added onto materials that were prepared for SEM-EDX. SEM micrographs were taken at various magnifications (×500 and ×5000). Cells were attached and well spread on the surfaces of Biodentine, PMTA and Dyract Compomer whilst varied cell density and morphological alterations were observed in Vitrebond, IRM, MM-MTA, SDR and PMMA bone cement groups with SEM. SEM-EDX analysis revealed maximum calcium percentage on PMTA specimens while maximum silicon percentage on Dyract Compomer specimens. This *in vitro* study demonstrated that Biodentine and Dyract Compomer support the PDL cell adhesion and spreading. PMTA presents a favourable scaffold for better attachment of the PDL cells. Calcium and silicon content of a material may enhance PDL cell attachment.

#### **Key Learning Points:**

- Cell adhesion is one of the important indicators of the biocompatibility of a material.
- SEM helps visualizing density and morphology of PDL cells in contact with root repair materials. SEM-EDX provides information about chemical composition of the materials.
- The root repair materials recommended are Biodentine, PMTA and Dyract Compomer due to their influence on PDL cell adherence onto materials.
- Calcium and silicone components of the material may positively influence cell adherence.

**Time:** 12:50 - 13:10

### **Periapical radiolucent lesions of non endodontic origin**

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*Department of Endodontology, School of Dentistry, Aristotle University of Thessaloniki, Thessaloniki, Greece*

**Aim** To address the incidence of radiolucent lesions of non pulpal origin that can mimic apical periodontitis and to emphasize on the importance of the consideration of non endodontic diseases in the differential diagnostic process.

**Summary:** Periapical radiolucent lesions are usually developed as a sequel to root canal infection, are commonly detected during the endodontic routine and have been classified as periapical abscess, granuloma or cyst. However there are other pathoses of non endodontic origin located in the periapical region that can lead to radiographical and clinical confusion as their appearance is not pathognomic. The localization of these lesions around the roots of teeth, especially if these have been endodontically treated or if the pulp vitality tests are negative or doubtful, can cause diagnostic difficulties and therapeutic problems. A comprehensive review of the literature, from



1975 to 2014, revealed a number of serious pathologic conditions or malignancies misdiagnosed as lesions of pulpal pathology. The most common of them are going to be illustrated. Clinicians should be aware of the occurrence rate and clinical characteristics of radiolucent jaw lesions that can be presented as apical periodontitis as they require different treatment procedures and exhibit different prognoses

**Key Learning Points:**

- Periapical radiolucent lesions may be of non endodontic origin.
- Non endodontic diseases should always be considered in the differential diagnosis of apical periodontitis.
- Histological examination of surgically removed lesions is essential to set the definitive diagnosis.

**Time:** 15:00 - 15:20

**The role of pulp diagnosis on success rate of two-visit root canal treatment : A systematic review and meta-analysis.**

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<sup>1</sup>Department of Endodontics, Military Hospital, <sup>2</sup>Department of Endodontics, Suleyman Demirel University, Isparta, Turkey

**Aim** The aim of this systematic review was to assess the status of the pulp (vital vs. nonvital) on success rate of two-visit root canal treatment.

**Summary:** A comprehensive systematic literature search through the MEDLINE via PubMed, EMBASE, CENTRAL (Cochrane), and TRIP electronic databases restricted to papers in English from 01.01.2004 was performed in accordance with the PICO-structured research question. The last search was performed on 03.01.2015. In addition, a handsearching was also carried out by screening the reference lists of the eligible studies and congress abstract books. Randomized controlled trials, randomized clinical studies, prospective cohort studies, case series, (except cross-sectional studies) were selected as study types. Inclusion and exclusion criteria were defined. The data extraction was performed by two independent reviewers and was subjected to a methodological quality appraisal by using a quality appraisal checklist. The data, which were appropriate for a quantitative analyzing (meta-analysis) were assessed by using the Comprehensive Meta-Analysis software. The heterogeneity was evaluated using Cochran Q and Tau-squared. The degree of heterogeneity was analysed using the I-squared statistics. The level of significance was set at  $\alpha = 0.05$ . A total of 345 articles were retrieved from the electronic databases and handsearching. Of these, 4 articles met the inclusion criteria. No substantial heterogeneity was observed ( $p=0,189$ ). It was determined that the success rate of two-visit endodontic treatment in vital pulps is 1,82 times higher than the treatment of teeth with nonvital pulp (Odds Ratio= 1,82; 95% CI, 1,04-3,20)

**Key Learning Points:**

- The results of the study showed that the pulp diagnosis affects significantly the outcomes of the two-visit endodontic treatment.
- The success rate of the two-visit endodontic treatment in vital pulps is 1,82 times higher than those performed in nonvital pulps.

**Time:** 15:22 - 15:42

**Cytotoxic effect of calcium hydroxide paste and chlorhexidine gel 2% on cultured rat fibroblasts**

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**Aim** To evaluate the cytotoxicity of different endodontic medicaments, in cultured ligamental periodontal rat fibroblasts, with WST-1 Colorimetric Method.

**Summary:** Primary cell culture were established from rat periodontal ligament (Histology Department, Faculty of Medicine, Hacettepe University, Ankara Turkey). The tissues plated in tissue culture flasks with Dulbecco's Modification of Eagle's Medium (DMEM), supplemented with 10 % FBS, 1mL penicillin, 2mM L-glutamine at 37C, 95% air and 5% CO<sub>2</sub>. Periodontal ligamental fibroblasts were plated 104 cells/well in 96-well plates (Falcon, BD Biosciences, Milano, Italy) in 100µl of culture medium. Tested medicaments were: Calcium hydroxide paste (Apexcal, Ivoclar- Vivadent), Chlorhexidine gel 2% (Consepsis Scrub, Ultradent Products, Inc USA). Pastes were obtained by incubation of 1gr of each material with 1 ml of DMEM without fetal calf serum for 3 hours, at 37C in 5% CO<sub>2</sub> atmosphere. Afterwards, the supernatant was removed carefully and serial dilutions were made with DMEM from 10<sup>-1</sup> and 10<sup>-4</sup> µg/ml. 100 µl of each medicament were added to 96-well plates containing cultured fibroblasts. Cell viability was measured with WST-1 colorimetric assay (Roche Diagnostics GmbH, Mannheim, Germany, REF 11644807001). Before the evaluation of cell viability in Scanning Multiwell Spectrophotometer, 10 µl of WST-1 was added and incubated for 4 hours at 370C. The absorption of cells was measured after 1h, 24h, 48h, 72h using a micro ELISA reader (VersaMax, Molecular Devices) at 420-600nm. Data were statistically analyzed with Simple Arithmetic Average (Mean) and Standard Deviation. Significant difference was tested with Anova test. In order to compare the role of medicament and dilution on the vitality of the cells >50% we have conducted analysis of multiple logical regression. There were statistically significant difference (p<0.05) among cell viability between groups at different concentrations and at all time intervals. Our results are indicative that all medicaments are more biocompatible when they are diluted

**Key Learning Points:**

- Calcium Hydroxide paste and Chlorhexidine gel 2% were highly cytotoxic 10<sup>-1</sup> concentration, but after the dilution at 10<sup>-4</sup> the cytotoxic effect was lowered significantly.

**Time:** 15:44 - 16:04

**Canal preparation with nickel-titanium or stainless-steel instruments without the risk of instrument fracture: preliminary observations**

\*Yared G

*Private Practice, Limited to Endodontics, Toronto, Canada*

**Aim** This report introduces a novel technique for initial canal negotiation, creation of a glide path and canal preparation. In this technique, nickel-titanium or stainless-steel engine-driven instruments are used in reciprocating motion with very small forward and reverse angles. Hand files are not used regardless of the complexity of the canal anatomy.

**Summary:** Nickel-titanium engine-driven instruments are widely used for canal preparation. However, their fracture associated with flexural and torsional stresses is a notable disadvantage. When used according to specific guidelines, these instruments perform well. The procedure usually involving three steps, initial canal negotiation, glide path creation and canal preparation, allows the clinician to successfully prepare most root canals with nickel-titanium engine-driven instruments. In some instances, with a complex anatomy such as an abrupt apical curvature, canal negotiation should be performed with small pre-curved stainless-steel hand files used in reciprocating motion, a watch winding motion. This procedure can be time consuming and challenging. Moreover, the conventional use of nickel-titanium engine-driven instruments should be avoided in these instances for glide path creation and canal preparation. Instead, pre-curved stainless-steel and pre-curved nickel-titanium hand files should be used, also with a watch winding motion. This procedure can be demanding and frustrating and could result in an increased incidence of procedural errors regardless of the clinician's expertise. This novel technique for canal negotiation, glide path preparation and canal preparation with nickel-titanium or stainless-steel engine-driven instruments uses a reciprocating movement with very small forward and reverse angles which would eliminate the risk

of instrument fracture. This technique eliminates the use of small hand files for canal negotiation. It also allows canal negotiation and glide path preparation not otherwise possible. The preliminary experience with this technique was encouraging. However, the need for proper laboratory and clinical evaluation is warranted.

**Key Learning Points:**

- Limitations of current procedures for initial canal negotiation, glide path management and canal preparation in canals with a complex anatomy.
- Use of engine-driven stainless-steel or nickel-titanium instruments for management of canals with a complex anatomy (abrupt curvature, ledge).

**Time:** 16:06 - 16:26

**The staining effects of different root canal medicaments on mature teeth and bleaching of tooth discoloration caused by medicaments**

Akkor T, Öztan Dartar M, \*Yılmaz F

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

**Aim** The aim of the present *in vitro* study is to assess the color changes resulted with root canal medicaments (Ledermix, triple antibiotic paste, Kalsin, Klorhexidine gel, Vitapex) and then to determine the bleaching effect of sodium perborate-hydrogen peroxide mixture and carbamide peroxide on discolored teeth.

**Summary:** Methods: 112 human maxillary central incisors extracted for periodontal reasons were used. The teeth were then randomly divided in to seven groups five as experimental and two as positive and negative control groups. Study groups were filled with medicating pastes. Positive and negative control groups also examined. After the incubation period, measurements were carried out with a spectrophotometer. The colour changes were calculated by subtracting the baseline L\*, a\* and b\* values from the values at subsequent observations. Data in this study is determined by using SPSS 20.0 analytic software. After test of normality Mann Whitney U test was used to determine independent differences. While comparing multiple groups Kruskal Wallis H test with Bonferroni correction was used. The statistical difference of colour changes relating to each time interval with non-normal distribution, Wilcoxon Sign test was used. P value < 0,05 was considered significant. Results: The negative controls showed the least tooth discolouration ( $\Delta E < 1.85$ ). Positive controls showed immediate severe discolouration, which was significantly different from the experimental groups ( $p < 0.05$ ). Ledermix showed more discolouration than other experimental groups for each time intervals. According to the bleaching effects of the materials statistically significant differences were found for Kalsin and triple antibiotic paste groups. Teeth discoloured with Kalsin demonstrated higher  $\Delta E$  values after bleaching with sodium perborate-30% hydrogen peroxide paste than 37% carbamide peroxide gel. In contrast, 37% carbamide peroxide gel was more effective than sodium perborate-30% hydrogen peroxide paste on teeth discoloured with triple antibiotic paste. Conclusions: All tested endodontic medicaments have staining ability on teeth which Ledermix caused most severe. For intracoronal bleaching the use of sodium perborate-hydrogen peroxide mixture for teeth stained with calcium hydroxide, and carbamide peroxide for teeth stained with triple antibiotic paste were recommended.

**Key Learning Points:**

- Assessed the tooth discoloration induced by endodontic medicament and subsequently compared the bleaching effects.

## HALL 5

**Time:** 9:00 - 9:20

### **Standardized Endodontic Diagnostic Terminology**

**\*Spatafore CM**

*Department of Endodontics, Virginia Commonwealth University, Richmond, United States*

**Aim** This presentation will present the new standardized endodontic diagnostic terminology. In 2008 the American Association held a consensus conference and published the results in the Journal of Endodontics in 2009. Endodontists from all over the world attended the conference and developed standardized diagnostic terminology, and determined the radiographic criteria, objective test results, and clinical criteria needed to validate the diagnostic terms. The goal of this presentation would be to present this information at the ESE meeting to help clinicians understand the progressive nature of pulpal and periapical disease, directing them to the most appropriate treatment approach for each condition. Each pulpal and periapical diagnosis will be discussed along with proper terminology, appropriate diagnostic testing, clinical findings, radiographic examples and treatment options. Full case examples of each diagnosis will be presented. We will also discuss the dynamics and progression of the diseases of the pulp and periapical tissues and that signs and symptoms will vary depending on the stage of the disease as well as the patient health and dental history. Proper treatment requires a complete endodontic diagnosis that includes both a pulpal and a periapical diagnosis for each tooth evaluated. Another goal of this consensus conference was that all dental clinicians, educators, testing agencies, dental boards and insurance companies were utilizing the same standardized endodontic diagnostic terminology. Handouts provided: Results from the conference that were published in the Journal of Endodontic and AAE Colleagues for Excellence that was sent out to all dentists in the United States and Canada.

**Summary:** this is an informative lecture to familiarize the participants with the standardized endodontic diagnostic terminology, the radiographic presentations along with the signs and symptoms associated with the diagnosis, as well as the appropriate treatment plan for the patient.

#### **Key Learning Points:**

- Understanding the standardized periapical and pulpal diagnostic terminology
- Understand the progressive nature of pulpal and periapical disease and the diagnostic criteria required for each diagnosis.
- Decision making for the proper treatment plan for each diagnosis based on radiographs, clinical findings and patient feedback

**Time:** 9:22 - 9:42

### **The effect of hypnotherapy on success of infiltration anesthesia in maxillary teeth with irreversible pulpitis- randomized clinical trial**

**\*Ramazani M**

*Department of Endodontics, Medical University, Sari, Iran, Islamic Rep. of*

**Aim** To evaluate the effectiveness of hypnotherapy on infiltration anesthesia depth in maxillary teeth diagnosed with irreversible pulpitis.

**Summary:** Materials and Methods: 100 volunteers with irreversible pulpitis in one maxillary tooth, participated into this single-blinded clinical trial and randomly divided into two groups each of 50. After taking informed consent, In group A the patients received routine infiltration anesthesia with 2% Lidocaine and EP 1/200000, without any further intervention, but in group B, adjunctive hypnotherapy including Hand levitateion plus glove anesthesia techniques was performed immediately prior to infiltration anesthesia (like group A). Patients hypnotizability was ascertained through using Spiegel biological scale. All patients recorded their pain scores on VAS before study onset, 15 minutes after anesthesia in response to Endo Ice test, during access cavity preparation and

during root canal instrumentation. Success was considered as no or mild pain (VAS<5.4) at any stage. Furthermore, anxiety was evaluated upon Corah's questionnaire. Data collected, and were analyzed by the chi-square and analysis of variance tests. Success rates for group A and B were 45%, and 68% respectively ( $p<0.05$ ). The depth of anesthesia following hypnotherapy was more in women than men ( $p<0.05$ ). According to Corah's questionnaire, patients' anxiety scores were significantly lower in group B than A ( $p=0.001$ ). Anxiety management by hypnosis was more significant in women than men. Any somatic manifestation has a psychotic component which is not allowed to be ignored. In pain system, this integration is of utmost importance. Regarding the importance of anesthesia in teeth with irreversible pulpitis, it is suggested that endodontists familiarize with and use the safe and effective hypnosis techniques for deepening anesthesia in teeth with irreversible pulpitis.

**Time:** 9:44 - 10:04

### **Reduction of postoperative pain by preventive administration of analgesic drugs**

\*Panopoulos P

*Department of Endodontics, Dental School, University of Athens, Athens, Greece*

**Aim** To present the clinical evidence regarding the efficacy of the preventive use of analgesic drugs in reducing the postoperative endodontic pain. In addition, the indications of prophylactic use of anti-inflammatory drugs and their dosage will be discussed.

**Summary:** Postoperative pain is a frequent complication during endodontic therapy. In many cases it is relatively easy to diagnose and treat; however, some times its alleviation is cumbersome and necessitates an emergency appointment. The etiology of pain is periapical inflammation which is caused, most probably, by the extrusion of debris through the apex during instrumentation. When pain occurs it can be alleviated either by administration of analgesic drugs, or by emergency dental procedures, or by a combination of the above. Since prevention is preferable to treatment, the clinician should employ techniques that minimize the amount of extruded debris during canal instrumentation and, further, to use anti-inflammatory drugs with proven efficiency. During the last years convincing evidence is accumulated regarding the efficacy of the preventive use of analgesic drugs. It is possible that administration of a nonsteroidal anti-inflammatory drug before the endodontic treatment may interfere with the inflammatory process before it begins; therefore, presumably decreasing postoperative pain. Most studies tested the preventive use of analgesic drugs during extraction of third molars, and they reported a reduction of expected pain by 35-60%. Few studies have examined the efficacy of the preventive use of analgesic drugs in reducing the postoperative endodontic pain. Some of them did not find any significant difference in alleviating post-treatment pain. However, others have shown that administration of one tablet of a non steroid anti-inflammatory drug either before or immediately after the canal debridement resulted in significantly less pain compared to placebo.

#### **Key Learning Points:**

- Understand the mechanism of post treatment endodontic pain
- Understand the effect of prophylactic administration of an anti-inflammatory drug on the inflammatory process
- Understand the indications and methods of the preventive use of analgesic medicaments during endodontic therapy

**Time:** 10:06 - 10:26

### **From past to present, from apexification to pulp regeneration, what are these treatment limitations?**

\*SADR A, Mirhosseini I, Rainbow Y

*Department of ENDODONTICS, CHARLES STURT UNIVERSITY, ORANGE, Australia*

**Aim** Revascularization of the pulp followed by continued root development as the newest treatment plan for immature permanent teeth.

**Summary:** There are some major concerns and several clinical challenges that must be bypassed when treating permanent teeth with non-vital pulp and open Apices. Sealing Apices requires a special method of treatment. Giving opportunity to APICES for full formation is regarded as the best solution. To attain this, the apexification method has been advised for some years. The length of the treatment as well as the possibility of a dentin wall fracture was the main problem for this method. The artificial apical barrier method with mineral trioxide aggregate (MTA) has somehow improved the patient compliance but still cannot stimulate the development of apical closure and thickening of radicular dentin. Revascularization of the pulp followed by continued root development can occur under ideal circumstances as the newest treatment plan for such immature permanent teeth. In this presentation after a review of the regenerative procedure with the recent American Association of Endodontics calcium hydroxide recommendations some of the cases of revascularization will be discussed.

**Key Learning Points:**

- Clinical management of the open apex teeth and comparison with new revascularization technique
- The outcome of the revascularization procedures
- Complications of revascularization

**Time:** 11:00 - 11:20

**Regenerative endodontic treatment of immature teeth with apical lesion**

Turk T, \*OZISIK B

*Department of Endodontology, Ege University School of Dentistry, IZMIR, Turkey*

**Aim** To describe and discuss the successful outcome of regenerative endodontic treatment on immature permanent teeth with extensive apical lesions

**Summary:** Teeth which have incompletely developed root with an open apex and large apical lesions were selected for study. After local anaesthesia and rubber dam isolation, an access cavity was prepared and necrotic pulpal remnants were removed. The canals were disinfected without mechanical instrumentation. A triple antibiotic paste (metronidazole, ciprofloxacin and minocycline) was mixed with distilled water placed to the root canal space for 4 weeks. After medication period antibiotic pastes were removed and bleeding was induced into the canal space from the periapical tissues using a K-file. Mineral trioxide aggregate (MTA) was placed directly over the blood clot. Two days later, the teeth were restored with permanent filling materials. Patients were recalled for 3,6,12,24 and 36 months for clinical and radiographic follow up. A three year follow up radiographs revealed resolution of periapical lesions, increased thickening of the root walls, further root development and continued apical closure of root apex at all cases. On the other hand, only two of them displayed a positive response to vitality testing

**Key Learning Points:**

- Regeneration is viable treatment modality that allows continued root development of immature teeth with open apices and necrotic pulp.
- Regenerative endodontic procedures may offer an effective treatment option to save the teeth with comprised structural integrity

**Time:** 11:22 - 11:42

**Revascularization of traumatized necrotic immature teeth - are we there yet?**

\*Slutzky Goldberg I

*Department of Endodontics, HUHSMD, Jerusalem, Israel*

**Aim** To present the clinical and radiographic outcome of revascularization procedure in traumatized immature teeth and to establish guidelines for case selection towards the procedure.

**Summary:** Revascularization of necrotic immature teeth gained a lot of popularity in the last decade, since the case report published by Banchs and Trope in 2004. The expected goals of this procedure are apical repair, thickening of the root canal walls and elongation of the root. The Mahidol study compared the radiographic outcome and survival rate of teeth undergoing apexification with Ca(OH)<sub>2</sub> or MTA or revascularization and found more favorable results for the teeth after revascularization. Due to coronal discoloration, attributed to the use of Minocycline, it was suggested that only two antibiotics (DAP) should be used for medication of the infected root canals. Alternatively, It was recommended to use only Ca(OH)<sub>2</sub> as the disinfectant agent. Additional changes from the original protocol include the use of EDTA during the procedure, irrigation with lower concentrations of sodium hypochlorite, and use of an anesthetic without adrenalin. Different treatment outcomes were observed after a revascularization procedure. While apical repair was almost always evident, elongation of the root and thickening of the root canals is not a constant finding. Variable patterns were described for continued root development following revascularization, including root maturation, obliteration, hard tissue formation in the middle of the root and, bony ingrowth, lack of change in the tooth length with the apex becoming blunt or elongation of the root without apical closure. Reports as to the treatment outcome of traumatized necrotic immature teeth are scarce and the results are inconsistent. In several case reports of human teeth which underwent revascularization the newly formed roots were examined histologically. None demonstrated dentin and pulpal tissue formation. In view of the results the procedure should be adopted when the root canal is wide and divergent and the dentinal walls thin, in relatively very immature teeth when the prognosis of other treatment options such as apexification is less favorable.

**Key Learning Points:**

- New protocol
- Appraisal of the outcomes
- Criteria and case selection

**Time:** 11:44 - 12:04

**Revascularization protocol using scaffold blood clot plus collagen (collacote) and emdogain (EMD)**

\*herrera AF

*Asociacion Mexicana de Endodoncia Colegio de Especialistas en Endodoncia Ac, Mexico, Distrito Federal, Mexico*

**Aim** Describe the technical process using the scaffold blood clot plus COLLACOTE and EMDOGAIN; present clinical cases with their respective controls.

**Summary:** The complete development of the root sometimes is affected due to many factors; and we have to carry out clinical procedures to solve this problem. A new and promising gate has been open for this method to handle the open apex, called Regenerative Endodontics that has been defined as biologically based procedures designed to replace damaged structures such as dentine, root structures, and cells of the pulp-dentine-complex. Three critical challenges to successful regeneration and root maturation include:

1. - Disinfection of the canal
2. - Establishment of a scaffold in the canal to facilitate tissue in-growth and differentiation
3. - A bacteria tight seal of the access opening.

Repair of the pulp by vital tissue is better than replacement of the pulp with biomaterials in an immature permanent tooth with pulp necrosis and apical periodontitis. Has been demonstrated that the EMD has a potential to stimulate and promote the formation of new connective tissue, bone, periodontal ligament and cement. Also some studies have demonstrated that the EMD promotes the odontogenic differentiation of the pulp and tissues. (Nakamura 2002; Minn 2009). This presentation covers the clinical protocol more advance at this day; in addition presents the incorporation with the blood clot and collagen scaffold; the use of EMDOGAIN. EMD increases chemo taxis of epithelial

cells, gingival fibroblasts, PDL cells, osteoblasts, and endothelial cells. These suggest that EMD might accelerate wound healing through clearance of the wound. One of the most important phases of the procedure is the creation of the scaffold; and the success depends in the promotion of the adequate regeneration. We try to strengthen this by using the EMDOGAIN.

**Key Learning Points:**

- regenerative endodontics
- scaffold blood clot
- collacote
- emdogain

**Time:** 12:06 - 12:26

**Revascularization techniques: the point through 6 years follow-up of several cases**

\*Ricci CR<sup>1</sup>, Medioni E<sup>2</sup>

<sup>1</sup>Post graduate program Endodontic, Pole Odontologie CHU de Nice, NICE, France

<sup>2</sup>Micoralis Laboratory (EA7354) and Restorative and Endodontics department, Pole Odontologie CHU de Nice, NICE, France

**Aim** The purpose of this presentation is to present through a short literature review, our personal experience on revascularization techniques based on the limitations of the French laws, through a 6 year follow up of several cases.

**Summary:** Since the first case of revascularization shown by Banchs and Trope in 2004, we also tried to realize this kind of treatment. The advantages of this technique are indisputable and allow healing of periapical lesions on necrotic immature teeth. In case of failure, a classical technique of apexification using Calcium Hydroxide dressing may be still considered. Different techniques have been proposed: their common point is to establish a first phase of root canal disinfection using sodium hypochlorite. According to clinicians and researchers, different products have been proposed to continue this disinfection phase: local light antiseptic, tri-antibiotic mixture ore paste, bi antibiotic paste and calcium hydroxide. But, once this disinfection step is carried out, three weeks after, another problem remains in obtaining a bleeding in the apical end. This bleeding must be sufficient to allow colonization of the root canal by stem cells from the apical papilla. This blood clot has to be capped with a biomaterial. Then, the focus of this lecture will explain different kinds of healing listed in the literature, both at the clinical level based on hundreds case-reports and histological finding. Even if apical closures are radiographically observed, currently, we cannot ensure that a real pulp tissue is present inside the root canal. Through several clinical cases treated since 2008, we will explain evolutions of the techniques and justify our current therapeutic choice. In addition, we will propose a classification of the results obtained by this revascularization technique. Through this personal experience and literature review, discussion and conclusion will try to determine if what we call “revascularization” is only an apical closure with healing of periapical lesions or a real regeneration.

**Key Learning Points:**

- At the end of this presentation, participant will be able to:
- Understand evolution of revascularization techniques
- Know the dressing used for the disinfection phase
- Understand the conditions of healing
- Apply these techniques

**Time:** 12:28 - 12:48

**Regenerative endodontics: evidence, theory and practice**

\*Hashem AA

Department of Endodontics, Faculty of dentistry, ain Shams University, Cairo, Egypt



**Aim** to evaluate the current procedures and discuss the future trends in regenerative endodontics.

**Summary:** Difficulty in cleaning and shaping, Difficulty in obturation and liability to fracture, are problems encountered during treating non vital open apex teeth. Calcium hydroxide apexification stood a long time as the treatment of choice but concerns about its long-term use had arisen. In the last decade, MTA has emerged as the wonder material and permitted one visit procedure. However, all these solutions aimed only to induce an apical barrier. In recent years, attention has been focused on the regenerative potential of such teeth after through disinfection of the root canal system. Several case reports and series have shown us cases where root thickness increased and apical closure occurred. The application of the regenerative triad "Stem cells, growth factors and scaffolds" have been investigated in some studies with varying degrees of success. There is a lack in Randomized controlled Trials evaluating the success of regenerative endodontic procedures. Where do we stand now and what are the future trends? At conclusion, participants should be able to:

**Key Learning Points:**

- Evaluate the different techniques to manage non-vital open apex teeth with reference to their advantages and drawbacks.
- Discuss the current evidence based approaches to regenerate pulp-dentin complex.
- Appraise the current published and ongoing research on regeneration of pulp dentin complex in the Endodontic dept. Ain shams University.

**Time:** 12:50 - 13:10

**Regenerative pulp treatment applications: modelling the molecules' transport mechanisms in dentinal tubules**

\*Gogos C<sup>1</sup>, Passos AD<sup>2</sup>, Kodonas K<sup>1</sup>, Mouza AA<sup>2</sup>, Paras SV<sup>2</sup>, Tziafas D<sup>1</sup>

<sup>1</sup>Department of Endodontology, School of Dentistry, <sup>2</sup>Department of Chemical Engineering, Chemical Process and Plant Design Laboratory, Aristotle University of Thessaloniki, Thessaloniki, Greece

**Aim** The presentation of three related methods for evaluating various therapeutic applications in deep dentinal cavities. The methods and their preliminary results will be reviewed.

**Summary:** Regenerative treatment modalities mimicing natural tissue formation rather than scar formation during the healing process are designed and tested at preclinical level. Research using specific signaling molecules (Growth factors, Bone Morphogenetic Proteins, etc.) to stimulate dentinogenic reactions in the dentin-pulp complex gave promising results. The inter-relationship between the biological activity of the molecule signaling mechanisms and their transfer mechanisms in dentinal tubules seems to be of prime importance in evaluating critical aspects, such as dose response effects, in relation to the therapeutic validity of a given application. The methods evaluated are: CFD model: A simplified computational model for investigating the transdentinal fluid flow characteristics and the transport mechanism of biological molecules or nanoparticles from the dentin surface to the pulp. The evaluated variable is the concentration of the substance inside the dentinal tubules and pulp. The influence of parameters e.g. temperature, pressure on the transport rate were also evaluated. Microchannel model: This method was used to validate the CFD model. The transport rate and the concentration of biological molecules or nanoparticles inside an artificial microchannel simulating a dentinal tubule was evaluated using the Laser Induced Fluorescence method. Dentin disc model: An experimental set-up simulating clinical conditions for validating the findings from the two previously mentioned methodologies. The transport rate through dentin was evaluated using the Laser Induced Fluorescence (LIF) method. Major points of comparison from previous pertinent studies on the effects of critical parameters on transdentinal diffusion mechanisms and the data obtained from the present methodologies are discussed.

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**Key Learning Points:**

- Transport rates of substances through dentin could be reliably approached by computational and ex-vivo models.
- The CFD model accurately simulates flow characteristics through dentin.
- Laser Induced Fluorescence is a useful tool for real time mass transport evaluation.

**Time:** 15:00 - 15:20

**Role of leptin in oral biology**

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**Aim** Leptin acts as a mediator of inflammation. The expression of leptin in oral tissues and its possible functional role in dental pulp immune and defensive responses and in periapical tissues are reviewed.

**Summary:** Leptin, an inflammation-related adipokine, acts as pro-inflammatory cytokine. It has been shown that it regulates both innate and adaptive immune responses, not only in normal but also in pathological conditions. Compelling evidences implicate leptin in oral biology. The presence of leptin has been reported both in healthy and inflamed gingival tissues, in gingival crevicular fluid and in human chronic periapical lesions. Elevated serum leptin concentration has been associated with increased chronic periodontitis. Recently, the first evidence has emerged that leptin has effects on dental pulp stem cells, acting as an important modulator of pulpal mesenchymal stem cell differentiation being synthesized and secreted *in vitro* by human pulp fibroblasts and is expressed in ameloblasts, odontoblasts, dental papilla cells and stratum intermedium cells in tooth germs of human mandibular third molars at the late bell stage, and in rat dental pulp. Moreover, it has been reported the up-regulation of leptin and its receptor (LEPR) expression in inflamed human dental pulp, odontoblasts express LEPR and leptin enhances the expression of DSPP in human dental pulp. As well human periapical granulomas express leptin and LEPR and only macrophages showed expression of LEPR. The leptin and LEPR level found in the pulp was low compared to that found in periapical granulomas suggesting that the expression of these proteins correlated with the grade of tissue inflammation. These findings point to a role for leptin mediating the response of the host to the infectious and inflammatory stimuli and it can be suggested that leptin can play a functional role in oral pathophysiology, acting as an important modulator of inflammatory and immune responses.

**Key Learning Points:**

- Leptin and leptin receptor are expressed in oral tissues.
- The expression of these proteins correlate with the grade of tissue inflammation.
- LEPR is expressed by odontoblasts.
- Leptin enhances DSPP expression level.

**Time:** 15:22 - 15:42

**Epigenetic modulation of dental pulp stem cells using pharmacological inhibitors: Endodontic implications**

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**Aim** The use of stem cells within regenerative endodontic regimens remains the subject of intense research activity. This oral presentation aims to briefly describe the importance of stem cell DNA epigenetic modification on cell behaviour, focusing on the role of Histone-deacetylase-inhibitors

(HDACi) in altering dental pulp stem cell (DPSC) phenotype. The clinical potential for therapeutic application of HDACi (and other inhibitors) during endodontic treatments will also be discussed.

**Summary:** DPSCs offer significant potential for use in regenerative endodontics and therefore, identifying molecular and cellular regulators that control stem cell fate is critical to devising novel treatment strategies. Stem cell lineage commitment and differentiation are regulated by an intricate range of host and environmental factors of which epigenetic influence is considered key. Epigenetic modification of DNA and DNA-associated histone proteins has been demonstrated to control cell phenotype and regulate the renewal and pluripotency of stem cell populations. The activities of the nuclear enzymes histone deacetylases are increasingly recognized as potential targets for pharmacological induction of stem cell differentiation and de-differentiation. Depending on cell maturity and niche *in vitro*, low concentration HDACi application can promote de-differentiation of stem cell populations and conversely increase differentiation and accelerate mineralisation in DPSC containing cell populations. Notably studies *in vivo* have also shown that HDACi can induce an increase in stem cell marker expression during organ regeneration. Interestingly, epigenetic modifiers have also been demonstrated to dramatically increase the reprogramming of somatic cells to induced pluripotent stem cells (iPSCs) for use in regenerative therapeutic procedures.

**Key Learning Points:**

- Epigenetic control of DPSC fate and differentiation is key
- Histone-deacetylase (HDAC) function plays an essential role in the process
- Cell-based regenerative endodontic techniques may require cell expansion *in vitro* and maintenance of self-renewal capacity
- Epigenetically modifiers, including HDACi, may facilitate the above process
- Opportunities exist for HDACi to improve the efficiency of adult/post-natal cell reprogramming to iPSCs
- Within vital pulp treatment, a topically-applied low dose HDACi (or other pharmacological inhibitor) could promote reparative responses
- New generation dental restoratives could harness epigenetic modifier properties which target pulpal repair processes

**Time:** 15:44 - 16:04

**Complexity and extension of odontoblast processes in intact and damaged rodent dentine**

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**Aim** To compare odontoblast morphology and physiology in intact and damaged regions of rodent molar teeth using contemporary immunohistochemical techniques and the examination of ground tissue specimens. This work provides novel insights on the formative and maintenance roles of odontoblasts, and may be relevant to the understanding of normal physiological processes and the optimisation of vital pulp therapies.

**Summary:** 10 lower 1st molars were carefully dissected from freshly culled Wistar rats (3 months age). Decalcified sections (50 in each group) were stained with antibodies to cyto-skeletal proteins: vimentin (vim),  $\alpha$ -tubulin (tub) and  $\alpha$ -actin, and cellular homeostatic elements: sodium potassium ATPase (NaK-ATPase) and sodium hydrogen exchanger (nhe-1). Areas of interest (mesial cusp) with intact dentine surfaces (lateral walls and occlusal fissures), and opened dentine surfaces (worn occlusal areas) were examined by fluorescence microscopy. Ground sections were prepared from another 6 lower 1st molars and examined by light microscopy. Immunoreactivity (IR) to vim, actin and NaK-ATPase was observed along odontoblast processes (OPs) approximately half of the distance to the DEJ. IR to tub and nhe-1 was expressed along the entire length of the OPs until the DEJ. In areas associated with progressive occlusal wear, the dentinal tubules appeared empty throughout most of their length. The odontoblasts beneath regions with intact enamel appeared as a single cell

layer which was easily distinguished from the sub-odontoblast cells. In regions with tubules opened by tooth wear, the odontoblast and sub-odontoblast cells presented in stratified or pseudo-stratified arrangement. The differences in OPs extension and pulp cellular arrangement between worn and unworn tooth areas could reflect the role of OPs in detecting the integrity of the tooth surface, and transmitting information to the pulp.

**Key Learning Points:**

- Odontoblast processes extend full length in dentine with healthy DEJ.
- Odontoblast processes response to damaging in DEJ by retreating toward the inner dentine.
- Odontoblast processes could play role in sensing and conveying information to pulp cells.