ESE 2019

VIENNA
11 - 14 SEPTEMBER

Vienna calling

experience the sound of Endodontology

Oral Presentations on freely chosen subjects

19th Biennial ESE Congress

11-14 September 2019

Austria Center Vienna

Contents

Thursday

Hall 6

Tooth and canal anatomy

9:00

Variations of the morphology of mandibular first molars

*Mercan MO

Department of Endodontics, Gaziantep University, Gaziantep, Turkey

Aim Untreated missed canals leads to the failure of root canal treatment. Particularly, lower first molars have complex root canal morphology and several variations that may result in unsuccessful treatments. Finding all canals, especially mid-mesial canals provides better disinfection of root canal systems. Studies dealing with possible variations related to root canal morphology provide important information during routine clinical practice. Thus, the purpose of the present study is to determine the prevalence of different canal morphologies including number of canals exceeding 3 canals, mid-mesial canal and the presence of different apex at the end of mid-mesial canals by using dental operating loop at a magnification of x4.

Summary The present study included 100 patients scheduled for primary root canal treatment in their lower first molars. Following local anesthesia and isolation, access cavities were prepared. The number of canal orifices was detected with dental operating loupes with a magnification of x4. The location and presence of either a separate apex or combining canals were confirmed using digital periapical radiographs. Then, data including the number of canals, their location, the prevalence of mid-mesial canals and their separate apices was recorded. A Miller Explorer was also used for better detection of all canal orifices. All evaluated teeth represented 46% had 3 canals, 46% 4 canals and 8% had 5 canals. The prevalence of mid-mesial canals was 11%. Among them, 28% ended with a different foramen while 72% percent combined with one of mesial canals (60% to the buccal canals and 40% to

the lingual canal). Fifty percent of teeth had 2 separate distal canals. Among them, 76% ended with a different foramen.

Key Learning Points

• Mandibular molars have great morphological variations of the root canal system.

• Awareness of clinicians on different canal morphologies may provide better treatment outcomes.

• More than a half of mandibular first molars had 3 or more canals.

• Detecting mid-mesial canals avoids inadequate disinfection.

• Mid-mesial canals rarely have separate faramina.

9:18

Three dimensional modeling and measurements of root canal anatomy in second primary mandibular molars: a micro CT study

*El Hachem C[1], Nehme W[2], Abou Chedid JC[1]

[1]Pediatric Dentistry, [2]Department of Endodontics, Saint Joseph University, Beirut, Lebanon

Aim To establish a comprehensive specification and detailed measurements of the root canal anatomy of second primary mandibular molars using micro CT.

Summary Ten second primary mandibular molars were selected. Micro CT imaging was performed to observe the roots and canals according to specific criteria. The Vertucci canal configuration, the presence of lateral canals and their location, the presence of an isthmus and its location, were first observed. Then, the length of the canals, their diameter in the mesio-distal and bucco-lingual direction, the thickness of dentine and the direction of the minimal dentine thickness were measured in the coronal, middle and apical thirds. The mean working length was not significantly different between the canals ($p = 0.710$). The bucco-lingual diameter was significantly larger when the tooth had a single distal canal at the coronal ($p < 0.001$), middle ($p < 0.001$) and apical ($p = 0.012$) levels. The

root dentine thickness on the distal wall of mesial roots and the mesial wall of distal roots were reduced respectively from the coronal to the apical thirds.

Key Learning Points

• The results obtained clearly show a complex, sometimes unpredictable anatomy with dangerous areas where dentine is extremely thin.

• The common presence of anastomoses, large bands of isthmus and lateral canals at all levels suggests the need for the development of instruments specific for pulpectomies in primary teeth.

9:36

CBCT and microscope examination in the diagnosis of anatomical extremes such as root canal obliterations or resorptive processes

*Kiefner P, Gliga A

[1]Private Practice limited to Endodontics and Dental Traumatology, Stuttgart, Germany, [2]Private Dental Office (Endodontics), Bucharest, Romania

Aim This presentation aims to show an overview of the possibilities either pre-, intra- or post-operative of the CBCT and dental-microscope examination in cases with extreme anatomy such as root canal obliterations and root resorptions. The audience will learn to understand the benefits of the pre-operative examination in cases with obliterated root canals or cases with root resorptions in order to make the best treatment decision based on a very detailed diagnostic imaging and planning the technical details for the endodontic treatment to follow. The audience will also be able to understand the benefits of using the dental microscope for the location of narrow canal orifices or controlling the disinfection and filling procedures during root canal treatment in cases with resorptive processes. By showing post-operative recall images this presentation aims to show the possibilities of modern endodontic treatment when CBCT and microscope examination are used to control difficult cases with extreme anatomy such as root canal obliteration or resorptive changes.

Summary In daily endodontic practice anatomical changes such as root canal narrowing and obliteration or extreme widening in cases with root resorptions can reduce the treatment outcome and lead to the tooth loss. Pre-operative diagnostic use of the CBCT examination and intra-operative microscope-aided magnification will help endodontists to control such complicated cases. Using video and photographic material, cases will be shown and decision making will be explained in order to give the audience the information needed to understand the problems and risks of such cases. Diagnostic, intra-operative and recall aspects will be extensively discussed, showing the problems that can occur during treatment of such complex cases.

Key Learning Points

• the pre-operative diagnostic use of the CBCT in order to localize obliterated root canals or identify the position and exact extent of resorptive processes.

• the microscope-aided process to identify the canal entrance in cases with extremely narrow root canals.

• the use of the microscope during the shaping, irrigation and filling procedures in cases with either narrow root canals or such with resorptive processes.

• the post-operative use of the CBCT in order to control the long-term success of the endodontic therapy especially in cases with root resorptions.

9:54

WITHDRAWN

10:12

Evaluation of root canal morphology of mandibular first and second premolars using cone-beam computed tomography in a Turkish population

*Ezentas N, Uzunoglu-Ozyurek E

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

Aim Root canal morphology of mandibular premolars present high variability and their endodontic treatment is considered to be one of the most difficult. The aim of this retrospective study was to investigate the number of roots and root canals of permanent mandibular first and second premolars in a patient population that attended to the University Hospital between 1st January-31st March 2018 using cone-beam computed tomography.

Summary The sample for this retrospective study included 418 cone-beam computed tomography (CBCT) images of 276 females and 142 males, representing 639 mandibular first and 592 second premolars. The percentage of single root was 94.99% and 98.99% for mandibular first and second premolars, respectively. The remaining teeth had two roots. Percentage of two canals in first premolars was 21.27% and 13.88% for males and females, respectively. Furthermore, the percentage of second premolars with two canals was 3.32% and 3.94% for males and females, respectively. When two-root canalled premolars were evaluated, 70.37% of males and 51.22% of females revealed symmetric root canal morphology for their premolars. Eighty-three percent of single-rooted first premolars had 2 apical foramina, while this value was 87.50% for second premolars. Average ages of females and males with at least one two-root canalled premolars were 36.6 years (n=42; 16-73) and 40.4 years (n=28, 14-72), respectively.

Key Learning Points

• There were differences in the morphology of roots and root canals between mandibular first and second premolars in this Turkish population.

• More attention should be given to the detection of additional canals during root canal treatment of mandibular premolars especially in male patients.

• The symmetric morphology of mandibular premolars may guide practitioners during root canal treatment.

11:00

Maxillary second molars with two distinct palatal roots and canals: a case series and literature review

*Zoya A

Conservative Dentistry & Endodontics, Dr Ziauddin Ahmed Dental College & Hospital, Aligarh Muslim University, Aligarh, India

Aim The primary aim of this report is to present a series of cases with two distinct palatal roots and canals in maxillary second molars. The secondary aim is to review extensively the number of palatal roots and canals in maxillary second molars among different ethnicities.

Summary The knowledge of common tooth morphology and root canal anatomy and its frequent variations is a basic prerequisite for successful endodontic therapy. Aberrations in root canal anatomy are commonly occurring phenomena. Therefore, the clinicians should always anticipate the occurrence of these variations and employ all the available tools to diagnose and manage them. Careful assessment of multiangle radiographs or preoperative cone beam computed tomography to locate and identify possible extra roots or canals are advised. Maxillary second molars most often have a single palatal root with a single palatal canal. The incidence of second palatal root in the maxillary second molar is very rare.

Three cases are presented in this report describing the endodontic management of four-rooted maxillary second molars with two distinct palatal roots and canals. Clinical examination and radiographs revealed the presence of two palatal roots during the endodontic procedure. A MEDLINE database search was done to identify studies on the palatal canal morphology of second molars. The overall prevalence of variation in the number of palatal roots and canal of second molars was less than 1%. This case series showed that even experienced endodontic clinicians can miss two palatal canals if they are not aware of or ignore the hidden signs for these anatomic variations.

Key Learning Points

• Knowledge of likely aberrations of the internal anatomy of teeth and proper examination of preoperative multiangle radiographs is imperative for the successful outcome of endodontic therapy.

• Modification of the access cavity outline is desirable for better during the search for additional canals.

• The traditional assumption of exclusively single-canal anatomy in palatal canals of maxillary molars needs to be changed, even though it is the most prevalent anatomy.

11:18

Three-dimensional non-destructive pulp-tissue visualization through micro-computed tomography imaging

*Belladonna FG[1], Cavalcante DM[1], Carvalho MS[1], Silva EJNL[1], Zehnder M[2], De-Deus G[1]

[1]Department of Endodontics, Fluminense Federal University, Niterói, Brazil, [2]Department of Preventive Dentistry, University of Zurich, Zurich, Switzerland

Aim The widespread use of non-destructive micro-computed tomography (micro-CT) in Endodontics has raised our ability to comprehensively detail and quantify several parameters related to root canal preparation. However, the utility of micro-CT imaging technology for gaining similar insights into the anatomy of pulp tissue has yet to be fully realized due to the naturally low X-ray absorption of non-mineralized tissues. Thus, the current oral presentation aims to demonstrate an iodine-enhanced staining protocol that allows the visualization of pulp tissue in teeth under micro-CT imaging.

Summary Maxillary and mandibular premolars and molars with vital pulps, were extracted for orthodontic reasons and stored in a formol solution to preserve their pulp tissue. After 2 months, the specimens were scanned in a micro-CT device and then immersed for 1 week in an iodine-based contrast agent. After a period of time, the sample were scanned again and all the acquired images were reconstructed. Some specimens were also prepared using a nickel-titanium reciprocating system with 5.25% NaOCl irrigation and further scanned. All specimens were then subjected to histological

processing with haematoxylin and eosin staining. The cross-section images of the teeth scanned after the immersion in an iodine-base contrast agent revealed the presence of pulp tissue, which was not visualized in the scans after extraction. Histological analysis confirmed the presence of pulp tissue inside those teeth. In root canal prepared teeth, a correlation between remaining pulp tissue was observed between micro-CT images and the histological ones. Within these results, it can be concluded that this iodine-based solution allowed the visualization of pulp tissue on micro-CT images.

Key Learning Points

• The present study provides a new insight regarding the visualization of pulp tissue of extracted teeth.

• Using an iodine-based contrast agent, it is possible to visualize the pulp tissue of extracted teeth and quantify several parameters of root canal preparation.

Microbiology

11:36

Endodontic infection-mediated systemic interactions pose a global cardiometabolic risk

*Niazi SA[1], Bakhsh A[1], Moyes D[2], Mannocci F[1]

[1]Department of Endodontics, [2]Mucosal and Salivary Division, King's College London, London, UK

Aim To characterize the microbiome in endodontic infections and identify the profile of bacteremia and inflammatory biomarkers before and after root canal treatment, and compare those with healthy individuals in order to elucidate the links between endodontic disease and treatment with systemic health.

Summary The microbiome of refractory endodontic lesions from patients grouped in the CVD (n=15) after screening using National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) criteria, were investigated by targeted partial 16S rRNA gene sequence analysis using the MiSeq Next generation sequencing (NGS) platform (http://www.homd.org/). A neighbour-joining tree was constructed using MEGA (version 6) program (http://www.megasoftware.net/). *Propionibacterium*

acnes was the most prevalent taxon recovered from refractory endodontics infections. Bacteremia in pre- and post-endodontic treatment blood samples was investigated using culture-based 16SrRNA gene sequence analysis and also targeted partial 16S rRNA gene sequencing using MiSeq Next generation sequencing (NGS) platform. Five out of 15 post-endodontic treatment blood cultures were positive for bacteremia. Good quality/yield of DNA extracted was analysed using NGS for targeted partial 16S rRNA gene. The cytokines, chemokines and inflammatory mediators in pre- and post-endodontic treatment sera samples [including biomarkers associated with endodontic infection and CVD (e.g. high sensitivity-C Reactive Protein, Pentraxin 3 etc)] were investigated using multiplex microbead assays and compared with the healthy controls (n=15).

Key Learning Points

• The endodontic microbiome is a complex biofilm community and *P. acnes* is a prevalent taxon of this community.

• The endodontic microbiome can be source for translocation of microbes into the systemic environment during root canal treatment, which can result in metastatic inflammation leading to CVD.

• There is association of systemic inflammatory burden related to endodontic disease and its treatment with the risk of CVD.

11:54

Evaluation of *S. mutans* and *C. albicans* adherence on various composite materials when exposed to bleaching agents

*Eldeniz AU[1], Akbulut MB[2], Guneser MB[3]

[1]Department of Endodontics, Selcuk University, Konya, [2]Department of Endodontics, Necmettin Erbakan University, Konya, [2]Department of Endodontics, Bezm-i Alem University, Istanbul, Turkey

Aim The restorative materials which harbour a biofilm with high levels of *S. mutans* can accelerate the occurrence of dental caries. Yeast cells also have remarkable potential to adhere to host surfaces, such

as teeth or mucosa, and to artificial, non-biological surfaces, such as restorative dental materials. The purpose of this study was to evaluate the effect of *S. mutans* and C*. albicans* adherence on various composites and a new nano-ceramic restorative when exposed to a home-bleaching agent.

Summary For each group, forty eight specimens of the composite materials Herculite Classic (Kerr, Italy) XRV Herculite Enamel (Kerr, Italy), Ceram-X (nano ceramic restorative, Dentsply DeTrey, Konstanz Germany) were prepared (diameter 4 mm, height 2mm) polished and divided into 2 subgroups (n=24) and a home bleaching agent applied (White&Brite, 3M ESPE, USA) for seven times for 2 hours to one group. Surface roughness was assessed by atomic force microscopy. Each group was then divided into 2 subgroups (n=12) according to the microbial suspensions used *S. mutans* and *C. albicans* (O.D.600=600). The specimens were incubated at 37°C with *S. mutans* or *C. albicans* for 24 hours. *C. albicans* adhered to bleached and non-bleached materials significantly more than *S. mutans*. One-way ANOVA and Tukey HSD tests revealed highest *C. albicans* adherence on bleached and unbleached Herculite Classic group (P<0.05). Highest S*. mutans* adherence was detected in bleached XRV Herculite enamel group (P<0.05). More candidal cells adhered to Ceram.X than *S. mutans*.

Key Learning Points

• Since adhesion is an essential prerequisite in colonization and infection, the role of adhesion in the pathogenesis of several diseases by *C. albicans* and other microorganisms is widely acknowledged.

• Therefore, using dental materials that might inhibit plaque formation and adhesion of oral microorganisms to restorative materials is increasing.

• Some treatment procedures; polishing and bleaching agents also have effect on the surface of the materials that might influence their surface and increase bacterial adherence.

• *Candida albicans* cells adhered to the various material surfaces more than *S. mutans* cells while, *S. mutans* cells adhered to Herculite XRV more than other tested materials after bleaching.

WITHDRAWN

Imaging

2:30

Invasive Cervical Resporption (ICR), the use of 3D technology in diagnosis and treatment planning

*Mashyakhy M[1], Shibani M[2], Gambarini G[2]

[1]Dental School, College of Dentistry, Jazan University, Jazan, Saudi Arabia, [2]Odontostomatological Sciences and Maxillo Faccial, University of Rome "La Sapienza", Rome, Italy

Aim The role of Micro-computed tomography (Micro CT) and Cone-beam CT (CBCT) in understanding the extension of the lesion which helps to predictably determine the prognosis of the treatment.

Summary ICR is a relatively uncommon form of external root resorption. Clinical, radiologic and pathologic features of ICR provide the basis for a clinical classification, which is of use both in treatment planning and for comparative clinical research (Heithersay, 2004).

Treatment, where indicated, should aim at the inactivation of all resorbing tissue and the reconstitution of the resorptive defect either by the placement of suitable restorative material or by the use of biological systems (Heithersay 2004). Despite the lack of knowledge in finding the exact aetiological factors of ICR, detecting the extension of the lesion and treatment is vital. Extension of the lesion, ability of the clinician to approach it and treat it helps to determine the prognosis. The lesion cannot be accurately detected with periapical radiograph. Micro-CT as an *ex vivo* technology that allows a precise understanding of the way a lesion behaves. While, *in vivo*, advances in diagnostic tools, especially the use of CBCT helps to determine the prognosis of treatment since its accuracy reveals the extension of the lesion. Also, advances in materials and armamentarium help in performing the restorative procedure successfully and predictably.

Key Learning Points

• Understanding the progress of the lesion *ex vivo* using Micro-CT.

• Determine the extensions of the lesion *in vivo* using CBCT.

• Describe and discuss the treatment and prognosis.

2:48

Cleaning efficiency of three endodontic retreatment systems: an innovative CBCT study

*Diemer F, Fisse J, Michetti J, Hamdan R, Georgelin-Gurgel M

Department of Endodontics, Paul Sabatiers University, Toulouse, France

Aim Cleaning the root canal system during endodontic retreatment is a difficult task. The aim of this study is to assess the root canal cleaning of the Protaper Universal Retreatment, D-Race and a prototype system during retreatment.

Summary Fory five roots were chosen, shaped with RevoS® (size 25) and filled using a single cone technique (Gutta-Percha + root canal sealer). The roots were then randomly divided in 3 groups to undergo removal of the root filling material using either the Protaper Universal Retreatment (PUR), D-Race (DR) or prototype systems. CBCT acquisitions of roots were performed. Coronal root slices were imported in CTan software where the dentine, the amount of residual filling material and the canal space were individualized. The images obtained were analysed with ImageJ® software. The endodontic instruments were inspected with a stereomicroscope under x16 magnification. A statistical analysis (ANOVA and PLSD Fischer's test) was undertaken with α=5%.

Statistical analysis shows that the PUR system is more efficient at removing filling materials (7.15% residual material) than DR (15.5%) and the prototype (36.31%). When studying the unfilled roots, proportionally, less remaining filling material was found in the apical third than in the rest of the canals, this may be explained by the fact that the canals were found to more frequently have a round cross-sectional shape in their apical third and hence a larger contact surface between files and tooth meaning better cleaning of the root canal walls. No geometrical deformation of the prototype, D1 and D2 (PUR) and DR1 (DR) files was found after use. However one D3 (PUR) file showed unwinding of the flutes, a DR2 (DR) file had overwound flutes and a second DR2 file broke. Our study showed that PUR

is the most efficient of the three systems that we scrutinized for removing root canal fillings. However no canals were void of filling material.

Key Learning Points

• New CBCT assessment method of the canals and the remnant filling materials volumes.

• Assessment of the Protaper, D-Race and a prototype system's efficiency in retreatment.

• Retreatment systems were all statistically different.

• All three systems correctly cleaned the apical third of the canals.

3:06

Diagnostic accuracy of cone beam computed tomography used for diagnosis of apical periodontitis using histopathology of *ex vivo* human jaws as reference standard

*Kruse C[1], Spin-Neto R[1], Evar Kraft DC[1], Væth M[2], Kirkevang LL[1]

[1]Department of Dentistry and Oral Health, [2]Department of Public Health, Aarhus University, Aarhus, Denmark

Aim To assess the diagnostic accuracy of combined and individual Cone Beam Computed Tomography (CBCT) sectioning planes (sagittal and coronal) used for assessment of apical periodontitis (AP) with histopathology of *ex vivo* human jaws as reference standard.

Summary During recent years, the use of CBCT has increased within endodontics. Compared to periapical radiographs, more periapical lesions are in general detected when CBCT is used, but basic research on the true nature of these lesions is still sparse. Human dentate jaws were collected from bodies donated for science. Based on information from periapical radiographs 223 teeth with 340 roots were selected including all tooth groups, different disease and treatment status. Small field-of-view CBCTs were acquired (5x5cm, isotropic resolution 0.085mm). Three observers assessed the sagittal and coronal CBCT sectioning planes individually using a probability index for the presence of AP. Histopathological examination of the periapical area served as reference standard for the

estimation of diagnostic accuracy. For non-root filled roots, all estimates of diagnostic accuracy; sensitivity (SENS), specificity (SPEC), positive predictive value (PPV), and negative predictive value (NPV) were high. All estimates were lower for root-filled roots. On average, all estimates of diagnostic accuracy for the coronal sectioning plane were equal to or higher compared to those found in the sagittal sectioning plane, but only difference in PPV for non-root filled roots was statistically significant (p=0.016).

Key Learning Points

• The diagnostic accuracy of CBCT used for diagnosis of AP is dependent on the treatment status of the root.

• For non-root filled roots the diagnostic accuracy of CBCT is high and almost all cases of AP can be diagnosed correctly with only a small to moderate risk of over-diagnosis.

• All diagnostic accuracy parameters were lower for root filled roots, hence the diagnosis of AP on root filled roots using CBCT was less accurate.

• Only minor differences in the diagnostic accuracy parameters between the sagittal and coronal sectioning plane were observed.

Education

3:24

Temperature rise on the external root surface during broken instrument removal

*Mahran M[1], Hashem A, Saber S[2]

[1]Department of Endodontics, Magrabi Dental Center, Jeddah, Saudi Arabia, [2]Department of Endodontics, Ainshams University, Cairo, Egypt

Aim To measure the amount of heat generated on the external root surface during broken instrument removel using different types of ultrasonic tips and to measure the amount of remaining dentine following instrumentation .

Summary Sixty extracted human mandibular first molars were used, and 3 mm fragments of size 30 K- files were intentionally separated inside mesio-lingual canals. Teeth were placed in Eppendorf tubes containing alginate to simulate the human body. Two fine thermocouples connected to a digital thermometer were connected to the mesial and distal aspect of the mesial root. The amount of lost dentine thickness was assessed through comparing pre- and post – instrumentation CT scans at 0.5 mm from the separated instrument.

Key Learning Points

• Learn how to use ultrasonic tips to trough dentine around separated instruments.

• Acknowledge the amount of heat generated by ultrasonic activation of tips made from different materials or coatings.

• Learn the most conservative method to remove radicular dentine when managing separated instruments.

3:42

The use of a new generation of Endodontic Simulators to improve preclinical training

Crigny Casadesus A, *Simon SRJ

Paris Dierot University, Paris, France

Aim To show how, by using a step by step approach mixing blocks and dental models made with a new technology of 3D printing, we can improve the pre-clinical training of different level of learners.

Summary Simulation based endodontic education can be defined as any educational activity that utilizes simulation aides to replicate clinical scenarios. For decades, real extracted teeth have been used for endodontic training, considering that working on real organs is the best way to simulate clinical situations to train undergraduate and postgraduate students. Even though new international regulation and ethical restriction render the use of real teeth difficult to be used for labwork training, it appears also that lots of clinical situation cannot be simulated. 3D impression has considerably

improved the quality of endodontic simulators. There are different types of simulators and their cost vary according to the degree of their resemblance to the reality, or 'fidelity'. For years, plastic blocks have been used as a first step for training. But tactile sensation is very far from reality. Nevertheless, the concept of the rectangular transparent block remains interesting. To improve the quality of these simulators, we recently developed new blocks with graduated complexity of anatomies and printed with the same technology that the one used for dental printing. In this presentation, we will discuss the step by step teaching of endodontics using simulators for undergraduate, postgraduate students but also for continued education in endodontics. We will present new blocks and recent dental simulators designed and produced by a French Company (Naodent-France) that developed and patented a new technology to make simulators with very narrow canals (close to 0.06 mm in diameter).

Key Learning Points

• New 3D models improve the quality of pre clinical simualtion in endodontics.

• Using several types of models allow the organisation of a progessive learning curve.

4:00

Methodological quality of systematic reviews and meta-analyses in Endodontics

*Nagendrababu V, Pulikkotil SJ, Sultan OS

Kuala lumpur, Malaysia

Aim The objective of the current review was to evaluate the methodological quality of systematic reviews (SR) and Meta-analyses (MA) in Endodontics.

Summary A literature search was performed in two electronic databases to identify relevant SRs between the period of January 2000 and June 2017. SRs and MAs assessing interventional studies with a minimum of two therapeutic strategies in Endodontics were considered eligible for the review. The study selection process and date extraction was performed by two reviewers independently.

Methodological quality of the included reviews was assessed using the A Measurement Tool to Assess Systematic Reviews. The inter-observer reliability was calculated using Cohen's kappa. Categorical variables were presented using descriptive statistics, frequency analysis and percentage analysis while means and standard deviation were used for continuous variables. Multivariate analysis was done using Kruskal Wallis tests followed by post-hoc analysis as appropriate. A total of 30 reviews satisfied the eligible criteria and were included in the review process. Studies were classified based on the interquartile range (IQR) of the quality scores using the AMSTAR tool. Eight reviews were identified as high (score range 10-11) quality studies, while 12 studies as moderate (score range 6-9) and 10 as low (score range 1-5) quality. The overall mean AMSTAR score of included reviews was 6.8 ± 2.86. The seven reviews published in Cochrane database achieved the maximum scores. The item related to scientific quality of studies used in the conclusion was adhered by less than 40 % of studies. The mean number of authors per article was found to be 4.4±1.54, however, no significant association was observed among the number of authors and country to the quality of the reviews. SRs in Endodontics showed variability in methodological quality. Considering the existing deficiencies in SRs, authors of future SRs need to consider these issues to achieve acceptable quality of SRs.

Key Learning Points

• The overall quality of included reviews was found to be moderate.

• This review identifies the strengths and weaknesses in published SRs in Endodontics.

4:48

Behavioral analysis to evaluate the students' search strategies for a diagnosis in Endodontics

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

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

Aim In part, endodontic treatment failure could be explained by an inaccurate diagnosis and thus, an inadequate treatment procedure. The semiological approach, based on the search for signs and

symptoms for diagnosing a disease, constitutes the framework of the physician's (semiological) approach, but it is not commonly taught in Dentistry, despite European undergraduate curriculum guidelines. Teaching students to apply the pathways of clinical reasoning during the diagnosis of pulpal diseases is challenging as it could further help practitioners to associate the correct procedures to each pulpal disease. This work analyzed the clinical reasoning of students who were faced with eight cases of pulpal disease.

Summary A software was developed to train students to search for diagnosis criteria in virtual patients who may have been potentially suffering from a pulpal disease (http://pathopulp.odontologie.uca.fr). After a conventional 2-hour lecture on the diagnosis of pulpal diseases, sixty-five 4th year students logged onto the web site as often as desired for one month, using prelisted questions for diagnosing 8 cases of pulpal disease. Four lecturers in endodontics also followed suit in order to provide Gold Standard data. The data were extracted and provided for each participant and disease: i) the chronological order of the questions asked; ii) the success in finding the disease. Each student undertook on average 108 ± 90.7 diagnosis search sessions. For each disease, experts and students used the same diagnosis criteria. However, students used a great deal of diagnosis pathways (ex: asymptomatic apical periodontitis 266 differing approaches in 480 attempts). Failure rates varied between 5.2% for healthy vital teeth to 19% for asymptomatic apical periodontitis. In more than 50% of failed cases, students either had not applied enough criteria to reject all differential diagnoses or had used a large number of criteria, implying vagrancy in their strategies. Behavioral analysis could allow for the identification of students who did not use a rationalized diagnosis approach, assisting the improvement of diagnoses success rates and preventing inadequate treatments.

Key Learning Points

• Students and experts used the same diagnosis criteria for pulpal diseases but did not use a rationalized clinical diagnosis strategy.

5:06

WITHDRAWN

5:24

Design and evaluation of a mobile application of dentoalveolar trauma, pilot study

*Toloza R, Benadof D, Correa V, Cárdenas S, Jamett J, Flores V, Caballero R, Herrera C

School of Dentistry, Andrés Bello University, Santiago, Chile

Aim To design and evaluate a mobile application that provides information to teachers in cases of dentoalveolar trauma in children at schools and preschools.

Summary In this study the Dental Safe application was created. Its effectiveness was evaluated through focus groups with teachers from school and preschool institutions, in order to know their opinion about the design, content and use of the application in daily life obtaining satisfactory answers highlighting the delivery of a map with the health services close to the user's location. Teachers suggested to improve the lexicon and the writing of its written contents to generate a greater understanding and highlighting that the App is an effective means to deliver information relevant in the immediate treatment of dentoalveolar trauma. Currently the application is operational and available for download on iOS and Android devices.

Key Learning Points

• The App is relevant because it allows quick and effective access to the current society that is developed in a digital and technological environment.

• Dental Safe is a technological innovation at the forefront of modern dentistry.

• Dental Safe allows timely delivery of information to teachers in the emergency care of dentoalveolar trauma, which can bring benefits in the treatment prognosis.

5:42

Evaluation of the knowledge of final-year dental students on the use of antibiotics in Endodontics in Turkey

*Arican Öztürk B, Çiftçioğlu E, Işık V, Karagöz-Küçükay I

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

Aim To assess the knowledge of final-year dental students on the systemic and prophylactic use of antibiotics in Endodontics in Turkey.

Summary The study was conducted at the Dentistry Faculties of 20 Universities, 17 public and 3 private, across seven regions of Turkey. A study invitation letter and the ethics committee approval were sent to the Universities including the questionnaire concerning when to use systemic antibiotics in endodontic treatments such as symptomatic irreversible pulpitis (SIP), pulp necrosis (PN), symptomatic apical periodontitis (SAP), acute apical abscess with diffuse (AAA-diffuse) or localized fluctuant swellings (AAA-localized), chronic apical abscess with (CAA-sinus tract) or without sinus tract (CAA-no sinus tract), retreatment, inadequate local anesthesia, patient requests as well as in prophylaxis for medically compromised patients. Data were analysed using chi-square test significance set at $p<0.05$. Overall, 1113 final-year dental students, males 38.4% and females 61.96%, participated in the study. Respondents' significant choice was not to administer antibiotics in endodontic treatments of SIP, PN, SAP, CAA with or without sinus tract, retreatment, inadequate local anaesthesia and patient requests ($p>0.05$). In AAA-diffuse cases, choice of antibiotic administration was statistically higher ($p<0.05$) while in AAA-localized cases, the ratio of antibiotic administration versus non-administration was similar. Amoxicillin was found to be the first-choice antibiotic in patients without medical allergies, whereas in allergic patients the first-choice was clindamicin. In prophylaxis for medically compromised patients, the choice of antibiotic administration was found to be high statistically ($p<0.05$). Final-year dental students attending Turkish Universities have fundamental knowledge on the principles of antibiotic administration in Endodontics. Hovewer, for the dental

students to reach the desired level of knowledge and awareness on indications and contra-indications of antibiotic administration in Endodontics, the current Antibiotic Administration Guidelines and similar clinical-scenarios should be emphasized especially in the clinical years of the curriculum.

Key Learning Points

• Do final-year dental students attending Turkish Universities have fundamental knowledge on the principles of antibiotic administration in Endodontics?

Hall 7

Endodontic surgery

9:00

Retrospective evaluation of intentional reimplantation cases

*Güllü GS

Department of Endodontics, Faculty of Denitstry, Gaziantep Universty, Gaziantep/ Şehitkamil, Turkey

Aim Intentional replantation is a treatment option with a high success rate when applied with the appropriate technique, which has been known for many years. In cases where there are anatomical limitations leading to the failure of endodontic treatment and endodontic surgery is not preferable, intentional reimplantation can be performed. In the present study, we evaluated the success rate of 12 intentional reimplantation cases by using radiographic and clinical records.

Summary All radiographic and clinical records of 12 intentional reimplantation (single or multi rooted) cases were evaluated. For radiographic evaluation, pre and post treatment periapical images were examined. For clinical evaluation, previous anamnesis forms were used. Included cases had both postoperative radiographs and clinical records belonging to follow-up time intervals ranging between 1 year – 2 years. The relevant teeth were indicated for extraction for various reasons including; apical blockage, perforation, persistent periapical infection and complex root canal anatomy. Furthermore, one of the cases was used as an abutment of a bridge. It was observed that all cases were root-end

resected and retrograde filled with MTA or Resin Modified Glass Ionomer cement. Following reimplantation, all cases had been periodically recalled except one patient who did not obey recall visits. According to the results of the present study, only 1 of the followed patients failed while the other 10 did not represent and sign of failure either radiographically or clinically.

Key Learning Points

• Intentional reimplantation is a novel approach for the survival of hopeless teeth.

• It is necessary for the clinician to learn evidence-based approach for successful cases.

• Extra-oral time should not exceed 15 minutes and moisture working media is required for long-term success of intentional reimplantation.

• It can be applied to both anterior and posterior teeth.

• Reimplanted teeth may further be used as abutments for bridges.

9:18

Intentional Replantation, a new light?

*Freitas VN[1], Caetano L[2], Santiago F[3], Fernandes V[4], Garcez J[5]

[1]Department of Conservative Dentistry, IUCS-CESPU, Guimaraes, [2]Department of Conservative Dentistry, IUCS-CESPU, Porto, [3]Department of Conservative Dentistry, IUCS-CESPU Viseu, [4]Department of Conservative Dentistry, IUCS-CESPU, Braga, [5]Department of Restorative Dentistry, IUCS-CESPU, Porto, Portugal

Aim To inform, explore and emphasize an option not very often selected by endodontists as a valid treatment options, within its limitations and indications.

Summary Intentional Replantation is a surgical procedure that has often been regarded as the last treatment option. Although it may seem less preferred than implant and endodontic retreatment, the last decades brought increasing interest in IR with biomaterials, including root-end biomaterials and periodontal regeneration techniques. Recent studies have shown consistent success rates as high as

88% to 95%. Regarding this data, intentional replantation may now be considered a more commonly accepted treatment modality. In endodontics, intentional replantation consists of the atraumatic extraction of the offending tooth, resection, preparation, filling and reinsertion of the extracted tooth.

Key Learning Points

• When considering this treatment option one should consider: Patient factors and physical limitations, endodontic and anatomic tooth factors and operator factors.

• Careful extraction to avoid fractures and minimize the damage of the periodontal ligament (this step has been considered by some as the most technique-sensitive portion of the procedure).

• Examination of fractures, additional canal or POE, isthmi and any aditional anatomic structures that should require attention by the operator.

• Root resection made usually by high-speed handpiece of at least 3 mm which ensures elimination of 93% of lateral canals and 98% of apical ramifications.

• Granulomatous tissue, when present should be carefully curetted or removed in the same step of the root resection.

• Retro-preparation of at least 3 mm of depth regarding the natural anatomic outline of the root

• Different materials will be discussed regarding root-end fillings.

• Tooth replacement technique and different methods to approach and prepare the socket of the extracted tooth.

• Splinting – A controversial aspect of the technique.

• Time limits for extraoral time.

9:36

Endodontic microsurgery updated

*Al Omari TMNT

Department of Conservative Dentistry, Jordan University of Science and Technology, Irbid, Jordan

Aim To explain the difference of microsurgery from oral surgery and to give the clinician a guideline of when to consider microsurgery as a treatment modality in their practice and when to do Retreatment. To shed light on how to perform microsurgery and when to refer cases for endodontic microsurgery and to who.

Summary In the past few years, Endodontic Microsurgery has gained wide interest as a solution for failed endodontic treatment. Conventional oral surgery has a low success rate as they look to failed endodontic treatment from a surgical point of view of only removing the lesion, however, endodontic microsurgery is a retrograde endodontic treatment for failed cases in which we treat the cause of failure rather than enucleating the lesion, this insight will increase the success rate of microsurgery tremendously up to 90 %.

Key Learning Points

• Explain the difference of microsurgery from oral surgery.

• Give the clinician a guideline of when to consider microsurgery as a treatment modality.

• Focus on treating the cause of failure rather than enucleating the lesion.

• Give an overview of how to perform endodontic microsurgery.

9:54

Breaking limits in Endodotic microsurgery

*Polovinshchykov DR

Department of Endodontics, VMDS, Vinnitza, Ukraine

Aim Endodontic microsurgery has gained popularity over time since its introduction to Endodontics. 3D imaging and the advancements in dental materials, techniques, and surgical micro-endodontics has a higher degree of success and greater predictable outcomes. More and more clinicians utilize microsurgery in their routine practices, however, case selection, the benefits and the disadvantages

of using this technology are still in discussion among endodontists. This presentation will provide an understanding and the possibilities of microsurgery.

Summary Discuss the surgical procedures of microsurgery. Explain some causes of failure of tooth endodontic microsurgery. Describe the prognostic factors of endodontic microsurgery.

Key Learning Points

• Why the team uses the microsurgery in everyday practice.

• How to perform all aspects of endodontic microsurgery procedures using the microscope.

• Diagnosis / treatment planning.

• Management of difficult cases.

10:12

3D-guided endodontic micro-surgery

*Gaffuri SG[1], Salgarello S, Tonini R, D'Ambrogio R, Mazzoleni F, Pasquariello F, Boschi G, Tagliabue R

Department of Medical and Surgery Specialties, Radiological Sciences and Public Health, Dental School, University of Brescia, Brescia (BS), Italy

Aim To scientifically evaluate the applicability of guided surgery (software assisted) in the therapeutic field of micro-surgical endodontics. In particular, we wanted to verify mathematically as well as clinically both linear and angular precision of software-guided virtual designs of apical resections, after execution of guided osteotomies through a template provided by the virtual technique itself.

Summary We selected and fixed a human hemimandibles with soft tissues and intact teeth from 4.2 to 4.7 housed in their own alveoli. A preoperative CBCT and a silicone impression were taken. The plaster model obtained was scanned to generate an STL file. It was mated with the DICOM files from CBCT until a defined overlap. Through the same software 6 virtual apical resections of the elements 4.3, 4.4, 4.5, 4.6 (mesial and distal root) and 4.7 (confluent mesial and distal root) have been made through virtual cylinder guides which represent the future real guide for the drills (bushings).

Afterwards, a dental and bone support surgical template has been constructed, with steel bushings able to drive a coring cutter inside the mandibular bone, first passing through the cortical and medullary portion (where present) and then the dental tissue, until reaching the predefined horizontal depth. The length of the bushings was fixed to 5 mm to limit possibility of deviation and their diameter varied between 4 and 6 mm depending on the apical anatomy and interradicular bone tissue. A postoperative CBCT was performed. By 3D overlapping and subtraction of the soft and skeletal structures, data before and after the micro-surgical endodontics were elaborated: the linear discrepancy coefficient did not exceed one millimetre (except for element 4.5) and the three-dimensional discrepancy coefficient was between 4° and 6° (except for elements 4.4 and 4.5). Teeth have been extracted and analyzed, as well as cored plugs and contained apices, in order to a visual verify of apical yields. Neo-formed root canal apices resulted always centered within the root, essential factor for the success in micro-surgical endodontic therapy.

Key Learning Points

• Steps and parameters to design a template for guided osteotomy and root resection.

• Steps to achieve a 3D-guided endodontic micro-surgery

11:00

Apical surgery for lower molars : The bone window approach

*Mallet JP

Department of Endodontics, Toulouse University, Paris, France

Aim Endodontic apical surgery may be the solution to remove an apical lesion and treat the endodontic cause of the infection, especially if the lesion is a cyst or if the prosthetic restoration is recent or the retreatment too destructive for a good prognosis. Howecver, on lower molars the access may be difficult or very invasive with a thick mandibular bone (external oblique line)

Summary The bone window technic was traditionally performed by drilling a series of holes with a thin bur in order to prepare the quadrilateral piece of cortical bone to remove. Nowadays, the piece of bone to be released could be delimited with piezo inserts in order to avoid overheating of the bone during the procedure. Moreover additional materials such as PRF (Platelet Rich Fibrin) could be placed in the bone crypt, or might be placed below and above the bone window repositioned in order to fix it before sutures. The bone window technique will simplify the operational procedure during apical surgery and a may lead to quicker healing of lower molars after surgical endodontics.

Key Learning Points

• Analyze the indication of a bone window technique.

• Learn the surgical approach of the bone window removal.

• Understand the benefit of the bone window technique.

11:18

Intentional replantation in the implant era

*Alharbi MA

Department of Endodontics, King Abdulaziz University, Jeddah, Saudi Arabia and University of Pennsylvania, Philadelphia, USA

Aim To highlight the importance of intentional replantation as a predictable alternative method to dental implants when endodontic micro-surgical procedures are not applicable.

Summary Prevention and/or elimination of pulpal pathosis and apical periodontitis is the ultimate goal of endodontic treatment. The success rate of root canal treatment is >90%. However, periradicular periodontitis may not heal after the RCT and root canal retreatment. Endodontic micro-surgery is the procedure of choice in those cases. The success rate of the endodontic micro-surgery was reported to be (94%) as shown in the systematic review and meta-analysis by Setzer et al. Despite its very high success, endodontic micro-surgery may be difficult to perform in certain cases. Intentional

replantation (IR) might be the treatment of choice to eradicate the periradicular pathosis, to seal the root canal system, and to resolve the patients' symptoms if present. Intentional replantation was described by Grossman as "the purposeful removal of a tooth and its almost immediate replacement with the objective of obturating the canals apically while the tooth is out of the socket." A broad range of indications for intentional replantation were mentioned by Grossman including but not limited to; root canal blockage, iatrogenic errors such as perforations, complex anatomy. He also added the aim of removing an extruded material or to disrupt the walls of a cystic lesion in the indication list when root-end surgery is not applicable. The technique has developed in the past years with the incorporation of dental operating microscopes as well as the use of tricalcium silicate based materials such as MTA and Bioceramics. There are various studies that looked into the success and the survival rates of intentional replantation using modern techniques and the factors that affected the outcome. Those articles will be critically evaluated in the presentation.

Key Learning Points

• Causes of root canal failures.

• IR indications and contraindications.

• Critical factors for a successful replantation.

• Clinical technique and the required armamentarium.

• Methods of atraumatic extraction.

• Success rate of IR vs implants.

11:36

Surgical approach of large periapical lesions with application of l-PRF

Melo-Ferraz A, Ferreira S, *Freitas VN, Fernandes V, Caetano L, Miller P

Department of Conservative Dentistry, IUCS - CESPU, Gandra, Portugal

Aim Presentation of a clinical case showing that L-PRF (leucocyte platelet rich fibrin) may constitute the biological signature that promotes an acceleration of healing on the surgical approach of large apical lesions, achieving a better healing and an early patient recovery.

Summary Larger periapical lesions may constitute a challenging surgical procedure due to the greater amount of resorbed bone tissue, which interferes in the required time estimation for bone recovery. L-PRF, a new concept of naturally guided tissue regeneration, contains a dense fibrin network that releases a significant amount of autologous growth factors (particularly PDGF-AB, TGFβ, and VEGF), cytokines and healing proteins (fibronectin, etc.). It is known that at least 30 growth factors and 7 antimicrobial proteins are located in the platelet alpha granules, which are the main constituents playing an active role in the healing process. L-PRF improves the early stages of healing (hemostasis and epithelial closure), reducing the inflammatory process and the infection risk. This material is particularly useful and efficient in complex situations when some bone walls are destroyed, and regeneration is difficult. This clinical case is about a healthy 30-year-old female who presents a 18x11x15 mm radiolucid lesion associated with the root of the tooth 12, and a 6x10x5 mm radiolucid lesion associated with the root of tooth 22. It was performed a surgical approach using merely L-PRF as a graft, without any other filler material. Both teeth had previous endodontic treatment. A posterior anatomopathological analysis showed that the 12 lesion was a cyst and the one of the 22 was a granuloma. At 9-month follow-up, there wasn´t any signs or symptoms, and the CBCT shows a three-dimensional radiographic evidence of almost complete bone regeneration.

Key Learning Points

• How to achieve a faster regeneration of injured bone tissue with a simplified protocol using only an autologous blood concentrate without the addition of any filler material.

• Main Benefits of L-PRF Protocol and their cellular products.

11:54

Management of invasive cervical resorption using combined heithersay's and laser assisted approach – case report

*Ali S

Conservative Dentistry & Endodontics, Dr Ziauddin Ahmed Dental College & Hospital, Aligarh Muslim University, Aligarh, India

Aim To present the efficacy of laser irradiation and Hiethersay's approach using MTA in the management of a tooth with class III Invasive Cervical Resorption lesions.

Summary Invasive cervical resorption (ICR) is a localised and aggressive form of tooth destruction that usually begins in the cervical area below the epithelial attachment. Microorganism infection or secondarily infected aseptic resorptive process can start this type of resorptive inflammatory reaction. ICR is a relatively rare and uncommon phenomenon and if not treated may lead to ultimate loss of tooth structure. Likely predisposing factors include external trauma, orthodontic movement, surgical procedures, periodontal therapy, and idiopathic factors. Different approaches are advised for the treatment of ICR, depending on the location and extent of the lesion. The clinician should provide the patient with several treatment choices and discuss the benefits and drawbacks of every treatment approach. This case report outlines the management of a case of Heithersay class III ICR with mineral trioxide aggregate. Cone Beam Computed Tomography was used for diagnosis and assessment of the 3-dimensional extent of the lesion. The lesion was treated surgically, aided with laser irradiation and Heithersay's approach. Long-term clinical and radiographic follow-up demonstrated adequate periapical healing and no pathologic changes around the restored resorptive defect.

Key Learning Points

• Long term success of treatment of ICR depends upon careful case selection and accurate diagnosis.

• A combined endodontic, periodontic and restorative approach is needed for the management of ICR lesions.

• Further research is required to device biocompatible materials with adhesive, reinforcing, and esthetic properties for restoring extensive ICR defects.

12:12

WITHDRAWN

Clinical outcome studies – root canal treatment and retreatment

2:30

Does technical retreatment have a high success rate?

*Mer IM

Private Practice in Endodontics, Moscow, Russian Federation

Aim To analyze the prevalence of technical retreatment in private practice by the author, to discuss indications for this procedure and compare the success rate with cases with apical periodontitis.

Summary The most frequent procedures in the endodontic office are cases of retreatment with apical periodontitis. Using contemporary approach and modern technologies, success rate can reach 80% and even higher. However, in some cases we have to perform retreatment even without clinical or radiographic evidence of apical periodontitis. Usually this situation happens before a new restoration is placed. The success rate of technical retreatment is significantly higher than retreatment with apical periodontitis. Clinical trials conducted in universities show a success rate of 90% and higher. Research done in private practice demonstrate results approaching to 100%. Presentation analyzes prevalence of technical retreatment in private practice, discusses indications for this procedure, and compares the success rate with retreatment with apical periodontitis.

Key Learning Points

• Technical retreatment is one of the routine aims of endodontic treatment in the endodontic office.

• Success rate is high and can reach maximum value.

• Predictors such as incorrect working length, canal blockage, absence of patency, separated instruments, quality of restoration show minimal impact on success rate.

2:48

Influence of operator experience in post-operative-pain in Endodontics

*Pirani C[1], Iacono F[1], Arias A[2], Karami Shabankare A[1], FitzGibbon RM[1], Zamparini F[1], Gandolfi M[1], Prati C[1]

[1]School of Dentistry, Endodontic Clinical Section, Department of Biomedical and Neuromotor Sciences (DIBINEM), University of Bologna, Alma Mater Studiorum, Bologna, Italy, [2]Department of Conservative Dentistry, School of Dentistry, Complutense University, Madrid, Spain,

Aim Many factors inherent to patients' response, tooth type and operator skills can influence the prevalence of post-operative pain (PP). At the same time, the development of NiTi rotary shaping systems seem to make endodontic treatment for inexperience operators easier. The aim of the study was to investigate the incidence and intensity of PP after root canal treatments (RCT) performed with recently launched NiTi rotary systems by operators with different levels of experience.

Summary This observational prospective study was conducted in the Endodontic Department, University of Bologna, Italy. One-hundred-five patients were enrolled based on inclusion criteria. After obtaining informed consent, RCTs were performed in multiple-visits by either trained endodontists or postgraduate master students. Preoperative pain was recorded. Presence of periapical lesion was scored using periapical index (PAI). RCT were performed using manual K-files and 2 different recently launched NiTi rotary systems. Solutions of 5% NaOCl alternated with 10% EDTA were used as irrigants. Canal obturation was performed using AH-Plus cement and Thermafil after 7-10 days. PP was reported using a 100 mm Visual Analogue Scale (VAS) at 24, 48, 72 hours and 7 days both after instrumentation and obturation. Demographic and clinical variables were recorded to evaluate their correlation in PP aetiology. Bivariate and multilevel analysis were performed using Friedman (p=0.001) and Wilcoxon

tests (p=0.008). Recorded VAS values were significantly higher regarding instrumentation compared to obturation (p=0.008). Bivariate and multilevel analysis showed significant associations (p<0.05) between post-instrumentation pain and: preoperative pain (pulpitis and acute periapical abscess), female gender, and reduced clinical experience.

Key Learning Points

• No significant difference was observed between the different rotary systems used.

• No statistically significant factors emerged regarding post obturation pain.

• Patients treated by experienced operators have 4 times less probability of feeling PP, representing the most relevant factor analyzed.

3:06

Post-operative quality of life following root canal treatment performed with different shaping and root canal filling techniques: an observational study.

*Brondino A, Brasoveanu M, Multari S, Carpegna G, Berutti E, Pasqualini D

Surgical Sciences Dental School Endodontics, University of Torino, Turin, Italy

Aim The aim of the study was to compare two different shaping systems, Protaper Next and WaveOne Gold, and two different root canal filling techniques, Thermafil and bioceramics, in terms of postoperative quality of life (POQoL).

Summary Sixty-nine healthy subjects with asymptomatic or symptomatic irreversible pulpitis and pulp necrosis, with or without apical periodontitis, were enrolled and a primary root canal treatment was carried out. The treatment was performed in two sessions, at least 3 days apart from each other. Cavity access and root canal shaping were carried out during the first session, while the second one was dedicated to root canal filling. After data collection, patients were divided into 4 groups:

1. shaping performed with Protaper Next (PTN) and filling with Thermafil;
2. shaping performed with WaveOne Gold (WOG) and filling with Bioceramics;

3. shaping performed with WaveOne Gold and filling with Thermafil;

4. Shaping performed with Protaper Next and filling with Bioceramics;

Glide path was performed with ProGlider in group 1 and 4 and with WaveOne Gold Glider in group 2. Irrigation was conducted with 5% NaOCl and 10% EDTA for each treatment. POQoL indicators were evaluated for 3 days after each session with self-assessment questionnaires. They evaluated difficulty in chewing, speaking, sleeping, carrying out daily functions, social relations, medium and maximum pain and quality of life with a Likert-like scale ranging from 0 (none) to 10 (very much). The variation of each indicator over time was analysed with T-student test for repeated measures, and statistical significance was set at $P<0.05$. Post-operative pain curves demonstrated a more favourable time-trend in the PTN ($P=0.02$), probably due to a lower amount of debris extruded beyond the apex during shaping when compared to reciprocating instruments. Moreover, lower pain values were recorded in the Bioceramic groups, especially in the first day following the root canal filling ($P=0.023$).

Key Learning Points

• Reciprocating instrumentation may be associated with postoperative pain.

• Instrumentation with PTN showed lower impact on POQoL compared to WOG.

• Importance of patients' point of view.

• Bioceramics may be associated to other QoL parameters.

Clinical outcome studies - vital pulp therapies

3:24

Outcome of pulpotomy using calcium silicate based material in symptomatic mature permanent teeth with carious pulp exposure: 2 years results

*Taha NA, Alkhatib HO

Conservative Dentistry, Jordan University of Science and Technology, Irbid, Jordan

Aim Vital pulp therapy (VPT) has been increasingly considered as a minimally invasive approach for the management of teeth with inflamed pulps compared to the conventional approach of root canal therapy. The aim of the presentation is to report on the outcome of full pulpotomy in symptomatic mature permanent teeth with carious pulp exposure using a stain-proof calcium silicate based material over 2 years follow up.

Summary A total of 101 permanent molar teeth with symptomatic vital pulps in 90 patients aged 12-60 years were included. Preoperative pulpal and periapical diagnosis was established. After informed consent the tooth was anaesthetized, isolated using rubber dam and disinfected with 5% NaOCl before caries excavation; subsequently the pulp was amputated to the level of the canal orifices. Haemostasis was achieved and a 3 mm layer of Neo MTA plus (Avalon Biomed, Houston, USA) was placed as the pulpotomy agent. The tooth was restored with resin composite, and a postoperative periapical radiograph exposed. Clinical and radiographic evaluation was completed at 6 months, 1 and 2 years postoperatively. Pain levels were scored preoperatively and 2 days post treatment.

Clinical signs and symptoms indicative of irreversible pulpitis were established in 46/101 teeth, and periapical rarefaction was present in 9 teeth. After 2 days 93.4 % reported complete relief of pain. 3 teeth had immediate failure, at 6 months 89/98 attended recall with 94.4 % clinical and radiographic success. At 1 year 91/93 attended recall, with 96.7% clinical and radiographic success,and at 2 years 80/90 attended recall with 90% success. 8 out of 9 cases with periapical rarefaction had improvement in the PAI score. A hard tissue barrier was detected radiographically in 6 cases. Full pulpotomy was a successful treatment option for cariously exposed pulps in permanent molar teeth over 2 years follow-up.

Key Learning Points

• The improved understanding of pulp biology and the healing potential of the inflamed pulp has encouraged the adoption of VPT in properly selected cases.

• Vital pulp therapy has a reported success rate above 90% over medium term follow up.

• Clinical signs and symptoms indicative of irreversible pulpitis are not a contraindication.

3:42

Full pulpotomy and endocrowns in permanent teeth during one chairside appointment: a cohort study

*Munoz-Sanchez ML, Decerle N, Linas N, Cousson PY, Hennequin M

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

Aim In endodontics, indications for pulpotomy in vital permanent teeth were recently reconsidered in relation to the use of regenerative biomaterials. The success of pulpotomy depends both on asepsis pre-operatively and on the immediate sealing of the coronal restoration. Computer Aided Design and Computer Aided Manufacturing technology (CAD/CAM) restorations could be used to achieve immediate and definitive restoration. However, no such cases are described in literature.This study reports the first qualitative results of a cohort of patients for whom one molar was treated using pulpotomy and CAD/CAM endocrowns.

Summary From November 2017 to February 2019, 21 patients were included in a cohort study and had one molar treated using pulpotomy and CAD/CAM endocrown during one single chairside session. Indications for full pulpotomy were reversible pulpitis for 16 cases, irreversible pulpitis for 3 cases, chronic pulpitis for one case, and one case for prosthetic reasons. Radicular pulp sections were capped with Biodentine™. Endocrowns were carried out using CAD/CAM technology with E-max® or VitaEnamic® ceramics. Follow-up monitoring was planned 1 month, 6 months and 1 year postoperatively. During each postoperative appointment, clinical and radiological examinations were conducted to search for the presence of pulpal inflammation or infection. FDI clinical criteria were used for the evaluation of endocrowns. Seventeen patients were examined one month postoperatively, seven patients at 6 months and one patient after 1 year. No cases of pulpal inflammation or infection were detected. Aesthetic, functional and biological FDI criteria were satisfied in all cases. This is the first case of a series describing the outcome of immediate restorations

with CAD/CAM endocrowns for pulpotomized permanent teeth. Thus far, the reported success rates encourage the continued observation of the cohort.

Key Learning Points

• Full pulpotomy and CAD/CAM restoration could be associated with treating permanent teeth in a single session.

4:30

WITHDRAWN

4:48

Paradigm shift in vital pulp therapy: current clinical evidence

*Alshayban MU

Department of Restorative Dental Science, Endodontic Division, King Saud University, Riyadh, Saudi Arabia

Aim To provide an overview and explore the paradigm shift in the concept of vital pulp therapy based on current clinical evidence.

Summary Vitality of dental pulp tissue is essential for tooth nutrition, dentine formation, innervation, defensive and protective functions of the pulp. Pulpless teeth have compromised mechanical resistance and have lower long-term survival rates compared to vital pulp teeth. Therefore, any efforts should be made to maintain the vitality of dental pulp tissue. The aim of vital pulp therapy is to preserve and maintain healthy pulpal tissue by eliminating any irritant to the pulp and provide a hermetic seal from restorative leakage using biological compatible materials. There are two main approaches of vital pulp therapy in management of traumatized or decayed teeth; direct/indirect pulp capping and partial/full pulpotomy. Apexogensis is a typical example of vital pulp therapy in management of immature vital root apex to promote further root development and maturation.

Recent clinical studies using tricalcium silicate materials such as MTA and Biodentine have shown promising results in management of teeth diagnosed clinically as symptomatic/asymptomatic irreversible pulpitis by capping and/or pulpotomy procedures.

Key Learning Points

• The advancement in dental material has improved the success of vital pulp therapy.

• Recent accumulative clinical studies have shown that vital pulp therapy become more predictable procedures and have promising clinical results.

• Clinical signs of teeth with irreversible pulpitis and teeth with carious pulp exposure can be treated by vital pulp therapy and should not be considered a contraindications for such procedures.

Other

5:06

Quality assessment of systematic reviews published in Endodontic journals

*Mishra L, Singh NR

Conservative Dentistry and Endodontics, Institute of Dental Sciences, Bhubaneswar, India

Aim To describe critical considerations for appraising the quality of systematic reviews published in various endodontic journals.

Summary Systematic reviews have become increasingly popular across the allied health, education, and disability and rehabilitation fields. Unlike traditional narrative reviews, systematic reviews aim to minimize bias by locating, selecting, coding, and aggregating individual studies. Despite their undisputed benefits, systematic reviews are no panacea. As with primary research studies, systematic reviews vary greatly in quality. Hence, it is critical that consumers of research know the features that help distinguish high-quality systematic reviews from questionable reviews. This technical brief will energize readers to seek out systematic reviews and help them determine to what degree they can trust their findings in evidence-based decision making.

Key Learning Points

• The AMSTAR guidelines evaluate the quality of systematic review published in various endodontic journals.

• The quality of systematic reviews published in the International Endodontic Journal and the Journal of Endodontics are of the highest quality compared to the other endodontic journals.

• The better the reporting of systematic reviews, the better will be the impact on evidence-based clinical decision making.

5:24

The validity of systematic reviews to answer clinical questions: Introduction of AMSTAR 2, PRISMA, and GRADE systems

*Salem Milani A, Rahimi S, Frough Reyhani M

Department of Endodontics, Faculty of Dentistry, Tabriz university of Medical sciences, Tabriz, Islamic Republic of Iran

Aim To introduce AMSTAR 2, PRISMA, and GRADE systems to critically appraise systematic reviews.

Summary Rapid outbreaks of biomedical research publications makes it difficult for a clinician to find a definitive answer for his/her clinical questions simply by reviewing the available published studies which have sometimes contradictory results. Systematic reviews/meta-analyses, at the top of the level of evidence pyramid, are considered the best available ways to answer clinical questions; however, a surge in publication of systematic reviews in recent years has revealed their potential shortcomings which influence their validity to answer our clinical questions. These shortcomings of systematic reviews can be classified into following three categories: 1) weakness in conducting the review; 2) weakness in reporting; 3) quality of the evidence that the review provides. To find out whether a given systematic review reliably answers a specific clinical question, these three aspects of the review should be assessed. Recently, some systems/approaches have been introduced to critically appraise

published systematic reviews and show that to what extent we can rely on a given systematic review to find answer for a clinical question. Here, we introduce three simple and practical systems that lack intricacies of other similar systems. We will discuss AMSTAR 2 tool (2017) for assessment of review conduction and PRISMA checklist for qualification of review report, and finally, GRADE system (2011) for evaluation of quality of evidence that the review provides.

Key Learning Points

• Published systematic reviews may have weaknesses that potentially reduce their validity to answer clinical questions.

• AMSTAR 2 is a simple practical tool to assess the 16 methodological domains related to the necessary steps to be taken when performing a systematic review.

• PRISMA checklist is a useful tool for critical appraisal of systematic reviews regarding the minimum set of items required for reporting in a systematic review.

• GRADE is a systematic approach for rating the certainty of evidence in a systematic review.

5:42

Patient Reported Outcome Measures in Endodontics using a mixed methodology following treatment by postgraduate students in a UK dental hospital

*Jacobs RP, Jarad FD

Department of Restorative, School of Dentistry, University of Liverpool, Liverpool, UK

Aim Endodontic treatment outcomes are typically measured via clinical outcomes, rather than patients' perspectives. The aim of this study was to design a user-friendly, reliable tool for reporting patient reported outcomes in endodontics. Tool piloting was followed by a prospective longitudinal study on endodontic patients in secondary care treated by postgraduates. Following this, semi-structured interviews from a sample of patients involved in the longitudinal study explored the concerns and impact of endodontics on quality of life.

Summary A PROMs tool was developed using OHIP-14, consisting of 14 questions over 7 domains, answered on a Likert scale ranging from 0 (never) to 4 (very often). In addition, 4 visual analogue scales assessed patients' levels of pain, anxiety, concern and oral health state from 0 (no problem) to 100 (maximum problem). Ethical approval was granted, and data collected from patients treated by postgraduates at Liverpool University Dental Hospital (LUDH). Eligibility criteria were adults (age ≥18) requiring: RCT, ReRCT or Surgery. Questionnaires were completed pre-treatment (T0) and 6 months post-treatment (T2). 21 patients participated in a qualitative study involving telephone interviews following a schedule. All interviews were recorded and transcribed, followed by coding and thematic analysis. 53 patients provided PROMs at both T0 and T2, analysed with Paired Samples t-Test. OHIP-14 mean values revealed a non-statistically significant reduction of 2.6±10.3 (P=0.067). The VAS scale means showed statistically significant reductions in anxiety 12.9±32.1 (P=0.005),and concerns 15.5±32.3 (P=0.001), and non-statistically significant reductions in mean levels of pain 3.0±21.1 (P=0.305) and oral health state -1.6±35.8 (P=0.752). Qualitative analysis highlighted patient awareness of treatment complexity and subsequent referral to specialist services. Patients were concerned about pain levels in relation to endodontics. Trust and resultant reduced anxiety were key themes in terms of expertise and equipment at LUDH, as well as dentist qualifications and consultant supervision. Patients valued endodontics to avoid the consequences of tooth loss and resultant functional and cosmetic concerns.

Key Learning Points

• PROMs revealed an improvement in oral health-related quality of life following endodontics.

• Key points raised from the telephone interviews were the important impact of tooth loss regarding function and aesthetic, and the complexities surrounding referral to secondary care.

Friday

Hall 5

Other

9:00

Interradicular canal frequency at the bifurcation area of first mandibular molars.

*Briseño Marroquín B[1], Wentaschek S[2], Tennert C[1], Wierichs R[3], Wolf T[1]

[1]Department of Restorative, Preventive and Pediatric Dentistry, School of Dental Medicine, University of Bern, Bern, Switzerland, [2]Department of Prosthetic Dentistry, University Medical Center of the Johannes Gutenberg-University Mainz, Mainz, Germany, [3]Department of Biohybrid & Medical Textiles (BioTex), AME - Institute of Applied Medical Engineering, Helmholtz Institute, RWTH Aachen University, Aachen, Germany

Aim To investigate the frequency of interradicular canals in the bifurcation area of first mandibular molars.

Summary An access cavity was prepared in 117 first mandibular molars. The pulp chambers were cleaned from pulpal tissue in an ultrasonic bath (5 min) with 5% sodium hypochlorite. The pulp chamber was coloured by means of 4% methylene blue and centrifuged (Cryofuge 5000, Heraeus Sepatech, Osterode, Germany) at 2000 rpm for five minutes. The teeth were enbedded in a methyl metacrylate based resin (Technovit 9100, Heraeus Kulzer, Wehrheim, Germany) and the area between the pulp chamber floor and bifurcation sliced (MT1 1900, Renfert/Hilzingen) with a 0.145 mm/± 0.03 mm thickness. The frequency of interradicular canals was observed microscopically at x125 magnification. The results were analyzed descriptively and the confidence interval was calculated with the Clopper-Pearson for binomial distributed variables. Nine (7.7% [confidence interval: 0.04-0.14]) teeth had 1 interradicular canal. Two teeth (1.7%) had 2 interradicular canals. 11 teeth (9.4%

[confidence interval: 0.05-0.16]) had 29 interradicular canals, which did not reach either the pulp chamber floor or the bifurcation area.

Key Learning Points

• An interradicular canal can appear in first mandibular molars between 4 to 14% (p>0.05).

9:18

Saving the "Natural Implant" through apical surgery ... minimal pain, optimal healing and unprecedented patient perception

*Nguyen TNN

Polaris Dental Specialists, Salem, United States

Aim To create awareness about the outstanding role of lasers in endodontic surgery and how its minimally-invasive and biostimulation properties have led to extraordinary service to our patients.

Summary In the current context of “Extract & Implant” popularity, it is our ultimate goal, as endodontists to be on a “Surg & Rescue” mission and strive more than ever to keep the “natural implant” alive. Adequate training, experience and specialized equipment allow endodontic experts to diagnose properly, plan adequately, execute effectively and harm minimally. For years now, the Er,Cr:YSGG laser has established itself as the most versatile dental all-tissue laser. This provides an extremely precise, while highly efficient cut within 2 mm from the laser tip, through both soft and hard tissues. At the same time, diode lasers have been scientifically proven in both the dental and medical literature as a true alternative not only in pain control but also in post-operative healing. The minimally-invasive quality of the Er,Cr:YSGG laser paired with the biostimulation benefits from the diode laser, has caused a paradigm shift in short and long-term soft and hard tissue healing. Therefore, when coupled, the Er,Cr:YSGG laser and diode laser, enable endodontists with an unrivaled level of precision with minimal pain and, optimal and fast healing. Patients’ perception about apical surgery has hence lost much of its fear aspect, allowing them to favor saving over extracting their natural

teeth. To quote William Jennings, “Destiny is not a matter of chance; it is a matter of choice. It is not a thing to be waited for, it is a thing to be achieved.”

Key Learning Points

• Discuss the benefits of integrating Er,Cr:YSGG and diode laser technology in the service of patients. Literature review will be used as scientific support.

• Describe the clinical steps of laser-assisted apical surgery. Videos and related materials of Dr. Nguyen's clinical cases will be discussed and used as visual aids.

• Evaluate the impact of high-tech, high-expense technology on practice overhead and practice growth.

• Discuss factors that favorably affect patients' acceptance

Treatment planning

9:36

Age-related clinical algorithm

*Ben-Itzhak J, Solomonov M

Department of Endodontics, Israel Defense Forces Medical Corps, Tel Hashomer, Netanya, Israel

Aim Age-related algorithm for the shaping, cleaning and obturation of the root canal system, based on the available evidence will be suggested.

Summary The global population is growing worldwide and is experiencing both an increase in life expectancy and a decrease in tooth loss. Endodontic treatment is performed in young and old patients. The clinicians must be aware of the age-dependent differences: the canal cross-sectional outline, the canal diameter, presence and characteristics of isthmuses, auxiliary canals existence, quantity and diameter of the dentinal tubules, and dentinal sclerosis. Nowadays, a wide range of endodontic instruments, irrigation and obturations materials as well as techniques exist for shaping, cleaning and obturation of the root canal system. Age-related morphological changes and suitability of endodontic

approaches in different situations will be reviewed. A clinical age-related algorithm for choosing the most proper endodontic approach for shaping, cleaning and obturation will be proposed and discussed.

Key Learning Points

• The clinician's choice of instruments, irrigation methods, and obturation techniques are influenced by the age-related changes in root canal morphology and dentine structure.

9:54

WITHDRAWN

10:12

Incidence of external apical root resorption(EARR) in patients undergoing orthodontic treatment – case report

*Timplalexis D[1], Koumpia E[2], Mikrogeorgis G[1]

[1]Department of Endodontology, [2]Department of Orthodontics, School of Dentistry, Aristotle University, Thessaloniki, Greece

Aim The objective of this oral presentation will be primarily to present the latest information about the mechanical, environmental factors and/or inter-individual genetic variations that can deliberate susceptibility or resistance to the occurrence of EARR during the course of orthodontic treatment. Secondarily, a case report of a patient with moderate to severe EARR of the maxillary lateral incisors induced by ectopic eruption of maxillary canines will be presented.

Summary Some degree of external root resorption is a frequent and unpredictable consequence of orthodontic tooth movement. Orthodontic treatment is known to require remodeling of bone adjacent to tooth roots, mediated by odontoclasts/cementoclasts originating from circulating precursor cells in the periodontal ligament. The interaction between orthodontic forces and the

periodontal ligament can lead to an inflammatory reaction inducing apical resorption by clastic activity, namely external apical root resorption (EARR). The detection of EARR is accomplished mainly by the use of periapical radiographs and secondly by panoramic imaging. An etiological factor recently described is genetic predisposition, together with mechanical factors derived from orthodontic treatment. Other factors related to orthodontic treatment that seem to play a role during EARR include: increased treatment duration, orthodontic treatment plan that included tooth extraction, type of tooth and the biomechanics of the orthodontic treatment. Patients that exhibited higher average treatment time are prone to present more severe resorptions, which is in accordance with the results of studies stating that after 36 months of treatment 70% of patients developed EARR. Moreover, treatment that involves extractions generally requires larger tooth movements which in turn may cause greater amounts of root resorption. Usually, the most affected teeth are maxillary central and lateral incisors. To conclude, there is a paradigm shift in the research field of EARR towards basic science research in an effort to clarify the exact nature of EARR which could possibly lead to the prevention or even eradication of this phenomenon during orthodontic treatment.

Key Learning Points

• Biological and mechanical factors and a combination of the two are associated with increased levels of EARR.

• Maxillary lateral incisors are the most affected teeth.

• Decreased orthodontic treatment duration is suggested along with radiographic observation.

11:00

Do orthodontists consider endodontic complications in their orthodontic management of teeth with a history of dental trauma?

*Al Hourani A[1], Al Badri S[2], Jarad F[1]

[1]Department of Restorative, [2]Department of Paediatric Dentistry, Dental School, University of Liverpool, Liverpool, United Kingdom

Aim To evaluate whether orthodontists consider the endodontic implications associated with the orthodontic treatment of teeth with a history of dental trauma.

Summary A mixed methods vignette survey was designed, and distributed to UK registered specialist orthodontists electronically over a 4 month period from May–Sept 2018. GDPs, orthodontic trainees and incomplete surveys were excluded from the study. The survey was split into two parts. Part 1 explored the orthodontist's professional background and experience in dental trauma. Part two consisted of three vignette clinical scenarios with open/closed questions to explore the orthodontist's understanding of endodontic risk with the provision of orthodontic treatment of three cases, which were a mid-root fracture, pulp canal obliteration and an immature open apex. Overall, 76 orthodontists responded from the UK. Following quantative analysis of the data and thematic analysis of the transcripts, the following was identified; with regards to diagnosing dental trauma, 46% of orthodontists utilised an OPT and 53% did not carry out pre-treatment sensibility tests. 46% of orthodontists felt they had insufficient training in dental trauma and 42% lacked confidence in the treatment of traumatic injuries. In addition, 32% of clinician's felt there is lack of guidance in the orthodontic treatment of traumatised teeth and pulpal sequalae. Qualitative themes identified were: non-standardised pre- treatment examination, dental trauma experience, dental trauma training and lack of literature guidance on the orthodontic treatment of traumatised teeth. There is no standardised protocol to examine teeth with a history of trauma prior to orthodontic movement, however, the majority of orthodontists were happy to request the support/ second opinion from their paediatric/endodontic colleagues in the management of complex traumatic cases requiring orthodontic treatment.

Key Learning Points

• There is no standardised pretreatment method in the examination of teeth with a history of dental trauma prior orthodontic treatment.

• There is a lack of dental trauma training within orthodontic specialist training and possible misdiagnosis of pulpal complications and management.

• Orthodontists lack confidence in the treatment of previously traumatised teeth and its management, the majority asking for a second opinion by paediatric/endodontic specialists.

• There is insufficient literature guidelines within orthodontics in the management of traumatised teeth.

11:18

Evaluation of treatment planning decisions among Endodontists, Postgraduate Students, General Dental Practitioners and Undergraduate Students for complicated endodontic cases: A survey study

*Alim B, Dincer A, Yurtgezen B, Guneser B

Department of Endodontics, Bezmialem Vakıf University, istanbul, Turkey

Aim To evaluate treatment choices for endodontic cases with different sizes of periapical lesion, resorption or broken instrument among endodontists, postgraduate students, general dental practitioners and undergraduate students.

Summary This study was carried out using questionnaires which were sent to endodontists (EN), postgraduate students (PS), general dental practitioners (GP) and undergraduate students (US) who had e-mail addresses available through the websites of various universities, public and private hospitals/offices in different cities in Turkey. The survey was mailed through “onlineanketler.com” (enuvo GmbH, Zurich, Switzerland). The questionnaire sent to 1881 participants and was completed by a total of 1039 (55.2 %) participants who gave approval for this study (702 female [67.6%], 337 male [32.4%]). 126 (12.1%) EN, 128 (12.3%) PS, 445 (42.8%) GP, 340 (32.7%) US answered questionnaires with 20 X-ray images. Periapical images (no lesion/1 mm/3 mm/5 mm/furcal lesion) on 5 different X-ray radiographs were formed with picsArt (Softonic International, Barcelona, Spain) and created a scenario. Options were included “wait and see, root canal treatment, retreatment, or

extraction" for different cases. The results were expressed as percentage. Chi-square test was used to determine the differences among the participant groups. $P<0.05$ was considered statistically significant. The results showed that as the level of endodontic education increased, the extraction decision decreased. Although US and GP decided on extraction for lesion of size 5 mm/ furcal lesion, EN and PS chose endodontic treatment for 17 and 15 cases, respectively. There was no significant difference between the groups in the case of instrument fracture with no lesion. Most participants decided to wait and see for this case.

Key Learning Points

• It is more important to keep the tooth in the mouth than extraction for all dentists working in the field of endodontics.

• If a dentist is in doubt about the prognosis of endodontic treatment, they should consult an endodontist prior to extraction.

11:36

3D reconstruction software in Endodontics

*Isufi A[1], Xhajanka E[2], Gambarini G[1]

[1]Department of Endodontics, Sapienza, University of Rome, Rome, [2]Faculty of Medical Dentistry, University of Medicine, Tirana, Albania

Aim To discuss new 3D rendering techniques for better visualization and manipulation, measurements and simulation of the root canal treatment.

Summary With scientific and technological advances in diagnostic and therapeutic methods in the biomedical field there has been an increase in the predictability and longevity of the outcomes of dental procedures. The development of software programmes and the use of these technologies for endodontic treatment can help in the diagnosis, preoperative treatment planning, makes it easier for patients to understand proposed procedures, increases the predictability of treatment and may

reduce treatment failures, making the endodontic treatment safer and less invasive. Image analysis and visualization techniques are essential problems in the successful application of CBCT data. Different software platforms such as MeVisLab, 3D Endo and Amira will be presented for 3D reconstruction and image analyses. MeVisLab can be used for 3D reconstruction and assessment of tooth and canal morphology from micro-CT or CBCT data, to evaluate root canal preparation and perform advanced simulation and analyses including virtual canal preparation. Amira is an extendable software system for scientific visualization, data analysis, presentation and modelling of 3D data. 3D Endo is a CBCT-based software that enables preplanning and optimization of endodontic treatments on the basis of imaging. It can be used for better analyzation of the natural shape of the root canal, measurements and virtual simulation of endodontic treatment by selecting the appropriate files from the integrated file database and can also help improve the communication with patients by clearly explaining the initial situation and the appropriate treatment planned. These preoperative procedures can increase predictability of the chosen technique, improve applicability of the treatment plan, shorten operative time and improve the communication with patients.

Key Learning Points

• 3D reconstruction software enhances diagnosis and treatment planning increasing the predictability of endodontic treatment.

• Highlighting the importance of 3D anatomy in endodontic access cavity preparation, root canal shaping and obturation.

• The importance of better visualization and manipulation, measurements and simulation of the root canal treatment in endodontic practice, research and education.

Other

11:54

Diagnosis and treatment perspectives of internal root resorption

*Baser Can ED

Department of Endodontics, Yeditepe University, Istanbul, Turkey

Aim Root resorption is the loss of dental hard tissues and in permanent teeth it is a pathological event. If left untreated this might result in the premature loss of the affected teeth. The aim of this presentation is to discuss the important points of the treatment of internal root resorption.

Summary Root resorption might be classified into external and internal according to the location of the resorption in relation to the root surface. The process involves a complex interaction of inflammatory and resorbing cells, resulting in the formation of multinucleated giant cells and resorption of dental hard tissues. Compared with external root resorption, internal root resorption is a relatively rare occurrence, and its aetiology and pathogenesis have not been completely elucidated. However, various aetiological factors have been proposed for the loss of predentine, and trauma seems to be the most advocated. Radiologically internal root resorption is often confused with external cervical resorption (ECR). The use of parallax radiographic techniques is advocated for differentiating internal from external resorption defects. However the advent and use of cone beam compted tomography (CBCT) has enhanced 3-dimensional geometric accuracy when compared with conventional radiography. Root canal treatment remains the treatment of choice of internal root resorption as it removes the granulation tissue and blood supply of the clastic cells. Internal root resorption presents specific difficulties during instrumentation. In the course of root canal filling, the material needs to be flowable to seal the resorptive defect. Thermoplastic gutta-percha techniques seem to give the best results when the canal walls are respected. Treatment of internal root resorption would show favourable results if modern endodontic tecniques are used. Proper diagnostic and imaging tecniques are mandatory for positive long term prognosis.

Key Learning Points

• CBCT may be more useful for making a confirmatory diagnosis and determining the treatment plan before undertaking the actual internal root resorption treatment.

• Root canal filling should be flowable in order to seal the resorptive defect 3-dimensionally.

• Bioceramic cements are the material of choice if the resorptive defect has perforated the root canal.

Canal preparation - apical extrusion

12:12

The impact of endodontic over-instrumentation on the anatomy of the root canal and the apical foramen: a comparison between three different endodontic motorized systems

*Shay B[1], Moreinos D[1], Udi Shmueli O[2], Abramovitz I[1]

[1]Department of Endodontics, [2]Institute of Dental Sciences, The Hebrew University Faculty of Dental Medicine, Jerusalem, Israel

Aim To present the effect of different motorized endodontic instruments on the anatomy of the root canal and apical foramen in case of unintentional over-instrumentation (UOI).

Summary This study compare three Ni–Ti motorized Systems: ProTaper Next (PTN), Self-Adjusting File (SAF) and XP-Endo Shaper (XP) on the anatomy of the root canal and apical foramen in case of UOI. 84 Maxillary and mandibular molar canals were divided into three groups of 28 canals in each group. Each group was randomly sub divided into a control and experimental groups. Each group was prepared with a different Ni–Ti motorized System with accurate WL which was 0.5 mm shorter than the extrusion point of number 06 file from the apical foramen or with an experimental WL 1 mm longer (EWL). Morphology of the apical foramen and canal axis were evaluated using pre and post instrumentation photographs using apical stereomicroscopy and cross sectional CBCT 3, 6, and 9 mm. parameters measured: transportation, centering ability, diameter increase and area increase. Results: UOI with PTN displayed: (1) apical transportation in MC ($p<0.05$) and VC directions ($p<0.001$); (2) less apical centering in VC direction ($p<0.05$); (3) greater apical diameter increase in VC direction ($p<0.001$); (4) greater apical foramen area increase ($p<0.001$); (5) increased transportation and canal diameter at the 6 mm cross sectional plane at the MC direction ($p<0.05$). XP displayed: (1) greater VC diameter increase ($p<0.05$); (2) greater apical foramen area ($p<0.001$) relative to controls. When comparing UOI

between the different filing systems, significantly less transportation was witnessed in the VC direction in SAF ($p<0.001$) and XP ($p<0.05$) compared to PTN and less apical diameter increase in VC direction in SAF ($p<0.05$) compared to PTN. Root canal UOI resulted in increased, less centralized and irregular shape of the apical foramen compared to correct WL preparation. The clinical impact of such morphological disruptions is yet to be determined. This effect was more significant in the PTN group.

Key Learning Points

• The unfavorable effect of root canal over-instrumentation varied between different root canal motorized instruments.

2:30

Quantitative assessment of apically extruded bacteria using different instrumentation techniques and preparation taper: An *In vitro* study

*Pandey V[1], Priyank H[2]

[1]Department of Conservative dentistry and Endodontics, Institute of Dental studies and Technologies, Delhi, [2]Department of Conservative Dentistry and Endodontics, Hazaribag College of Dental Sciences and Hospital India, Jharkhand, India

Aim To assess the change in the amount of apically extruded bacteria using Crown Down (CD) and Full Linear Motion (FM) instrumentation techniques produced by differences in taper between the instruments used during bio-mechanical preparation of root canals.

Summary One of the most important component steps for the successful completion of root canal therapy is the complete and thorough cleaning and shaping of root canal space for the purpose of removal of inflamed and necrotic pulpal tissue. During the process of root canal instrumentation apically extruded necrotic materials and microorganisms can cause post-treatment pain or a flare-up. In the present treatment scenario, apical extrusion of debris is associated with all types of preparation techniques and instrumentation procedures. This occurs even with clinicians prepare the root canal

short of the apical terminus. Both crown-down (CD) and full-length linear motion (FM) techniques are routinely used as a component of taper rotary instrument procedures for the achievement of thorough cleaning and shaping of the pulp canal space. Literature quotes that significantly less bacterial extrusion is associated with CD preparation techniques in comparison with FM instrumentation.

Key Learning Points

• To assess the change in the amount of apically extruded bacteria using CD and FM instrumentation techniques produced by the difference in taper between the instruments used during bio-mechanical preparation of root canals.

• To assess the numbers of Colony Forming Units in the samples.

• To compare both the instrumentation procedures when different taper files are used for bio-mechanical preparation of root canal.

Canal preparation - cleaning ability

2:48

Cleaning the third dimension

*Gawdat S

Department of Endodontics, Faculty of Dentistry, Cairo University, Cairo, Egypt

Aim To highlight the challenges faced in instrumentation of oval shaped root canals and to discuss the concept of anatomical shaping and the newly introduced systems that adopts it. It points out the effect of these systems that adopts minimally invasive concept on canal cleanliness, micro-crack formation and postoperative pain.

Summary The ultimate goal of root canal instrumentation is to develop a sterile root canal system before obturation while preserving as much as possible of root canal dentine. Frequency of oval or flat shaped root canal morphology ranges from 25-50% and it is present even in the apical area.

Cleaning of oval shaped canals represents a challenge to endodontists as most of the available rotary nickel titanium systems are circular in cross section, so the buccal and lingual aspects of the root canal remains improperly cleaned and shaped harbouring debris and bacteria. The latter, can lead to periapical inflammation and eventual postoperative pain with the ultimate failure of endodontic treatment. Anatomical shaping is a new concept that aims to shape the root canal, according to its anatomy and not to create an artificial canal . Several systems have been lately introduced in the market with this concept as Self Adjusting File (ReDent Nova), Trushape (Dentsply) and XP Endo-shaper and finisher files (Brasseler), Gentle file (Medic NRG) with different metallurgy and design features. The effect of these systems on canal cleanliness and their ability to induce micro-cracks have been studied and showed promising results. Also, randomized clinical trials have been conducted on some of these systems to study their effect on postoperative pain.

Key Learning Points

• Challenges in cleaning oval canals.

• Deficiencies of the currently available instrumentation systems.

• Concept of anatomical shaping and instrumentation systems introduced to the market supporting this concept.

• Effect of the use of these systems on canal cleanliness, micro-crack formation and postoperative pain.

3:06

Efficacy of automated Ni-Ti systems in eliminating bacteria from infected root canals

*Panopoulos P

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

Aim To present the available clinical and laboratory evidence regarding the reduction of root canal bacterial load following debridement with various rotary and reciprocating Ni-Ti systems.

Summary It is well accepted that the chemo-mechanical preparation of the root canal significantly reduces the bacterial load of the root canal. The evolution of automated instrumentation has led to the development of different rotary and reciprocating Ni-Ti systems. These systems differ in several aspects, such as kinematics, file design and manufacturing process. Since the reduction of root canal bacteria is mainly achieved by the debridement process, it is possible that the design of the instrument used might influence the bacterial reduction after root canal instrumentation. The available evidence suggests that rotary systems are more effective than the manual techniques in reducing the bacterial load of the root canal. However, it is not yet clear whether the reciprocating systems are more effective than the rotary ones. In addition, it is not clear whether the design and the manufacturing process of the Ni-Ti files plays a role in their ability to eliminate root canal bacteria. The results of the available laboratory and clinical studies are conflicting because of the different methodologies and file systems used. However, it appears that the file design and the movement of the instrument inside the root canal indeed influences the bacterial reduction following root canal instrumentation.

Key Learning Points

• Understand the mechanisms of bacterial reduction during instrumentation.

• Understand the differences among the various rotary and reciprocating systems.

• Evaluate the effect of rotary and reciprocating systems in reducing the intracanal bacterial load.

Canal preparation - shaping ability

3:24

Micro-CT evaluation of modern rotary and reciprocating glide path and shaping systems

*Tutino F[1], Bernardi M[1], Alovisi M[1], Carpegna G[1], Comba A[2], Bobbio E[1], Scotti N[2], Pasqualini D[1], Berutti E[2]

[1]Department of Endodontics, [2]Department of Restorative, Dental School, University of Turin, Turin, Italy

Aim To compare the micro-CT shaping outcomes after instrumentation with different rotary and reciprocating glide path and shaping systems.

Summary Thirty extracted maxillary first molars were selected. Mesio-buccal canals were randomized into two groups (n=15): rotary system ProGlider and ProTaper Next X1, X2 (PG-PTN) and reciprocating system WaveOne Gold Glider and WaveOne Gold Primary (WOGG-WOG). Canals were irrigated with EDTA 10% and NaOCl 5%. Specimens were micro-CT scanned before and after glide path and after shaping. Increase in canal volume and surface area, percentage of removed dentine from the inner curvature, centroid shift and canal geometry variation through ratio of diameter ratios and ratio of cross-sectional areas were measured in the apical and coronal levels and at the point of maximum curvature. One-way ANOVA and post hoc Turkey-Kramer tests were used ($P < 0.05$). Post glide path analysis revealed a non significant increase in canal volume and surface area between groups ($P = 0.051$). RDR was more favorable to PG in the coronal third ($P = 0.014$). In the apical third centroid shift was lower for WOGG ($P = 0.020$). Post shaping analysis showed a reduced removal of dentine by the PTN group, especially at the point of maximum curvature ($P < 0.05$). RA resulted more favorable to PTN ($P = 0.019$) at the point of maximum curvature and to WOG ($P = 0.040$) in the apical level. Centroid shift reported no significant differences, while the percentage of dentine removed from the furcation was higher for the WOG system ($P = 0.016$). Despite a higher dentine removal for reciprocating instruments at the point of maximum curvature, both systems seemed to produce a well-centered glide path and shaping.

Key Learning Points

• Rotary group showed a lower increase in canal volume and surface area.

• The reciprocating group removed more dentine at the point of maximum curvature.

• The reciprocating group seemed more centered in the apical third.

3:42

The influence of brushing movement on geometrical shaping outcomes: A micro-CT study

*Carpegna G, Alovisi M, Comba A, Pasqualini D, Scotti N, Berutti E

Surgical Sciences, Dental School, Endodontics, University of Turin, Turin, Italy

Aim To compare the maintenance of original root canal anatomy using WaveOne Gold reciprocating files with or without brushing motion.

Summary Sixty extracted human mandibular first molars with independent mesial canals were selected. Canal scouting with size 10 K-files and glide path preparation with ProGlider were performed. Samples were randomized into two groups (n=30 per group): WaveOne Gold Primary single files were used to shape the mesiolingual canals without (NB group) or with (B group) an intentional brushing motion. Canals were irrigated with 10% EDTA and 5% NaOCl. Specimens were scanned with micro-computed tomography before and after shaping in order to match the volumes for post-treatment analysis (SkyScan Bruker-micro-CT, 100 kV, 100 µA, 16 µm resolution, Al+Cu filter). Increase in canal volume and surface area were measured. Centroid shift and thickness of removed dentine from the inner curvature were assessed at the furcation, 1.5 mm and 3 mm apically from the furcation, and in relation to the point of maximum curvature. Results were analyzed by one one-way ANOVA and post-hoc Student-Newmann-Keuls test ($P < 0.05$). No significant shaping aberrations were observed in either group. The original canal anatomy was maintained to a greater extent when no brushing motion was used ($P < 0.05$), especially in the coronal third of the root canals. Within the limits of this study, when using the WaveOne Gold reciprocating single-file system, a no-brushing technique resulted in better preservation of the canal anatomy than using brushing, reducing the risk of stripping.

Key Learning Points

• Subjects in the brushing group had less remaining dentine from the furcation than those in the no-brushing group.

• Centroid shift in the brushing group was higher than in the no-brushing group.

• When using reciprocating single file systems, brushing may affect the maintenance of the root canal anatomy.

4:30

Comparison of the apical transportation and canal straightening between two rotary and two reciprocating systems

Erdogan D, *Akbal Dincer G, Turkyilmaz A, Erdemir A

Department of Endodontics, Kirikkale University, Kirikkale, Turkey

Aim To compare apical transportation and canal straightening between two rotary (ProTaper Next, Dentsply Maillefer, Switzerland), (HyFlex CM, Coltene-Whaledent, Switzerland) and two reciprocating systems (Reciproc, VDW, Germany), (Reciproc Blue, VDW).

Summary Material and methods: Mesiobuccal canals of 48 extracted human mandibular first and second molars with 20 to 45° curvatures and 3 to 7 mm curve radius were chosen for this study. After working length determination, the teeth were divided into four groups (n=12). Standardized radiographs from mesio-distal and bucco-lingual direction were taken prior to instrumentation with the initial root canal file of size 15 inserted into the curved canal. Root canals were prepared to an apical size 25 with ProTaper Next in group 1, HyFlex CM in group 2, Reciproc in group 3 and Reciproc Blue in group 4 . After instrumentation radiographs were taken with root canal file of size 25 inserted into the canals. Pre-instrumentation and Post instrumentation radiographs were superimposed. Apical transportation and canal straightening were analysed using Image J a computer imaging program. Data were analysed statistically using ANOVA and Student Newman Keuls test. Results: During root canal preparation, no instrument was fractured. There was no significant difference between mesio-distal and bucco-lingual apical transportation (P = 0.291). Group 2 and group 4 resulted in significantly less apical transportation than other groups (P<0.05), with no significant

differences between groups among themselves. No significant differences were found between all groups regarding canal straightening (P=0.171). Conclusion: Under the conditions of this study, all instruments respected the original canal curvature well and were safe to use. Preparation with Hyflex and Reciproc Blue revealed significantly less apical transportation than ProTaper Next and Reciproc.

Key Learning Points

• Under the conditions of this study, all instruments respected the original canal curvature well and were safe to use.

• Preparation with Hyflex and Reciproc Blue was associated with significantly less apical transportation than ProTaper Next and Reciproc.

4:48

Root dentinal microcracks: a post-extraction experimental phenomenon?

*De-Deus G[1], Cavalcante D[1], Silva E[1], Belladonna F[1], Souza E[1], Versiani[1], Dummer PMH[2]

[1]Department of Endodontics, Universidade Federal Fluminense, Rio de Janeiro, Brazil, [2]Cardiff University, Cardiff, United Kingdom

Aim The existence of pre-existing microcracks has been controversial. The somewhat puzzling occurrence of pre-existing microcracks has created interest in potential aetiological factors as well as in determining whether vertical root fractures are preceded by such microstructural defects. Considering its as-yet-unknown aetiology as well as the lack of knowledge on this phenomenon, this oral presentation aimed to demonstrate the prevalence, location and pattern of pre-existing microcracks in non-endodontically treated teeth from fresh cadavers as well as discuss future perspectives of this important issue.

Summary Dentoalveolar maxillary and mandibular bone-blocks, each containing 3-5 adjacent teeth (a total of 178 teeth), were collected post-mortem and scanned in a micro-CT device. All cross-section images of the 178 teeth (n = 65,530) were screened from the cementoenamel junction to the apex to

identify the presence of dentinal defects. A pilot study was conducted to evaluate if the microcracks observable when the dehydrated tooth was outside the bone-block remained detectable when the entire bone-block plus reinserted tooth was scanned. The results of the pilot study revealed the presence of the same microcracks in both experimental situations (the tooth outside and inside the maxillary bone-block). Moreover, the results of the main study demonstrated that from a total of 178 teeth in the bone-blocks removed from cadavers, no dentinal microcracks were detected in any of the 65,530 cross-sectional images. Therefore, this in situ cadaveric model revealed the lack of pre-existing dentinal microcracks in non-endodontically treated teeth. Thus, the finding of dentinal microcracks observed in previous cross-sectional images of stored extracted teeth is unsound and not valid. It should be assumed that microcracks observed in stored extracted teeth subjected to root canal procedures are a result of the extraction process and/or the post-extraction storage conditions.

Key Learning Points

• The present study provides new insights regarding dentinal microcracks formation.

• Using a fresh *in situ* cadaveric model, no pre-existing microcracks were observed.

• It proposes a new nomenclature for dentinal microcracks in stored extracted teeth: experimental dentinal microcracks.

5:06

Do pre-existing microcracks play a role in the *in vitro* resistance to root fracture?

*Cavalcante D[1], De Deus G[1], Silva E[1], Belladonna F[1], Souza E[1], Simões M[1], Zehnder M[2]

[1]Department of Endodontics, Universidade Federal Fluminense, Rio de Janeiro, Brazil, [2]Department of Endodontics, University of Zurich, Zurich, Switzerland

Aim Since 2009, it has been reported that root dentinal microcracks observable in extracted teeth in published studies on microcracks have plainly accepted the role of such dentinal defects on the development of VFRs (vertical root fractures), despite a complete absence of evidence to support a

cause-effect relationship in this context. The purpose of this oral presentation is to demonstrate the potential cause-effect relationship between pre-existing dentinal microcracks and fracture resistance in non-endodontically treated lower incisors.

Summary A sample of 60 mandibular incisors with circular-shaped canals was selected based on micro-CT pre-scans to create a homogeneous sample. Two pre-calibrated examiners screened the cross-section images of the specimens to identify and quantify the presence of dentinal microcracks. Teeth were embedded in polystyrene resin and subjected to axial compressive loading using a universal testing machine. After fractured, roots were re-scanned and fractography analysis was performed by inspection of 3D models to verify crack propagation. A correlation between the number of microcracks and force required to fracture was observed. The incidence of microcracks varied between teeth from 6% to 42% of the total slices per sample, with an average of 14 ± 17%. The number of microcraks per sample varied from 0 to 1605, with an average of 412 ± 484 (median = 221 and IQR 25% = 15 / 75% = 658). The load at failure values varied from 227N to 924N, with an average of 560.3 ± 168.1N (median 561 and IQR 25% = 458 / 75% = 694). The Spearman correlation coefficient (rho) equaled 0.065. It can be concluded that there is no cause-effect relationship between the amount of dentinal microcracks and fracture resistance of nonendodontically treated lower incisors in the sense that the presence and quantity of microcracks did not result in these roots being more prone to fracture.

Key Learning Points

• The present study provides new insights regarding the relationship between dentinal microcracks and development of VFRs.

• There is no cause-effect relationship between the amount of dentinal microcracks and fracture resistance of nonendodontically treated lower incisors.

Other

5:24

Influence of nickel-titanium rotary systems with varying tapers on the biomechanical behaviour of mandibular first molars with curved and straight mesial roots: a finite element analysis study

Cesur Y [1], *Askerbeyli Ors S[1], Serper A[1], Ocak M [2]

[1]Department of Endodontics, Hacettepe Univesity, [2]Department of Anatomy, Ankara University, Ankara, Turkey

Aim To discuss the influence of files with varying tapers and active cutting parts on stress distribution of mandibular first molars with curved and straight mesial roots via 3-dimensional (3D) finite element analysis (FEA).

Summary Mesial root canals of six artificial mandibular molar models were prepared up to ProTaper Universal F2 (Dentsply Maillefer, Switzerland), ProTaper Universal F3, FlexMaster (VWD, Munich, Germany) (size 25, .04 taper), FlexMaster (size 30, .04 taper), Hero Shaper (Micro-Mega, France) (size 25, .04 taper) and Hero Shaper (size 30, .04 taper). The 3D models with curved mesial roots were constructed from the micro-computed tomographic images of the six prepared and also one unprepared artificial models. Subsequently, 3D molar models with straight mesial roots were developed. Occlusal force of 200 N was applied and FEA was performed using the Abaqus software (Abaqus 6.14, ABAQUS Inc., USA). In both curved and straight rooted groups, the highest Pmax stresses were recorded for ProTaper F3 model and the lowest Pmax stresses were recorded for intact molar model, followed by Hero Shaper (size 25, .04 taper) model. All of the models in straight rooted group exhibited lower Pmax values than their counterparts with curved mesial roots. Curved mesial root anatomy seems to increase risk of fracture in mandibular molars compared to straight mesial root anatomy. Nickel-titanium rotary systems with shorter active cutting part and low degree of taper may be advantageous in terms of reducing fracture risk in mesial roots of mandibular molars.

Key Learning Points

• Learning about the model development stages in FEA studies.

• Learning about the influence of nickel-titanium rotary systems with varying tapers and active cutting parts on stress distribution of mandibular first molars under occlusal loading.

• Learning about the influence of mesial root curve on stress distribution of mandibular first molars under occlusal loading.

5:42

Micro guided endodontics: A futuristic concept of biominimalization

*Alkhawas M

Department of Endodontics, Faculty of Dental Medicine, Al-Azhar University, Cairo, Egypt

Aim One of the main goals of endodontic treatment is to preserve the structural integrity of endodontically treated teeth. Unfortunately, traditional surgical and/or non-surgical management of teeth with calcified and ledged canals, broken instruments, perforations, apical transportations may compromise the remaining tooth structure. Currently, a computer-aided design utilizing cone beam computed tomography (CBCT) data followed by 3D printing of a guided template to the endodontic field aims for augmenting the concept of Biominimalization. This lecture will spot the light on the futuristic concept of microguided endodontics while answering many questions regarding its direct and indirect effects on the treatment outcome in both surgical and non-surgical retreatment.

Summary Beside teeth conservation, using the microguided surgical and non-surgical templates can reduce the treatment time, accelerate the healing process and improve the treatment outcome.

Key Learning Points

• Learning the cut decision line for using the microguided templates in endodontic practice.

• Learning the benefits of using microguided endodontics during both surgical and non-surgical endodontics.

• Learning the limitations of using microguided endodontics.

Hall 6

Electronic apex locators and working length estimation

9:00

Electronic working length variation during endodontic treatment: a randomized clinical trial

*Mirra D, Carpegna G, Alovisi M, Comba A, Pasqualini D, Scotti N, Berutti E

Department of Surgical Sciences, Endodontics, University of Turin, Dental School, Turin, Italy

Aim A randomized clinical trial was designed to evaluate the shift of electronic working length (EWL) during the endodontic treatment between the shaping and the root canal obturarion performed at 7 days.

Summary According to the literature, the proper EWL should be determined to achieve a complete filling of the root canal system. Epidemiologial studies reported that a better prognosis is achieved when root canal obturation is within 2 mm to the radiographic apex. No studies in literature investigate the causes that may lead to EWL variations and its relationship with the pulp inflammatory status. 106 teeth were enrolled. Canal scouting was performed with a size 10 K-files (Dentsply Maillefer, Switzerland). Glide path was completed mechanically with Proglider (Dentsply Maillefer). Shaping was achieved using randomly: ProTaper Universal or ProTaper Next or MTwo. The working length was detected, from the same reliable anatomical landmark, 3 times during the first appointment and 1 time after 7 days, before filling the canal, using the apex locator Morita Root ZX (J Morita Corp. Japan); the measurement at the first red line of the instrument was considered valid. We investigated whether the hypothetical variation was related to the anatomy (mono or multiple canal element); to the preoperative pulp status (asymptomatic irreversible pulpitis, symptomatic irreversible pulpitis, necrotic pulp); to the possible presence of endodontic lesion (LEO). The data obtained were analyzed in a descriptive way using a logistic regression model. The EWL variation occurred in 34% of the cases with a value equal to ± 0.05 mm. The variables that showed a statistically

significant impact on EWL variation were: the presence of acute apical periodontitis (p = 0.0110), the presence of LEO (p=0.0708) and the type of canal instrumentation (p = 0.0006). To justify this variation we propose that the inflammatory status can induce a change in the physiological state of periapical tissues; or that there may be a slight change in the architectural pattern of the root apex capable of providing such a 0.5 mm variation.

Key Learning Points

• Preoperatory pulp status and LEO influence on EWL.

• Does the shaping technique influence the EWL?

Local anaesthesia and pain control

9:18

Management of postoperative pain: risk factors & predictability, prevalence, and management

*Alsofi L

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

Aim Postoperative pain is defined as pain of any degree that occurs after the initiation of root canal treatment, while endodontic flare-up has been defined as the onset or continuation of pain and/or swelling after endodontic treatment. Management may include incision and drainage, canal debridement, and prescribing appropriate medications. It is well perceived that pretreatment pain predicts posttreatment pain and is consistent with several endodontic studies. While postoperative pain following an endodontic procedure is distressing for the patient, particularly when he or she arrives asymptomatic to the dental office, it is also stressful for the clinician. According to modern concepts, pain control relies on prediction and early prevention whereas earlier concepts of control were implemented when errors were detected or anticipated.

Summary Comparison between studies of pain is difficult because of differences in study designs, preoperative conditions, treatment protocol, pain measurement tools, and methods of data collection

and analysis. According to recent studies, pain perception and modulation is genetically enhanced and altered in patients with persistent post-endodontic pain. Here we present information from the literature regarding predictors of postoperative pain, risk factors, and management. The objective is to try to come to the conclusion that prevention of postoperative pain is the key for successful pain management.

Key Learning Points

• Define postoperative pain and its causes.

• Predict the occurrence of postoperative pain and assess risk factors.

• Manage postoperative pain by prevention rather than by postoperative pain management.

9:36

Neuropathic pain, what is it and why it happens, where is the role of psychosocial issues in diagnosis and treatment

*Sadr A

Department of Endodontics, Dental School, University Of Sydney (USYD), Sydney, Australia

Aim To explain about orofacial neuropathic pain (ONP), its diagnosis and to discuss psychosocial or personality profiles connection with orofacial neuropathic pain according to the current evidence and to provide insights into treatment recommendations for NP patients.

Summary Neuropathic pain is defined as 'pain arising as a direct consequence of a lesion or disease affecting the somatosensory system'. It is still unknown what are the factors that lead to the development of oral neuropathic pain, as it does not occur in every person who undergoes endodontic procedures or minor oral surgical procedures. About 5-10% of individuals who undergo endodontic or minor oral surgical procedures experience persistent pain after the procedure and some of these individuals develop orofacial neuropathic pain. A number of factors are thought to contribute to the development of orofacial neuropathic pain and psychological factors are thought to play a role.

However, there is only limited information as to the possible relationship between psychological factors and treatment outcomes in patients with orofacial neuropathic pain. The International Association for Study of Pain (IASP) describes that pain has a multidimensional entity. In this new paradigm it is imperative to know your selection criteria for patients so you can predict the maximum result. Literature showed that the pain experienced by patients with neuropathic pain do correlate with some psychosocial factors and accordingly most difficult to treat. Cognitive-behavioral therapy is popular in chronic orofacial pain management, and therefore knowing psychosocial/psychological baseline of patients may be a reliable predictor for long-term prognosis and response to treatment of various chronic orofacial pain conditions including NP. Some evidence behind the mentioned matters will be discussed in the presentation

Key Learning Points

• Orofacial Neuropathic pain (ONP) description.

• ONP diagnosis and possible predictors.

• NP relationship with psychological factors.

• Persistant chronic pain diagnosis.

9:54

WITHDRAWN

Irrigants/medicaments - antimicrobial activity

10:12

Effective treatment protocol in C-shaped canals

Kim YM, *Yang SE

Conservative Dentistry, St.Mary's Dental Hospital, Seoul, Republic of Korea

Aim To establish effective treatment protocols in complex C-shaped canals and raise the success rate of root canal treatment.

Summary C-shaped canals are quite common especially in Asian patients. C-shaped canal system has more various complex structures and it is hard to get proper debridement of bacteria and their by-products during cleaning and shaping. Because the major goal of root canal therapy is completely elimination of irritant and smear layer generated during mechanical preparation, a number of irrigation methods and protocols have been introduced to do this. Passive ultrasonic irrigation (PUI) means that ultrasonic waves are transmitted from the ultrasonic device through the tip, which make acoustic streaming and cavitation effect. Previous studies have demonstrated that PUI shows better antibacterial efficacy compared to traditional needle irrigation. Recently, Gallium-aluminum-arsenide (GaAlAs) semiconductor laser has been introduced in endodontic procedure and is known to penetrate into dentinal tubule more deeply upto 1000㎛ with minimizing damage to the surface. Two adjunctive irrigation methods seem to have an effective elimination of irritant and smear layer in C-shaped canals. Complete obturation of root canal systems is one of main factors for successful endodontic treatment. Recently, alternative new materials like bioceramics or zirconium have been developed and reported as having great favorable biocompatibility and antibiotic effects. These newly developed sealers have been reported as a higher sealing ability due to flowability and can be considered as a proper filling material in C-shaped canals having complex structure.

Key Learning Points

• There are various types of C-shaped canals.

• In chemical preparation, combined use of PUI and Lasers can be effective.

• In canal filling procedures, newly developed sealers can be considered for solving the problem of structural inaccessibility.

11:00

Establishment of an experimental intraradicular biofilm model in pigs for the evaluation of irrigation techniques

*Yahata Y [1], Tanaka T [1], Handa K [1], V. Venkataiah S [1], Kanehira M [1], Hasegawa T [1], Noiri Y [2], Saito M8 [1]

[1]Department of Operative Dentistry, Department of Restorative Dentistry, Tohoku University Graduate School of Dentistry, Sendai, [2]Division of Cariology, Operative Dentistry and Endodontics, Department of Oral Health Science, Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan

Aim To develop an *in vivo* intraradicular biofilm model that induced apical periodontitis using cattle pigs and to compare the efficacy of the biofilm removal for different irrigant activation techniques.

Summary Intraradicular biofilms formation is a critical causative factor in the formation of a periapical lesion. Even though numerous studies have been performed on *in vitro* and *ex vivo* models, the elimination of the biofilm formed *in vivo* is still unclear. Therefore, we attempted to establish *in vivo* biofilm formation models using the mandibular second premolar of cattle pigs. After access cavity preparation, canals were left open for two weeks and then sealed for four weeks to induce intracanal biofilms. The formation of intraradicular biofilms was evaluated using SEM and metagenome analysis of bacterial 16S rRNA gene-sequence to characterize the microbiota. Result indicated that biofilm formation was confirmed by exposing the root canals to the oral environment. According to the microbial analysis, the predominant bacteria belonging to the phylum are Firmicutes, Bacteroides, and Fusobacteria, which is similar to the microbiome profile of humans. To investigate the efficacy of biofilms removal, root canal irrigation was performed in the following ways: conventional needle irrigation (CNI), passive ultrasonic irrigation (PUI), subsonic irrigation (SI), and laser-activated irrigation (LAI). All groups were irrigated using 6% sodium hypochlorite for a total of five minutes. Afterward, a real-time PCR was conducted to quantitate the remaining E.faecalis as a marker of biofilm component. Regardless no irrigation technique completely eradicated *E.feacalis* from the root canal, LAI and SI

groups showed lower bacterial counts than the CNI and PUI groups ($p<0.05$). Our results show that an intraradicular biofilm model in cattle pigs has been successfully developed, and LAI and SI demonstrated better chemical debridement of biofilms under these experimental conditions.

Key Learning Points

• We developed an *in vivo* root canal irrigation model using cattle pigs, whose induced the bacterial biofilm similar to that of humans, as confirmed by a morphological and microbiome analysis.

• Although it is difficult to induce a significant irrigant flow for the entire root canal system, SI and LAI could be effective in eradicating biofilms.

11:18

Effect of a novel antibiotic-steriod paste over conventional antimicrobials in regenerative endodontics

*Mahima T, Sannidhi H

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

Aim To evaluate the antimicrobial efficacy of a Novel Antibiotic-Steroid paste over the regularly used calcium hydroxide, double antibiotic paste and modified triple antibiotic paste and to check the antimicrobial efficacy of irrigating solutions, Chlorhexidine Digluconate (CHX) and Sodium Hypochlorite (NaOCl) against a 3 week old *E. Faecalis* biofilm.

Summary A total of 112 human extracted teeth were contaminated with *E. faecalis* for a period of 21 days.The teeth were assigned to 8 groups with n = 14 in each group. The novel Antibiotic-Steroid Paste,Calcium hydroxide, Double antibiotic paste,Modified Triple antibiotic paste and a placebo were placed inside the canal, sealed and incubated in an aerobic environment at 37°C. For irrigating solutions, each prepared sample was immersed in 1 mL of sterile saline for 1min followed by irrigating and immersion with 1.5% NaOCl and 2% CHX for 5 minutes. An antimicrobial assessment was performed at the end of 2 days and 7 days, with seven teeth from each group, for each time interval.

Dentine debris collected was transferred to the respective medium for culture. After 24h, colonies were counted using classical bacterial counting technique as colony formed units (CFU). Statistical analysis revealed that Novel Antibiotic-steroid paste showed statistically insignificant difference when compared to DAP which had the highest antimicrobial properties . 1.5% NaOCl provided complete eradication of *E. Faecalis* biofilms. 5-minute biofilm exposure to 2% CHX provided an antibiofilm effect against 3 week old *E. Faecalis*, but not as effective as 1.5% NaOCl.

Key Learning Points

• 1.5 % sodium hypochlorite and double antibiotic paste had the highest antimicrobial properties in their respective groups.

• The novel Antibiotic steroid paste had antimicrobial efficacy similar to that of double antibiotic paste.

• Before this study opens new opportunities for the use of this novel antibiotic steroid paste, its cytotoxicity to the underlying mesenchymal stem cells at varying concentrations needs to be studied in detail.

11:36

WITHDRAWN

11:54

Influence of Photon-Induced Photoacoustic Streaming (PIPS) on root canal disinfection and post-operative pain: a randomized clinical trial

Genta E, Gianello E, Bonino F, Mandras Roana JN, Pasqualini D, *Alovisi M

Dental School, Department of Endodontics, University of Turin, Turin, Italy

Aim To evaluate the ability of PIPS Er:YAG laser to reduce the root canal bacterial count *in vivo* compared to traditional technique by collecting intracanal bacterial samples. Moreover, the study

evaluated patients post-operative quality of life after therapy through a questionnaire filled by patients.

Summary Thirty anterior and posterior teeth with pulp necrosis and apical periodontits were selected for endodontic treatment and randomly assigned to group A (n=15) with traditional irrigation and group B (n=15) with PIPS method applied according to protocol. Irrigation was carried out with NaOCl 5% and EDTA 10% solutions. Intracanal samples were taken before and after endodontic treatment with sterile paper points and were subjected to culture test. Values of microbical analysis were evaluated with Kolmogorov-Smirnov normality test and Mann-Whitney test ($p<0,05$). Self-assessment questionnaire was presented to patients to evaluate postoperative pain during 7 days after therapy. Variation of quality of life's indicators were assessed with a form of analysis of variance for repeated measurements and the Student's T-test. Irrigation with PIPS device is more effective than conventional irrigation in reducing canal bacterial count in vivo. This reduction is statistically significant in the non-selective, medium, suitable for isolation and culture of obligate anaerobes. PIPS method didn't adversely affect postoperative pain perceived by patients. There were no statistically significant differences between the groups among quality of life's indicators, except the amount of painkillers recruited, which was lower for the traditional method. Therefore PIPS could represent a promising aid to root canals disinfection, especially in case of simplified operative protocols and reduced times of instrumentation.

Key Learning Points

• PIPS laser showed higher efficacy on bacterial count *in vivo* compared to traditional irrigation method.

• Patients post operative quality of life was not negatively affected by PIPS method.

WITHDRAWN

Irrigants/medicaments - canal cleaning

2:30

Does a clinical irrigation protocol exist? How to transfer research into practice.

*Tonini R, Boschi G, Salgarello S

Department of Endodontics, University of Brescia, Brescia, Italy

Aim To scientifically analyze irrigation in endodontics as a key part of a successful root canal treatment, between shaping and root canal filling. This work suggests how to develop an efficient irrigation protocol that takes into account time, type of tooth, type of irrigant, their volume and their activation, transposing results from the literature into daily clinical practice.

Summary The time needed by an endodontist in order to obtain a glide path and a correct shaping during an RCT is variable, but nowadays it is substantially decreased thanks to rotating nickel-titanium instruments. For this reason, there is a high risk of automatically reducing the three factors that represent the basis for correct root canal cleaning: time, volume of irrigants and activation. In order to avoid this problem, this work introduces a new clinical point of view and suggests to calculate the real cleaning protocol only when shaping has been performed, without considering irrigants used up to that moment. Moreover, the irrigants employed during shaping are completely buffered by dentine and pulp remnants and cannot be considered as really effective. A dedicated time, a continuous alternation between fresh irrigants and activation methods and a right volume of irrigants are the clinical aspects that must be considered for writing down a simplified and repeatable cleaning protocol, which can be adapted depending on the number of canals.

Key Learning Points

• Understand how to create an efficient, evidence-based clinical irrigation protocol.

• Recognize time, volume and activation of irrigants as keys points of a cleaning protocol and learn how to manage with them.

2:48

Ultimate laser techniques for irrigant activation (PIPS and SWEEPS) compared to PUI (EndoUltra) and Sonics (EndoActivator). An *ex vivo* Study: FESEM evaluation of smear layer removal.

Mancini M[1], Cerroni L[2], *Palopoli P[1], Buoni C[1], Olivi G[3], Olivi M[4] Cianconi L[1]

[1]Department of Endodontics, Tor Vergata University, [2]Department of Clinical Science and Translational Medicine, University of Rome "Tor Vergata",[3]"Catholic University of the Sacred Hearth of Rome", [4]Private Practitioner, Rome, Italy

Aim To assess the effectiveness of several irrigant activation methods in removing the smear layer at 1, 3, 5 and 8 mm from the apex in minimally shaped root canals. Little has been said about smear layer removal from conservative endodontic preparations and no information is currently available on the efficacy of SWEEPS, a novel laser technique, in removing the smear layer.

Summary Eighty-five human mandibular premolars were selected. Specimens were shaped to TRUShape 25/.06 (Dentsply) and irrigated with 5.25% NaOCl. Teeth were then divided into 5 groups: (1 control [n=5] and 4 test groups [n=20]) according to the final activation technique [EndoActivator, (Dentsply, OK), (EA)], Ultrasonic [EndoUltra, (Vista, USA), (PUI)] and Laser (Fotona, Slovenia), (PIPS and SWEEPS)]. EDTA followed by NaOCl and again EDTA were activated for each test group. Specimens were then split longitudinally and observed by Field Emission Scanning Electron Microscopy (FESEM). Blinded evaluation of the presence of smear layer at 1, 3, 5 and 8 mm from the apex was performed at 1000X magnification, according to a 5-score index system. Scores were analyzed by Fisher's exact, Bartlett, Wilcoxon, Kruscall-Wallis, One-Way Anova, and Pearson X2 tests. At 1 mm only PIPS and SWEEPS performed better than the control group. At 3, 5 and 8 mm from the apex, all activation techniques had significant reductions of smear layer when compared to the control group. PIPS and SWEEPS obtained better cleanliness compared to EA, while only PIPS was superior to PUI in terms of cleanliness. None of the activation systems completely removed the smear layer from the root canal,

especially in the apical third. Nevertheless, PIPS and SWEEPS had the best results in conservative canal preparations.

Key Learning Points

• The persistence of the smear layer after canal shaping may hinder the quality of root canal treatment.

• Smear layer is removed with an alternating irrigation with EDTA and NaOCL. The activation of these irrigants enhances their action and distribution.

• In conservative canal preparations, laser activation techniques, such as PIPS and SWEEPS, produce remarkable results as these devices do not need to enter the root canal system.

3:06

The evolution of the bubble: does it matter ?

*De Moor RJG, Swimberghe R, Lietaer D, Ligthart S, Declercq A, De Bruyne M, Meire, MA

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

Aim At present laser-activated irrigation can be considered as an established cleaning and disinfection method in endodontics. With the development of shorter pulse durations, and different cavitation bubble dynamics (single- versus double-pulse regime) it is a question if the enhanced fluid dynamics will lead to a better 3D root canal cleaning efficacy of the isthmus.

Summary Recently transparent resin blocks containing two standardized root canals (apical diameter of 0.3 mm, 6% taper, 16 mm long, with a coronal reservoir) connected by an isthmus (0.15 mm wide, 2 mm high) were developed to study and visualize the way in which an isthmus can be cleaned with endodontic irrigation techniques. In addition, we also developed a hydrogel-containing dentine debris (biofilm mimicking hydrogel – BMH) to fill the isthmus. During this presentation a comparison is made between the following activation groups: Eddy, ultrasonically activated irrigation (UAI) with an Irrisafe

and LAI with a 2940 nm Er:YAG-laser in PIPS and AutoSWEEPS mode, and needle syringe irrigation. All protocols were executed for 3 × 20 s. Standardized images of the isthmus were taken before and after irrigation, and the amount of removed hydrogel was determined using image analysis software, allowing to calculate the amount of removed BMH at the different stages. The fluid motion and the BMH removal patterns from the isthmus will be visualized by means of high speed image films.

Key Learning Points

• Enhanced fluid streaming with Erbium laser matters: UAI < EDDY < (PIPS 50 µs ≤ PIPS 25 µs ≤ AutoSWEEPS).

• Laser activated irrigation has proven its efficacy, and overcomes the problems of spatial hindrance encountered with instruments and tips vibrating within the confines of the root canal system.

3:24

Efficacy of XP-endo finisher and Er:Yag Laser on the removal of calcium hydroxide paste from an artificial standardized apical groove

*Hancerliogullari D, Durna Yurtseven F, Erdemir A

Department of Endodontics, Kirikkale University, Kirikkale, Turkey

Aim To evaluate the effect of XP-endo finisher and Er:Yag laser on the removal of Ca(OH)2 from artificial apical grooves created in root canals.

Summary The root canals of forty-five extracted mandibular premolar teeth were prepared using ProTaper rotary instruments up to size F4. After the specimens had been split longitudinally, a standardized groove was prepared in the apical part of the root canal and filled with Ca(OH)2. Each tooth was reassembled and the apices of the roots were closed with wax. The coronal part of the canal was sealed with Cavit (3M ESPE, Germany). The samples were stored at 37°C and 100% humidity for 1 week. After 7 days, Ca(OH)2 was removed with the irrigation techniques used in each group (n=15): 17% EDTA with needle irrigation (Group1), XP-endo finisher (Group2) or Er:Yag laser (Group3)

(0.3 W 15 Hz 20 mJ). The canals were irrigated with 2.5% sodium hypochlorite. The root segments were disassembled, and the amount of remaining Ca(OH)2 was evaluated under a dental operating microscope using a 4-grade scoring system. The percentage of the remaining Ca(OH)2 in each half was corrected with the photographs using the ImageJ program (The National Institutes of Health NIH, USA) by two observers. The data were evaluated statistically using the Kruskal-Wallis and Mann-Whitney U tests with 95% confidence level (P=0.05). XP-endo finisher and Er:Yag laser were significantly more effective than needle irrigation (P<0.05). There was no significant difference between XP-endo finisher and Er:Yag laser groups (P>0.05). The use of activation methods increased the removal of Ca(OH)2 from an artificial standardized apical groove in extracted teeth.

Key Learning Points

• Use of irrigant activation increased root canal cleaning.

3:42

WITHDRAWN

4:00

Irrigation of the pulp space in the 21st Century - Where are we now?

*Farmakis ETR

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

Aim To discuss the findings of contemporary and novel irrigation approaches.

Summary Irrigation is of key importance for the cleaning and disinfection of the pulp space. While still the starting point of irrigation was, and still is, the humble but irreplaceable needle and syringe, research has shown that this alone is insufficient to remove the content of the root canal. Thus, many approaches and devices have been invented, in order to achieve the goal of ultra clean pulp space.

These range from the simple gutta-percha piston-agitating action, to sonic and ultrasonic activation, up to the most sophisticated Laser-assisted irrigation and the GentleWave device. All of the aforementioned, have their pros and cons, leaving the final decision to the practitioner for the best value-for money acquisition.

Key Learning Points

• Activation of irrigation solutions is mandatory.

• Activation should not be considered as an extra step in the stairway to success.

• Not all inexpensive approaches fall short of the goal to adequately clean the pulp space.

Irrigants/medicaments - other

4:48

Do we really need to activate our irrigant?

*Elkholy MMA

Department of Endodontics, Faculty of Dentistry, The British University in Egypt, Cairo, Egypt

Aim Proper evidence synthesis of the efficacy of different activation methods and their impact on the clinical outcome of the root canal treatment will be reviewed to determine the necessity and the benefits of irrigant activation.

Summary The major causative role of microorganisms in the pathogenesis of pulp and periapical diseases has clearly been demonstrated, hence the goal of endodontic treatment is to remove all the vital and necrotic tissues, microorganisms and microbial by-products from root canal system. This goal can be achieved through chemical and mechanical debridement of root canals. However, the root canal complexity and the sophistication of the microbial biofilm suggested a shift from the static needle- delivered irrigation method to the dynamic activated irrigation techniques. In the last decades, several methods of irrigant activation was developed, tested and adopted by endodontists all over the world. But in the era of evidence-based dentistry it is important to understand that

laboratory studies are required for the development of endodontic instruments, materials and techniques, and when they are designed with the same scientific rigour used for in vivo studies, they provide valid information that can inform the design of clinical research. However, considering the limitations of extrapolating the results of laboratory studies to clinical reality, the biological basis of clinical outcomes, bacterial reduction, etc… has to be evaluated by a clinical trial. Therefore, clinicians have to carefully evaluate available scientific data before adopting new techniques.

Key Learning Points

• Review on root canal disinfection challenges.

• Different activation and agitation protocols.

• Evidence synthesis of the efficacy of different activation and agitation protocols.

• Identification of gaps in knowledge, to suggest future research strategies.

5:06

Effect of different final irrigation protocols on fracture resistance of endodontically treated teeth

Doganay Yildiz E, *Fidan ME

Department of Endodontics, Kirikkale University, Kirikale, Turkey

Aim To compare the effect of different final irrigation protocols on fracture resistance values of endodontically treated teeth.

Summary Sixty extracted decoronated human mandibular premolars were selected for this study. Twelve randomly selected roots were used as the control group. The remaining roots were prepared by the ProTaper Universal system (Dentsply MailleferSwitzerland) up to F4. The prepared roots were divided into 4 (n = 12) groups according to the final irrigation protocol used: Group 1: 5% EDTA, 2.5% NaOCl and distilled water; Group 2: 5% EDTA, 2.5% NaOCl, distilled water and 2% CHX; Group 3: 5% EDTA, 2.5% NaOCl and 5% sodium thiosulfate; Group 4: 5% EDTA, 2.5% NaOCl, 5% sodium thiosulfate and 2% CHX. Root canals were filled with gutta-percha and epoxy resin-based root canal sealer (2Seal;

VDW, Germany). After being stored under 37°C and 100% humidity for a week, the specimens were loaded in a vertical direction at 1 mm/min speed until they were vertically fractured. The data were evaluated statistically using one-way ANOVA test followed by LSD post hoc test ($P< 0.05$). Control group had the highest vertical fracture strength, followed by group 3 ($P<0.05$). Group 1 had the lowest vertical fracture strength ($P<0.05$). There was no significant difference between group 2 and 4 ($P>0.05$).

Key Learning Points

• The final irrigation regimen has an impact on the fracture resistance values of endodontically treated teeth.

• Final irrigation with 5% EDTA, 2.5% NaOCl and 5% sodium thiosulfate; or 5% EDTA, 2.5% NaOCl, distilled water and 2% CHX; or 5% EDTA, 2.5% NaOCl, 5% sodium thiosulfate and 2% CHX enhanced the fracture resistance values of endodontically treated teeth.

5:24

Effect of different laser-assisted irrigation activation techniques on apical debris extrusion

Doganay Yildiz E, *Dincer B

Department of Endodontics, Kirikkale University, Kirikkale, Turkey

Aim To compare apical debris extrusion when photon-induced photoacoustic streaming (PIPS), erbium-doped yttrium aluminum garnet (Er:YAG), or neodymiumdoped yttrium aluminum garnet (Nd:YAG) lasers are used for irrigation activation.

Summary A total of 60 human mandibular premolar teeth of similar dimensions were selected and divided into four groups according to the irrigation technique (n = 15): conventional needle irrigation, PIPS, Er:YAG and Nd:YAG. The canals were instrumented using the ProTaper Universal system (Dentsply Maillefer, Ballaigues, Switzerland) up to F4. Distilled water was used during instrumentation and irrigation activation. Apically extruded debris during instrumentation and irrigation activation was

collected into preweighed Eppendorf tubes. The tubes were then stored in an incubator at 70°C for 5 days. The weight of dry extruded debris was assessed by subtracting the initial weight of the tube from the final weight. The data were evaluated statistically using one-way ANOVA test followed by LSD post hoc test ($P< 0.05$).

Key Learning Points

• All the techniques tested caused extrusion of some debris from the apical foramen.

• Conventional needle irrigation was associated with significantly less debris extrusion than laser-assisted irrigation activation groups ($P <0.05$).

• There was no significant difference among laser-assisted irrigation activation groups ($P> 0.05$).

5:42

Root fracture resistance of human teeth after exposure to calcium hydroxide

*Al-Hiyasat AS, Elfarraj HS

Department of Conservative Dentistry, Jordan University of Science and Technology, Faculty of Dentistry, Irbid, Jordan

Aim There is a rising clinical debate and concern whether Ca(OH)2 can adversely affect the mechanical properties of radicular dentine which may lead to root fracture. The aim of this study was to evaluate the effect of Ca(OH)2 on root fracture resistance and to investigate its effect on the chemical composition of the root dentine.

Summary Fifty single-rooted extracted mandibular premolar were cleaned and the access cavity was prepared for each tooth. Root canals were prepared by Protaper Universal file system up to F4 with 5.25% sodium hypochlorite irrigation. Teeth were then divided randomly in five groups (N=10). In groups 1,2,3,4 the root canals were filled with non-setting Ca(OH)2, while in the 5th group the root canals were left empty serving as a control. A cotton pellet was placed in the pulp chamber and the access cavity was sealed by glass ionomer cement. Teeth in groups 1, 2, 3 and 4 were immersed in PBS

for 7,14,30,90 days at 37oC respectively. After the assigned time, the glass ionomer and the cotton pellet were removed, and the root was separated from the crown. Each root was then placed in a mould simulating PDL and tested for fracture using a universal testing machine (Instron), including the control group. One part of the root was subjected to Energy-dispersive X-ray spectroscopy for chemical elements composition. The data was statistically analyzed by one-way ANOVA followed by Tuky's test. There was a significant reduction on root fracture resistance in groups 1,2,3, and 4 comparing to the control group ($P< 0.05$). Furthermore, the mean value of group 4 was significantly less than the means of all the other groups, while the differences between group 1, 2, and 3 were not statistically significant. Only Oxygen and Chlorine elements showed to have significant variation between the groups ($P< 0.05$).

Key Learning Points

• Teeth subjected to Ca(OH)2 have a lower fracture resistant compared to control teeth.

• The longer dressing period with Ca(OH)2 the lower the fracture resistance of the root.

• Dressing with Ca(OH)2 for more than one month should be avoided.

Hall 7

Endodontic revitalization/regeneration

9:00

Aetiological factors influencing the outcomes of regenerative endodontic procedures

*Nagy M

Department of Endodontics, Faculty of Dentistry, Ain Shams Unversity, Cairo, Egypt

Aim To highlight the major aetiological factors affecting the prognosis of regenerative endodontic procedures.

Summary Over the past decades, Endodontics has gone from pulp mummification to root canal disinfection & sealing, from manual to rotary instrumentation, from culturing to one-visit

appointment, from two-dimensional to three-dimensional radiography, and from pulp removal to pulpal regeneration. Management of immature permanent teeth with pulp necrosis was previously done by apexification or placement of MTA apical plugs. Nowadays, under the right conditions, tissues can be programmed for self-regeneration to restore the lost pulp-dentine complex. The clinical outcome of regenerative endodontic procedures is highly variable depending on many general and local aetiological factors. These factors include preoperative factors such as patient age, sex, periapical state, morphological variations and apical diameter, or operative factors including different disinfection protocols and various clinical regenerative strategies either cell-based or non-cell based.

Key Learning Points

• Criteria for proper regenerative endodontic case selection.

• Influence of different pre-operative factors on the prognosis of such cases.

• Different disinfection protocols adopted and their effect on case prognosis.

• Various clinical strategies including cell homing and cell transplantation.

9:18

The potential of Regenerative Endodontics and its use in mature necrotic teeth

*Shibani M[1], Gambarini G[2]

[1]Department of Endodontics, [2]Department of Endodontics and Conservative Dentistry, University of Rome Sapienza, Rome, Italy

Aim 1.To suggest the use of regenerative endodontic therapy on mature permanent teeth, 2. To illustrate a new treatment modality.

Summary For many years clinicians have used regenerative endodontic therapy (RET) in immature permanent teeth with necrotic pulps and the results were promising as the clinical signs and symptoms were eliminated in addition to thickening of the canal walls or continued root development. Morever, the question or debate remains whether their real optional is still controversial in mature

teeth with necrotic pulp as an alternative treatment modalities to conventional root canal treatment (RCT). There have been many case reports where they used the RET with a very promising result rendering (RET) suitable treatment in some cases. In those cases, the vitality was regained in the canals of mature permanent teeth that previously was destroyed by infection or trauma. The induction of periapical bleeding into the disinfected canal of immature or mature permanent teeth during regenerative endodontic therapy (RET) brings mesenchymal stem cells (platelet-derived growth factor) as well as fibrin scaffold from the periapical tissues into the canal space. The stem cells capable of producing mineralized tissue have migrated into the canals and formed hard tissue On the canal walls and at the root apex. Therefore, it is likely that new vital tissue might also be able to generate in the canals of human mature permanent teeth with necrotic pulps after RET.

Key Learning Points

• Regeneration endodontics is the new era of endodontics.

• Case selection.

• Maintain / restore the health of periradicular tissues.

9:36

Cell-based dentine-pulp regeneration: Towards a biomimetic translation of the native stem cell niche control

*Fahmy SH

Department of Endodontics, Faculty of Dentistry, Ain Shams University, Cairo, Egypt

Aim To highlight the state-of-art in the cell-based regenerative therapeutic protocols in endodontics from the perspective of micro-environmental influence on stem cell function, i.e. the trials to replicate the native stem cell niche.

Summary The main rationale for regenerative endodontic discipline is to restore a functional dentin-pulp complex with immune-competent elements. Clinically, cell-free revitalization therapies were

successful at resolving apical periodontitis but not enough for regenerating a functional dentin-pulp complex. Alternatively, MSCs-based approaches provided plausible outcomes in many pre-clinical studies. Nevertheless, the difficulty of fully mimicking the wide array of in-vivo micro-environmental cues hampered consistent stem cell therapy. The identification of potential therapeutic stem cells was the last major effort but an equally important mission is to engineer 3D microenvironments that replicate the structural, biochemical and mechanical cues of the native stem cell niche. An interdisciplinary merging of tissue biology and engineering created many biomaterials of variable architecture and topography, including nano and micro-scale substances. Cell-instructive artificial scaffolds were manufactured by tethering biomolecules to inert polymers for active interaction between cells and supporting extracellular matrix. Yet, a gap still separates the full understanding of the in-vivo stem cell behavior in the native niche and outside of it. Exploring stem cell-microenvironmental control mechanisms in 3D would produce complex quantitative metrics thereby yielding new mechanistic biological hypotheses, for more realistic biomaterial development and outcome characterization methodologies. Developing these complex microenvironments entails the implementation of different ECM proteins, signaling biomolecules, mechanical stimuli, and diverse cell populations which creates a large search field for the engineering of new tissue constructs.

Key Learning Points

• The sheer native micro-environmental cues affecting MSCs function and paracrine signaling.

• Advances in biomaterial engineering encompassing scaffolds and morphogens.

• 3D microenvironments rather than 2D cultures would provide a more realistic translation of native niche control.

9:54

Biomechanical performance of teeth treated with revitalization during biting, trauma and orthodontic movement. A finite element analysis.

*Bucchi C [1], Marcé-Nogué J [2], Galler K [3], Widbiller M [3]

[1]Department of Pathology and Experimental Therapy, University of Barcelona, Barcelona, Spain, [2]Center of Natural History, University of Hamburg, Hamburg, Germany, [3]Department of Conservative Dentistry and Periodontology, University Hospital Regensburg, Regensburg, Germany

Aim To describe and compare the stress distribution of teeth after revitalization through finite element analysis.

Summary Histological analyses of revitalized teeth demonstrated that apical closure and narrowing of the root canal is mostly based on apposition of cementum instead of tubular dentine. As cementum is less hard and elastic than dentine the question arises whether a root developed with cementum can endure mechanical stress similarly to roots completed by dentine. A finite element model of an upper incisor was constructed on basis of a µCT-scan. According to templates of immature teeth, the dentine of the mature 3D-model was divided into two portions: (i) the actual tooth in an immature state with thin walls and lacking root tip, and (ii) intracanalar tissue with the root tip. Thus, the core part with the root tip (20 % of the root length) represented newly formed tissue, which was assigned with the mechanical parameters (Young modulus and Poisson coefficient) of dentine or cementum to simulate a dentine-reinforced tooth (DR) or a cementum-reinforced tooth (CR). The immature tooth and teeth reinforced by either dentine or cementum underwent simulation of biting, trauma and orthodontic movement. A non-linear structural static analysis assuming large deformations was performed using the finite element package ANSYS® 17.1 in a Dell Precision™ Workstation T7910. Von Mises stress values were compared between the teeth. Stress peaks were lower in DR compared to CR in all scenarios. Dentine reinforcement caused higher stress values in the apical segment due to absorbance of the applied force, whereas stress was barely transferred towards deposited cementum. Thus, DR had an evenly distribution of stress along the root. Maximum stress in the immature tooth developed apically and involved the entire thickness of the delicate walls. On the contrary, DR and CR revealed highest stress in the external portion of the root decreasing towards the apex. Greatest mechanical stress was caused by dental trauma followed by biting and orthodontic movement.

Key Learning Points

• The cementum-reinforced tooth distributed the stress disadvantageously compared to dentine-reinforced tooth.

• Dentine formation after revitalization reduces mechanical stress, which might decrease the risk of fractures.

10:12

WITHDRAWN

11:00

Dental pulp stem cells: Isolation, culture methods and effects of surfactant addition to EDTA

*Kucukkaya Eren S [1], Bahador Zırh E [2], Zeybek ND [2], Askerbeyli Örs S[1], Aksel H [1], Parashos P [3]

[1]Department of Endodontics, [2]Department of Histology and Embryology, Hacettepe University, Ankara, Turkey, [3]Department of Endodontics, University of Melbourne, Melbourne, Australia

Aim The primary aim is to discuss isolation techniques and culture methods of dental pulp stem cells (DPSCs). Secondly, to describe the effects of surfactant addition to EDTA solution on cell attachment, survival and growth factor release.

Summary DPSCs can be obtained from extracted teeth by various methodologies including the explant technique or enzymatic digestion method. In addition, commercially available cell lines can be used to obtain DPSCs. Many aspects of these methodologies such as size of the explant, type and concentration of enzyme and the ingredients of culture medium vary between studies. DPSCs are commonly cultured as adherent monolayer cells using a conventional tissue culture technique. The use of 3-dimensional culture systems is another test method of DPSCs. During regenerative endodontic procedures, EDTA solution is generally used for the release of growth factors to induce cell proliferation, differentiation and chemotaxis. The addition of surfactant to EDTA reduces the

surface tension of the solution and may increase the penetration of the solution into dentine and enhance the biological effects of the solution. The effects of surfactant addition to EDTA on the DPSCs proliferation, adherence to dentine, and growth factor release were evaluated by WST-1, LDH assays and human TGF-β1 ELISA kit, respectively and their results will be discussed.

Key Learning Points

• Learning about the isolation methods of DPSCs.

• Obtaining information about the current culture methods that can be used in experiments with DPSCs.

• Learning about the influence of surfactant addition to EDTA on the biological effects of the solution.

11:18

It's alive, will tissue regeneration in mature teeth become a future reality?

*Hassan R

Department of Endodontics, Minia University, Cairo, Egypt

Aim To summarize the biological basis of potential regenerative endodontic procedures of mature permanent teeth in adult patients and identify the benefits as well as the challenges that encounter this goal.

Summary A typical endodontic treatment or root canal therapy involves pulp extirpation followed by root canal enlargement and obturation. Despite reported clinical success, endodontically treated teeth become de-vitalized and brittle, susceptible to postoperative fracture and re-infections. Therefore, a conceptual shift, rather than incremental technical improvements based on the existing endodontic philosophy, is necessary to improve endodontic success rates and further promote the longevity of natural teeth. The indication of regenerative endodontic procedures are currently limited to immature teeth. From the perspective of tissue engineering, pulp regeneration in mature teeth offers the following advantages. Reconstitution of the neurovascular system in root canals by pulp

regeneration will provide pulp tissues with an immune system, which will function as the first line of defense against microbial challenge. The gain of nerve function in regenerated pulp tissues will provide an alarm system during the tissue injury and protect the pulp from further damage. However, Regenerative endodontic therapy in mature teeth will likely encounter more challenges than in immature teeth. Less stem/progenitor cells in mature teeth and narrower apical pathways for stem/progenitor cell migration will be major limitations. The regeneration of a functional pulp-dentin complex would have a promising impact on efforts to retain the natural dentition, the ultimate goal of endodontic treatment.

Key Learning Points

• Understand biological basis of regenerative endodontic procedures of mature permanent teeth.

• A clinically viable cell sources for dental pulp regeneration from outside the root apex.

• Describe the relation between the width of the apical foramen of mature teeth and tissue regeneration.

• Guided-endodontic repair (GER) rather than endodontic regeneration.

11:36

Evaluation of case-reports/clinical studies considering regenerative approaches in three indexed endodontic journals between 2009-2018

*Turer SH, Uzunoglu Ozyurek E, Altundasar E

Department of Endodontics, Hacettepe University, Ankara, Turkey

Aim To evaluate the case reports or clinical studies considering regenerative approaches in Journal of Endodontics, International Endodontic Journal and Australian Endodontic Journal.

Summary All issues between 2009-2018 were scanned by two researchers. The following data were analyzed according to publication year, number of; authors, citations, cases, country, type of treated tooth, reason and success of treatment and, materials . 78 articles were included (85.9% JOE, 12.8%

IEJ and 1.3% AEJ). Percentages of articles between 2009-2013 and 2014-2018 were 35.9% and 64.13%, respectively ($p<0.018$). Average of citations was 64.82 between 2009-2013, while it was 11.9 for last 5 years. Regarding the number of publications (30.76%) and citations (average: 39.08), leading country was United States, followed by China (11.53% publications; citations average: 26.77). Evaluation of number of authors revealed that 44.87% of the studies were performed with maximum three authors, while 12.82% of the studies included more than 6 authors ($p<0.001$). According to the results, 498 patients (20.68% between 2009-2013, 79.32% between 2014-2018) were treated with regenerative approaches. 92% of the studies were successful after 6 months follow up. Success of the treatment was confirmed clinically and radiographically. CBCT was used for evaluation of treatment success in 23.07% of studies. Age of patients were between 6-48 in studies. In 57.7% of the studies, regenerative approaches were preferred following trauma. Other scenarios included caries, morphological anomalies and, unintentional tooth extraction. MTA was used in the 75.64% of the studies ($p<0.05$). Other materials were: Biodentine, glass ionomer cement and Calcium Enriched Material. Double/triple antibiotic pastes were used in 55.13% of the studies for intracanal medication followed by calcium hydroxide (in 34.62% of the studies). 525 teeth treated with regenerative approaches and 55% were anterior, while 38.5% and 6.5% were premolars and molars, respectively.

Key Learning Points

• Regenerative approaches gained popularity in last 5 years with high success rates.

• MTA was preferred in most of the cases.

• Anterior and premolar teeth were treated with these methods compared to molars, frequently in patients aged 8-12.

11:54

Stem cells from apical papilla and their role in endodontic regenerative techniques. Review and future perspectives.

*Sarris K, Sakka D, Timplalexis D, Digka A, Lyroudia K

Department of Endodontology, Aristotle University, Thessaloniki, Greece

Aim To describe the role of stem cells from the apical papilla (SCAPs) in the regenerative techniques and analyze the potential of their use.

Summary Endodontology is a dental specialty concerning the maintenance of the natural dentition by preventing the evolution of pulp necrosis and periradicular pathosis. Preventing the loss of immature permanent teeth in young patients, due to pulp necrosis from trauma, caries or dental anomalies, as dens envaginatus, is of outmost importance. Clinical protocols regarding tissue engineering that regenerate the dental pulp tissue and enhance root development led to an increased research interest and the establishment of the Regenerative Endodontic Procedures (REP). The use of stem cells from the apical papilla for tissue engineering is widely admitted, as their multi-differentiation potential, their accessibility and their self-renewal capacity are clearly stated. SCAPs' (stem cells of Apical Papilla) ability to differentiate into osteo/odontoblast like cells, chondroblasts and adipocytes is documented. Furthermore, under proper stimulation a neurogenic resemblance as well as angiogenic potential of SCAPs is observed. As in the absence of those cells, root maturation is not taking place the absolute need to preserve them and use them for future therapeutic needs are a fact. The creation of cell sheets of stem cells from apical papilla will give a new perspective in the utilization of those cells for tissue regeneration.

Key Learning Points

• Preventing the loss of immature permanent teeth in young patients, due to pulp necrosis is of outmost importance.

• Regenerative Endodontic Procedures are widely used but further research needs to be carried out.

• The succsessful preservetion of SCAPs to use them for future therapeutic needs are a fact.

• Creating cell sheets of SCAPs will give a new perspective in the utilization of those cells for tissue regeneration.

12:12:

Dental pulp regeneration innovative protocol: a report of clinical cases

*Domini MC [1], Alovisi M [1], Comba A[2], Carpegna G[1], Pasqualini D [1], Berutti E [1]

[1]Surgical Sciences Dental School Endodontics, [2]Surgical Sciences, Dental School, Restorative Dentistry, University of Turin, Torino, Italy

Aim To evaluate a novel clarithromycin-containing triple antibiotic mixture (3-MIXC) vehicled by hyaluronic acid (HA) and to report pulp regeneration clinical cases using this antibiotic paste.

Summary Alternative antibiotic mixtures are already applied in pulp regeneration protocols, although tooth discoloration often occurs as a side effect. A previous study reported that 3-MIXC has no tooth discoloration effects in vitro. Ten patients underwent anterior teeth trauma with pulp necrosis. The element were permanent teeth with immature root and open apexes. Mini-invasive opening of the pulp chamber was achieved and 3-MIXC was positioned following the published protocol. Three weeks later, the second appointment consisted in removing the antibiotic paste, bleeding stimulation and MTA sealing at the cement enamel junction (CEJ) with composite restoration. The clinical and radiographic treatment outcomes were observed with a minimum follow-up of 6 months. The efficacy of the novel 3-MIXC was previously tested ex-vivo through confocal laser scanner microscopy (CLSM) viability staining to quantitatively analyze the mean depth of the antibacterial effect and the proportions of dead and live bacteria inside the dentinal tubules. 3-MIXC demonstrated an ex-vivo efficacy depth of action similar to the Trimix antibiotic paste. No post-operative pain and tooth discoloration were observed for all the cases.

Key Learning Points

• 3-MICX with HA efficacy and depth of action seemed comparable with Trimix from *ex vivo* evaluations

• The management of the necrotic immature permanent teeth is presented.

• The outcomes of the treatment and the lack of dentinal discoloration are discussed.

2:30

The potential application of Berberine in Endodontics

*Sun J [1], Cui Y [2], Xie J [3], Zheng L[1], Huang D[1], Ye L [1], Zhou X [1]

[1]State Key Laboratory of Oral Diseases/West China Hospital of Stomatology, Sichuan University, Sichuan, [2]West China School of Stomatology, Sichuan University, Sichuan, [3]State Key Laboratory of Oral Diseases, Sichuan University, Sichuan, China

Aim To find better substance which could promote mineralization of oral tissues and repair the hard tissue loss due to apical periodontitis, improve the regenerative endodontic treatment, begin to define regulatory mechanisms and further contribute to tooth regeneration.

Summary Regenerative endodontics is recommended to treat immature permanent teeth with pulp necrosis or apical periodontitis for thickening root wall and closuring root apex. while, the results of root maturation are variable and tooth are likely discolored after treatment. Berberine is a potential medicine for bone disorders, so we proposed to apply berberine to enhance tissue repair in apical area. In rats, we established the model of immature teeth with apical periodontitis, and the root canals were filled with berberine, calcium hydroxide or sterilized saline for 3 weeks. We found there were repaired tissue along the root apex in berberine group. To explore the mechanism, berberine in different concentration introduced into human stem cells of apical papilla (hSCAPs). In our research, we found that berberine promoted hSCAPs osteogenesis by stimulating canonical Wnt/ β-catenin signaling pathway. Notably, berberine formed new tissue in the apical area significantly. In conclusion, berberine can enhance tissue repair in immature permanent teeth with apical periodontitis.

Key Learning Points

• The current status of regenerative endodontic treatment.

• The biological function of berberine.

• The use of berberine to enhances tissue repair in an immature tooth with apical periodontitis and its possible molecular mechanisms.

Epidemiology

2:48

WITHDRAWN

3:06

Fracture incidence of Revo-S and ProTaper-Next instrument files by endodontic students or endodontic specialists: a cross-sectional retrospective study

*Bozkurt DA, Terlemez A

Department of Endodontics, Necmettin Erbakan University, Konya, Turkey

Aim To define the fracture incidence of Revo-S and ProTaper-Next instrument files by endodontic students or endodontic specialists.

Summary A retrospective study was conducted by reviewing the dental records of 5596 endodontic cases treated between December 2017 and December 2018 at Necmettin Erbakan University Faculty of Dentistry Department of Endodontics by students in an endodontic graduate program or endodontic specialists. Tooth type, number of treated root canals, number of fractured instruments and sizes, root canal treatment status, academic years data were collected. Chi-square tests were used for statistical analysis (p=0.05). There were significant differences for fractured files between academic years (endodontic student: 9.18%, specialist: 2.8%). There were no significant differences of fractured type of files and tooth location between academic years. There was a significant difference between fractured files for root canal and rotary files (Revo-S at mesiobuccal mandibular root canal; 83 fractured files), the other root canal types were not significantly different. Mesiobuccal mandibular molar, mesiolingual mandibular molar, mesiobuccal maxillary molar and distobuccal maxillary molar

root canals had more fractured files than the other root canals. There were significant differences for fractured files between Revo-s and ProTaper-Next files (70.98; 29.02 %, respectively). There were a significant differences for fractured file segment sizes; Revo-S files 2 and 3 mm or ProTaper-Next files 2 mm had more fractured segment sizes than the others (3 mm, 4 mm or 5 mm). There were a significant differences for fractured files between root canal treatment (272 fractured files) and retreatment (107 fractured files), no significant differences between root canal treatment status and academic years.

Key Learning Points

• Academic degree influenced the number of fractured instruments.

• Revo-S files can be fractured more than Protaper-Next files.

• Take more attention in mesiobuccal mandibular molar, mesiolingual mandibular molar, mesiobuccal maxillary molar and distobuccal maxillary molar root canals.

3:24

The role of systemic medications in the pathogenesis or healing of apical periodontitis

*Fouad A

Adams School of Dentistry, University of North Carolina, Chapel Hill, US

Aim To review the role of selected systemic medications on the pathogenesis and/or healing of apical periodontitis

Summary Endodontic patients frequently have health conditions that may affect the pathogenesis of endodontic disease or the healing after treatment. Conditions like smoking, diabetes mellitus, cardiovascular diseases, end-stage renal disease, preeclampsia and others have been studies with respect to their association with incidence and prevalence of apical periodontitis and its treatment. In recent years, published studies have also reported the role of systemic medications such as bisphosphonates, statins, metformin, and biologicals such as anti-TNF-alpha antibody in modulating

the pathogenesis of apical periodontitis or the healing after treatment. This presentation will review this information, and provide some recommendations on how to advise patients on these issues.

Key Learning Points

• The mechanism of action of selected medications that influence endodontic diseases

• The manner by which these medications may affect the development or healing of apical periodontitis.

• How this information may affect current recommendations to patients and future research.

Evaluation of a technique/materials

3:42

Separated instruments - algorithm of clinical decision making

*Solomonov M

Department of Endodontics, Israel Defense Forces Medical Corps, Tel Hashomer, Kiriat-ono, Israel

Aim To suggest a useful decision-making algorithm to deal with cases of a separated instrument in clinical practice.

Summary A separated instrument is always a stressful situation for the clinician. Reasons for separation of Stainless Steel and Nickel-Titanium instrument will be reviewed. Clinical hints for reducing these unwanted events will be discussed. The influence of separated instrument and their removal on the prognosis of endodontically treated tooth will be summarized and clinical procedures will be reviewed. A suggestive algorithm of the clinical decision will be proposed, based on the tooth vitality, cleaning and shaping stage, apico-coronal positioning of the separated fragment, the degree of root curvature and future outcome. Decisions to leave the instrument within the root canal, to bypass it or to retrieve will be clearly defined by our algorithm.

Key Learning Points

• The clinical decision in case of separated instrument: removal, bypass or follow up, is based on the tooth vitality, cleaning and shaping stage, apico-coronal positioning of the separated fragment and the degree of root curvature.

4:30

WITHDRAWN

4:48

Micro-CT study on cadaver of micro-cracks formation after rotary and reciprocating instrumentation

*Giuliano C, Tassone R, Carpegna G, Pasqualini D, Alovisi M, Scotti N, Berutti E

Surgical Sciences, Endodontics, Dental School Turin, university of Turin, Turin, Italy

Aim To describe micro-cracks formation using atraumatic methods in the lower incisors of cadavers during glide path and shaping with rotary and reciprocating instruments.

Summary Twenty-one cadaver lower incisors surrounded by alveolar bone were collected. After periapical radiography, access cavities were performed with a diamond bur. The canal scouting with a size 10 K-file and a second control radiography was done. Fourteen specimens were divided in two groups of 7: REC and CONT. In the REC group, the glide path and shaping were performed with reciprocating instruments: Wave One Gold Glider, for the glide path, and Wave One Gold Primary, for the shaping. In the CONT group shaping was carried out with continuous rotary instruments: Proglider and Protaper Next X1-X2. Three micro-CT acquisition were done for each tooth: pre instrumentation, after glide path and after shaping. Four specialists observed 10908 slices obtained during the post shaping acquisition and noted the position of the micro-cracks and the number of slices with cracks. Micro-cracks were researched in pretreatment and post glide path acquisition. A descriptive analysis for all the variables was done and the Chi-square test was used to evaluate the difference between the two groups ($p < 0.05$).On average, 780 slices for every sample were observed from the cement-

enamel junction to the apex. The results did not show significant differences (P=0.06). Methods used in this study, based on cadaver teeth with surrounding bone analysis by the micro-CT, is considered the most accurate to avoid bias caused by the tooth extraction and sectioning. The endodontic instruments motion, rotary or reciprocating, did not influence micro-crack formation.

Key Learning Points

• MicroCT evaluation may avoid bias linked to tooth extraction.

• Root canal shaping may create microcracks.

• Not every cracks evolves to a vertical fracture.

5:06

Post-operative quality of life following single-visit root canal treatment performed with WaveOne Gold technique: an observational study.

*Multari S, Carpegna G, Migliaretti G, Comba A, Scotti N, Berutti E, Pasqualini D

Department of Surgical Sciences, Dental School, Endodontics, Turin, Italy, University of Turin, Turin, Italy

Aim To evaluate the impact of reciprocating instrumentation performed with WaveOne Gold (WOG) compared to WaveOne Classic (WOC) on post-operative quality of life (POQoL) after single-visit primary root canal treatment.

Summary An observational study was designed and carried out in the University of Turin – Dental School. Healthy subjects with asymptomatic or symptomatic irreversible pulpitis and pulp necrosis, with or without apical periodontitis, scheduled for primary root canal treatment were enrolled until the achievement of the sample size. A single-visit primary root canal treatment was performed with ProGlider and WaveOne Gold Primary (n=25) or WaveOne Classic Primary (n=29) up to working length (WL). Irrigation was conducted with 5% NaOCl and 10% EDTA. Root canal filling was performed with a carrier-based technique. POQoL indicators were evaluated for 7 days post-treatment with a self-

assessment questionnaire, based on a Likert scale. The variation of each indicator over time was analysed with ANOVA and the impact of each variable on POQoL was analysed with a multivariate logistic regression model. Post-operative pain curves demonstrated a more favourable trend in the WOG group (mean pain P=0.43; maximum pain P=0.27). Difficulty in eating (P=0.50), performing daily activities (P=0.78), sleeping (P=0.79), social relations (P=0.91) were less evident in the WOG group, although the differences were not significant. Patients' perception of the treatment impact on POQoL was more favourable in the WOG group. WOG reciprocating instrumentation influenced patients' POQoL less than WOC.

Key Learning Points

• Reciprocating instrumentation may be associated with postoperative pain.

• Instrumentation with WaveOne Gold showed lower impact on POQoL compared to WO classic.

• Patient oriented outcomes seem to benefit from the WOG design.

• Importance of patients' point of view.

Other

5:24

The use of hypnosis in Endodontics

*İriboz E

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

Aim To discuss the nature of hypnosis, together with its therapeutic role in the control of the potential problems that occur in everyday dental/endodontics practice.

Summary Dental fear is a universal problem justifying the increasing relevance of psychology and the behavioural sciences to dental practice. Use of pharmacological sedation has been increased over the past two decades, in order to relieve dental anxiety and let the patient face oral surgery safely. Hypnosis is a still underused but powerful non-pharmacological tool in dentistry. It provides an

effective sedation whilst maintaining patient collaboration, but it also may help patients recovering from dental anxiety/phobia. While pharmacological sedation affords a temporary respite and helps the patient to cope with a single procedure, hypnosis can effectively allow for both an excellent sedation in a physiological way and the treatment of patients' anxiety, or substantially decrease the doses used for sedative and analgesic drugs when these are needed. Although there are lots of fields that we may use hypnosis in dentistry, endodontics is the most challenging one, as the patients mostly suffer pain along with the dental fear. Among the dental fears probably the most common one is the fear from injection or needle. Use of hypnosis can be an alternative to dental injections or even if not it can relieve the patient prior to injection. In the light of these information, I would like to explore what hypnosis is, its applications in dentistry/endodontics and provide a brief insight into how these hypnotic concepts may be put to use in daily dental practice.

Key Learning Points

• How hypnosis may replace or reduce the use of pharmacological sedation.

• Dental fields that we can use hypnosis, such as anxiety, bruxism or gag reflex.

• The reason why endodontics is a major field of dental fear.

Bleaching

5:42

Effect of different intracoronal bleaching agents and their interaction with the final irrigation regimen on microhardness, tubule radius and mineral content of coronal dentine

*Karaaslan H, Altundasar E, Özçelik B

Department of Endodontics, School of Dentistry, Hacettepe University, Ankara, Turkey

Aim To evaluate the effect of different intracoronal bleaching agents and their combinations on microhardness, micromorphology and mineral content of human coronal dentine, in consideration with their interaction with the final irrigation protocol used in root canal treatments.

Summary Hydrogen peroxide 35% (HP), carbamide peroxide 37 % (CP) and sodium perborate (SP) are the most common intracoronal bleaching agents used in internal bleaching which has become an important treatment modality in discolored teeth after regenerative procedures. Similar dimensioned 240 dentin sections were obtained from 60 intact human mandibular molar crowns. Samples were randomly divided into 2 groups according to the root canal irrigation exposure. Half of the samples (120) were exposed to root canal irrigants (10 ml NaOCl %2,5 for 20 minutes, 3 ml EDTA %17 for 3 minutes). Then samples were further divided into 6 groups (n=20) according to the bleaching agents used: SP, CP, HP, SP+CP, SP+HP and no bleaching as a negative control group. Samples were treated with respective bleaching agents, then they were isolated with PTFE tape and stored for 2 weeks. On day 7, bleaching agents were renewed. All samples were stored at 37 C at 100% humidity at the incubator. Vickers microhardness values were measured before and after the bleaching procedure. Samples were inspected under SEM for tubule radii and mineral content. Data was statistically analyzed. Irrigation alone did not influence the microhardness values of samples ($p > 0.05$). Treatment with SP, SP+CP, CP, and SP+HP significantly increased the microhardness values of samples regardless of the final irrigation regimen ($p < 0.05$). Microhardness values of irrigated/SP + CP treated samples were statistically higher than not-irrigated/SP + CP treated samples ($p < 0.05$). There was no significant difference among the bleached groups in terms of tubule radii although irrigated samples had significantly increased radii ($p < 0.05$). Ca/P ratio significantly increased in all bleached test subgroups when compared with non-bleached control groups ($p < 0.05$).

Key Learning Points

• Understanding how coronal dentine is affected by intracoronal bleaching agents, both chemically and physically.

• Understanding the physical and chemical effects of the interaction between irrigation agents and bleaching agents on human dentine.

Saturday

Hall 4

Pulp and periapical tissue biology and pathology

9:00

The influence of Type 2 Diabetes on clinically normal dental pulp tissues

*AlSamahi S [1], Milne TJ[1], Rich AM [2], Hussaini HM [1], Friedlander LT [1]

[1]Sir John Walsh Research Institute, Faculty of Dentistry, [2]Dental School, Otago University, Dunedin, New Zealand

Aim 1) To compare the histology and morphology of normal dental pulp tissue from Type 2 diabetes (T2D) and non-diabetic participants, 2) To examine the expression and distribution of AGE, RAGE, inflammatory markers and immune cells using immunohistochemistry.

Summary Ethical approval was obtained from the University of Otago Human Ethics Committee (H16/069). Twenty permanent extracted teeth (10 T2D, 10 non-T2D) that had been diagnosed clinically with a normal dental pulp were decalcified in 10% EDTA, and embedded in paraffin. Sections were stained with haematoxylin and eosin, and special stains (Massons Trichrome, van Gieson, silver stain) for histological evaluation. Immunohistochemistry using anti-AGE, anti-RAGE, anti-IL1-?, anti-IL6, anti-TNF-?, anti-CD4 (Th Cell marker), anti-FOXP3 (Forkhead transcription factor), anti-CD68 (monocyte marker) and anti-CD83 (T Cells and dendritic cells) and visualized with the chromogen DAB. Positive control tissues included lung (RAGE), thymus (AGE, IL1-?), dentigerous cyst (CD68), spleen (IL6, TNF-?, CD-83) and tonsil (CD-4). Non-specific anti-IgG was the isotype negative control. Qualitative and quantitative analyses were performed to evaluate pulpal morphology and protein expression. Data analyses were performed with GraphPad Prism, using students t-test at $P < 0.05$. Our results showed that the pulp of T2D was less cellular and had fewer blood vessels. Blood vessel walls tended to be thickened and calcifications were frequently seen within the central pulp. There was

increased collagen and less elastin compared with non-T2D. IHC showed T2D was associated with significantly greater expression of AGE, RAGE, IL1-?, TNF-?, CD68 ($P \leq 0.001$), IL6, CD-4 ($P = 0.02$), CD83($P = 0.04$), and decreased expression of FOXP3 ($P=0.01$). FOXP3 was mainly expressed in the subodontoblast region and on endothelial cells while immunity markers were seen throughout the pulp. AGE was strongly expressed in collagen fibres.

Key Learning Points

• T2D influences the morphology of normal dental pulp tissue with increased collagen deposition and reduced vascularity.

• T2D alters the immune response in the pulp which may impair healing

• T2D increased the expression of AGE, RAGE and the inflammatory markers in the pulp and have been observed in other body sites.

• The general medical status of patients should be considered when making clinical decisions.

9:18

Injectable functionalised phosphopullulan-based biomaterial for pulp-tissue engineering. An *ex vivo* and *in vivo* study.

*Pedano MS[1], Li X[1], Camargo B[1], Yoshihara K[2], Yoshida Y[3], Van Landuyt KL[3], Van Meerbeek B[1]

[1]BIOMAT - Oral Health Sciences, KU Leuven, Leuven, Belgium, Department of Biomaterials Okayama University, Okayama, Japan, [3]Department of Biomaterials and Bioengineering, Hokkaido University, Sapporo, Japan

Aim To evaluate the histological reaction and mineralised tissue formation after pulp capping with a recently developed injectable phosphopullulan-based biomaterial.

Summary Calcium-silicate biomaterials are the first choice for pulp-tissue engineering. However, the lack of adhesion to hard dental tissues together with difficult-handling properties make these materials far from the ideal characteristics they should possess. In this sense, a new injectable

functionalised phosphopullulan-based calcium-silicate material has been developed recently to overcome these major shortcomings. However, up to date, little information is available regarding the effect of this material against the dental-pulp tissue. In this study, and after approval by the Ethical Committee, we aimed to qualitative and quantitative characterise the inflammatory reaction and the regenerative potential of this bioceramic material by using an *ex vivo* human tooth-culture model and an *in vivo* minipig pulp-dentine defect model. This, by means of three-dimensional micro-CT and histology analyses. Treatment with the experimental biomaterial stimulated the formation of fibrous tissue and mineralised foci *ex vivo*. Moreover, it promoted early inflammatory reactions and the regeneration of the pulp-tissue interface *in vivo* after 7 and 70 days, respectively. Our results bring promising insights into the effects of bioceramic-mediated dental pulp regeneration and repair, and the novel ready-to-use functionalised calcium-silicate cement shows valuable therapeutic potential in dental pulp-dentine repair application.

Key Learning Points

• The phosphopullulan-functionalised biomaterial showed promising results as a pulp-capping agent.

• The *ex vivo* human tooth model might be a valuable tool to study the early events occurring after pulp exposure and capping with bioceramic materials.

• Biodentine (Septodont, France) confirmed its ability to induce hard tissue mineralisation using an *ex vivo* study with human teeth and also in the *in vivo* animal study.

9:36

Global gene expression analysis of immunological responses during the development of apical periodontitis model in mice.

*Hasegawa T [1], Handa K [1], Yahata Y [1], Tanaka T [1], V.Venkataiah S [1], Njuguna M [1], Noiri Y [2], Saito M [1]

[1]Operative Dentistry, Department of Restorative Dentistry, Tohoku University Graduate School of Dentistry, Sendai City, [2]Division of Cariology, Operative Dentistry and Endodontics, Department of Oral Health Science, Niigata University Graduate School of Medical and Dental Sciences, Niigata City, Japan

Aim To establish apical periodontitis in mice and clarify the molecular pathogenesis by investigating the expression profile of genes involved in the immune reaction during the development of periapical lesion model.

Summary Apical periodontitis is chronic inflammatory disease caused by intraradicular biofilm infection which induced inflammatory cytokines that lead to periapical tissue destruction. Progression of apical periodontitis causes continuous inflammatory cytokines release which is not only progress destruction of the periapical tissue but also accelerate symptoms of systemic diseases such as autoimmune, cardiovascular, and endocrine disease. Despite the importance of endodontic retreatment has been noted in medical field, the immunology of apical periodontitis including inflammatory cytokines and the immune cell dynamics involved in the onset of the lesion are still unclear. Hence, we investigated the immune reaction during the development of apical periodontitis induced by exposing the pulp chamber of first molar in C57BL6 mice. To investigate spatiotemporal changes of local immune reaction, mandibles were removed at 3, 7, 14, 21, 28, 56 days after pulp exposure and, subjected to μCT scanning, HE staining and immunostaining using anti-Ly6g and anti-MMP9 antibodies. The apical periodontitis lesion volumes were remarkably increased from Day14 to Day28, and Ly6g and MMP-9 positive neutrophil infiltrations were transiently increased in the lesion at Day 3 and 7. Global gene expression analysis using PCR array revealed that IL-1 beta expression observed after 14 days, and significantly increased after 28 days. Similar expression patterns were observed with CCL and CXCL families including CCL5, CXCL5 and CXCL10. These data suggested that local immune system breakdown induced the release of inflammatory cytokines and chemokines leading to periapical lesion formation.

Key Learning Points

• The mice apical periodontitis model was able to investigate spatiotemporal changes during lesion development formation.

• H-E staining and Immunohistochemistry revealed that immune reactions including neutrophil infiltration and tissue destruction were involved in the initial stages.

• Global gene expression analysis indicated that inflammatory cytokines and chemokines were induced in the later stage of lesion development.

9:54

Variation of early endothelial dysfunction markers in patients with apical periodontitis after root canal therapy: A clinical and biomolecular study

*Giuggia B[1], Bergandi [2], Comba A[1], Alovisi M[1], Carpegna G[1], Scotti N[1], Pasqualini D[1], Berutti E[1]

[1]Department of Surgical Sciences, Dental School, [2]Department of Oncology, University of Turin, Turin, Italy

Aim To investigate vascular and molecular markers of early endothelial dysfunction before and after root canal treatment in patients with apical periodontitis.

Summary Cardiovascular diseases (CVDs) are the leading cause of mortality worldwide. Apical periodontitis (AP) has been associated with an increased risk of CVDs. A correlation has been demonstrated between chronic AP and endothelial dysfunction (ED), but there is no evidence to indicate ED improves following endodontic treatment in patients with AP. Twenty control subjects and 21 patients with AP were assessed at baseline. The AP patients were also evaluated 2 and 12 months post-treatment. Endothelial flow reserve (EFR) was assessed via an endothelial function test and ELISA assays were used to evaluate plasma levels of pro-inflammatory cytokines IL-1, IL-6 and TNF-alpha; vasoconstrictor ED marker, endothelin (ET)-1; circulating endothelial adhesion markers, intercellular adhesion molecule-1 (ICAM)-1/CD54 and soluble vascular cellular adhesion molecule-1 (sVCAM)-1/CD106; soluble CD14, and the endothelial leukocyte adhesion molecule (E-selectin). AP was significantly associated ($p < 0.05$) with increased serum levels of ET-1, ICAM-1, E-selectin, IL-1, and sCD14, suggesting early vascular ED, with no macroscopic evidence of a reduction in EFR. Root canal

treatment ameliorated inflammation and early ED, lowering plasma levels of IL-1, sCD14, ET-1, ICAM-1/CD54 and E-selectin to those of control subjects. Findings suggest that AP may drive early vascular ED and that the endodontic therapy of AP ameliorates early ED.

Key Learning Points

• Apical periodontitis (AP) was associated with increased serum levels of ET-1, ICAM-1, E-selectin, IL-1, and sCD14.

• Plasma levels of IL-1, sCD14, ET-1, ICAM-1 and E-selectin in patients with AP returned to those of healthy subjects after endodontic treatment.

• Root canal treatment ameliorated inflammation and early endothelial dysfunction.

10:12

The shortcomings of current clinical endodontic diagnostics and possible role of biomarkers

*Erdogan O[1], Gibbs JL[2]

[1]Department of Endodontics, New York University, New York, [2]Department of Endodontics, Harvard School of Dental Medicine, Boston, US

Aim To discuss the shortcomings of current clinical endodontic diagnostics and to highlight the need for translational research in order to understand the relationship between the degree of pulpal and periapical inflammation and clinical diagnostics to provide biologically based treatments as well as to predict the risk factors and outcome of treatments.

Summary Preserving the pulp in a healthy state and harnessing its healing capacity with minimally invasive biologically based treatments are fundamental in current endodontic practice. Our knowledge in biology of pulp-dentine complex and discovery of biocompatible materials have improved clinical practice. With these advancements, accurate clinical diagnosis which reflect the true degree of bacteria induced pulpal and periapical inflammation and predicting the risk factors and outcome of endodontic treatments from a biological perspective have become even more crucial.

Currently, clinical endodontic diagnosis profoundly rely on patient reported subjective pain as well as surrogate tests like cold test, electrical pulp test, percussion hypersensitivity test; and are limited in terms of reflecting the severity of pulpal and periapical inflammation. Understanding the association between current clinical endodontic diagnostic criteria, clinical findings; and the underlying biology with biomarkers can lead to more objective and quantitative data which can further improve our diagnostic skills. Translational research which focus on the relationship between anti-inflammatory, reparative biomarkers with pro-inflammatory biomarkers can help predicting the risk factors and outcome of the treatments from a biological standpoint.

Key Learning Points

• Current clinical diagnostic tools and patient reported pain are limited to determine the degree and severity of endodontic disease.

• Understanding the relationship between clinical diagnostics and underlying biology with biomarkers is essential.

• Biomarkers of pulpal and periapical inflammation can provide more accurate, objective and quantitative data.

• Translational research can improve our knowledge to predict the risk factors and outcome of treatments from a biological standpoint.

11:00

Macrophages hyperactivation in sustained exposure to *Enterococcus faecalis*

*Yaya A [1] 1, Polak D [2], Ginsburg I [3], Abramovitz I [2]

[1]Department of Endodontics, Hebrew University, [2]Department of Periodontics, Hadassah Medical Center - Hebrew University, [3]Department of Periodontics, Hebrew University, Jerusalem, Israel

Aim Persistent periapical lesions are associated with *E. faecalis* infection, chronic inflammatory infiltrate and bone loss. The aim of the study was to examine the impact of sustained *E. faecalis* infection on inflammatory cells.

Summary THP-1 cells (human monocytes) were differentiated into mature macrophages *in vitro*. At baseline, cells were inoculated with *E. faecalis* for up to 72 h. Bacterial intra-cellular survival and macrophages response to the infection was measured using florescent staining and flow cytometry. Macrophages` oxidative stress and cytokines expression (TNFα, OPG and RANKL) were tested using florescent plate reader and ELISA respectively. Results indicate that macrophages phagocytose *E. faecalis*, but fail to clear the bacterium for 4 days' post infection. A gradual decrease in macrophage viability was observed, while their mitochondrial, internal oxidative stress and TNFα expression were augmented in the infected cells. Furthermore, elevation in RANKL and decrease in OPG are observed overtime, indicating promotion of osteoclastgenesis.

Key Learning Points

• While macrophages attempt to clear *E. faecalis* in an *in vitro* model, the bacteria endured inside the cells.

• The sustained infection leads to tissue destruction pathways, such as oxidative stress, pro-inflammatory cytokine expression and promotion of pro-osteoclastgenesis cytokines.

11:18

Post-treatment symptomatic apical periodontitis and neuropeptide release in the periodontal ligament after root canal preparation with different single-file techniques

*Caviedes-Bucheli J [1], Munoz HR [2]

[1]Centro de Investigaciones Odontologicas, Pontificia Universidad Javeriana, Bogota, Colombia, [2]Department of Endodontics, Universidad de San Carlos de Guatemala, Guatemala, Guatemala

Aim To analyse the neuropeptide release in human periodontal ligament (PDL) after root canal preparation with different single-file techniques as a potential cause of post-treatment symptomatic apical periodontitis.

Summary Post-treatment PDL inflammation, clinically known as symptomatic apical periodontitis, is a common cause of pain after root canal treatment. It occurs due to physical, mechanical and chemical trauma provoked during canal preparation as a consequence of frictional heat from the instruments working inside the canal, apical extrusion of debris containing vital or necrotic pulp tissue mixed with irrigant solutions and microorganisms. PDL inflammation has a neurogenic origin due to neuropeptide release. Instrument evolution led to the single-file preparation systems, that could be activated in a reciprocating movement such as Reciproc/Reciproc Blue and WaveOne/WaveOne Gold, or in a continuous rotation movement such as XP-EndoShaper. Studies dealing with PDL neuropeptide expression after root canal preparation with different continuous rotation or reciprocating instruments have concluded that all preparation techniques cause a certain degree of inflammation, and therefore constitute a potential cause of post-treatment symptomatic apical periodontitis.

Key Learning Points

• Describe the neurogenic inflammatory process in the PDL that could take place after root canal preparation with different single-file techniques.

• Analyse the differences in the design and kinematic of the instruments used in single-file techniques that could lead to variations in PDL neuropeptide release after root canal preparation.

• Discuss the relationship between root canal endodontic procedures with the development of symptomatic apical periodontitis as a consequence of neuropeptide release in PDL.

11:36

Biological implications of occlusal trauma and orthodontic forces in the human dental pulp and its relationship with angiogenic mechanisms

*Munoz HR [1], Caviedes-Bucheli J [2]

[1]Department of Endodontics Department, Universidad de San Carlos de Guatemala, Guatemala, Guatemala, [2]Centro de Investigaciones Odontologicas, Pontificia Universidad Javeriana, Bogota, Colombia

Aim To review the angiogenic mechanisms in mature human dental pulp as a defence response to mechanical stimuli such as occlusal trauma and orthodontic forces.

Summary Angiogenesis is the formation of new blood vessels based on a pre-existing vasculature. It comprises two processes, sprouting of endothelial cells and the division of vessels due to abnormal growth of the microvasculature. Human dental pulp tissue responds to occlusal trauma and orthodontic forces with a neurogenic inflammatory phenomenon in which growth factors and neuropeptides play an important role in the direct and indirect mechanisms of angiogenesis by the action exerted over different cells, such as fibroblasts, endothelial and inflammatory cells, leading to new blood vessel formation which are needed to stimulate mineralised tissue formation as a defence mechanism.

Key Learning Points

• Describe the angiogenic mechanisms in the human dental pulp during normoxia and hypoxia.

• Explain the role of neuropeptides and growth factor in direct and indirect angiogenic mechanisms in human dental pulp.

• Analyse the relationship between occlusal trauma and orthodontic forces with angiogenic mechanisms to stimulate mineralised tissue formation.

Other

11:54

The local and systemic consequences of apical periodontitis on oxidative stress

*Georgiou AC, Cornejo Ulloa P, Crielaard W, van der Waal SV

Preventive Dentistry, Academic Centre for Dentistry Amsterdam (ACTA), Amsterdam, Netherlands

Aim To discuss how apical periodontitis associates with locally and systemically traced reactive-oxygen species that can lead to systemic stress and potentially increased risk for systemic disease.

Summary Oxidative stress plays an important role in the immune-mediated defense and helps the cell-signaling procedure to maintain homeostasis. Apical periodontitis (AP) is an inflammatory response around the root tip of teeth to an insult, in which reactive oxygen species (ROS) are involved. Reactive-oxygen species are produced by phagocytic cells in response to a bacterial challenge and are necessary for an adequate immune response. Anti-oxidant molecules counteract ROS and thus serve as regulators and modulate the concentration of ROS at the inflammatory site. There is evidence, summarised from a systematic review that we conducted, that ROS besides locally in the apical periodontitis lesion, can also be detected in increased levels in other body fluids such as blood and saliva. Reactive-oxygen species when increased and off-balance with the antioxidants interact with and can also cause damage in DNA, lipids and proteins resulting in oxidative stress. In this presentation, also the possible systemic consequences will be discussed.

Key Learning Points

• Reactive-oxygen-species production is an important host defense mechanism involved in the onset of apical periodontitis.

• Oxidative-stress markers, besides the AP lesion, can also be traced in blood and saliva of patients with apical periodontitis.

• Apical periodontitis is most likely not only a local burden, but it can have systemic consequences which should be considered and communicated to the patient while planning a treatment.

Restoration of root filled teeth

12:12

Aesthetic restorations of anterior teeth following endodontic treatment

*KOÇ P

[1]Department of Endodontics, Gaziantep University, Gaziantep, Turkey

Aim Coronal restoration of endodontically treated teeth is important for their long term success. Aesthetic problems resulting from discoloration and the large amount of hard tissue loss are two main problems complicating the gaining of aesthetic rehabilitation, particularly in anterior teeth. Routine composite restorations may not always provide satisfactory outcomes. Thus, alternative techniques including bleaching and crowns may be required. Especially, laser-aided bleaching and full-ceramic coronal restorations are contemporary approaches for the restoration of anterior root filled teeth. The aim of this study is to represent various root filled teeth restored with either full-ceramic crowns or composite resins following bleaching treatment and postoperative 1 year follow-up .

Summary The present study included 25 cases of anterior teeth with aesthetic disturbances related with endodontic treatment. Teeth with no hard tissue loss were applied 940 nm diode laser activated bleaching by using 9.9% sodium perborate. All the relevant teeth represented whitening at the first visit, the degree of whitening increased at following visits. Teeth with large amounts of hard tissue loss were restored with either glass-fibre supported composite resins or full-ceramic crowns. All cases represented satisfactory results in terms of aesthetics. All cases were recalled periodically for 1 year and none of them presented with complication; mainly external cervical resorption.

Key Learning Points

• Endodontic treatment may result in aesthetic problems, particularly in anterior teeth.

• Bleaching procedures provide less invasive solutions to the aesthetic problems related to endodontic treatment.

• Activation of bleaching agents with diode laser provides less time consuming and more effective whitening.

• Full-ceramic restoration of anterior root filled teeth either glass fibre post or alone provide a more easthetic appearance compared to conventional restorations.

• Sodium perborate activated with diode laser did not result in root resorption.

2:30

Rehabilitation of endodontic treated teeth with extensive loss of coronal structure – Where do we come from, where do go?

*Fernandes V[1], Ferreira S[2], Miller P [3], Ferraz A [4], Souza J [5]

Departments of Conservative Dentistry, IUCS - CESPU, [1]Braga, [2]Paredes, [3]Porto, [4]Cantanhede, [5]Ermesinde, Portugal

Aim To present a scoping review on the behavior and mechanical proprieties of post design and material in the rehabilitation of endodontic treated teeth with extensive loss of coronal structure.

Summary Considering the long term performance of endodontic treated teeth, mechanical failures can occur due to the lack of remaining walls, cementation, stress distribution, coronal restoration, and materials of post and core. A scoping review was performed on the effect of mechanical performance of non-metallic endodontic post: materials, design, and amount of remaining cervical dentine on the long term performance of endodontic treated teeth. A bibliographical review was conducted on PUBMED with several search terms related with restoration of endodontic treated teeth, posts and biomechanical proprieties. The results pointed out that posts are used to provide retention of the core, but not to reinforce the tooth. We can consider that the main factor influencing the resistance of an endodonticaly treated tooth is the presence of a ferrule effect and the remaining coronal structure. The post design and material evolved in the last years. Previously metal cast or prefabricated metal posts made up of materials with high modulus of elasticity, such as gold alloys, stainless steel or titanium were considered strong and clinically effective. Nowadays, fibre reinforced glass, quartz, polyethylene and carbon-reinforced composites posts are the gold standard on post rehabilitation of endodontic treated teeth, because of their low modulus of elasticity. Despite the advantages of fibre posts regarding catastrophic root fractures, several studies report debonding as a frequent complication. Debonding is a consequence of the fibre post characteristics (design, length,

diameter), the adopted clinical procedures, integrity of the adhesive surface and thickness of the adhesive cement. We speculate whether a new type of post design with a new material could improve biomechanical characteristics of the post and adapt to different root morphologies reducing the subjection to intra radicular bonding and cement.

Key Learning Points

• Biomechanical proprieties necessary for long term success of endodontic treated teeth.

• Limits of the materials used for rehabilitation of endodontic treated teeth.

• Material and design enhancement needed to improve the long time performance of endodontic treated teeth.

2:48

Restoration of endodontically treated teeth: chasing longevity

*Metwally AT

Department of Conservative Dentistry, Misr International University, Cairo, Egypt

Aim To propose well defined, evidence-based guidelines for durable restoration of endodontically treated teeth

Summary The main goal of restorative dentistry is to conserve natural tooth structure. No doubt that endodontic treatment results in a significant loss of tooth structure, i.e. during preparing access cavity and canals instrumentation, leaving the unrestored endodontically treated teeth structurally compromised having a lower lifetime prognosis. Different protocols have arose to restore endodontically treated teeth including direct restorative protocol, indirect restorative protocol, post and core placement followed by full coverage. Multiple factors must be considered during the selection of a final restoration. These include the amount of remaining tooth structure, occlusal function, and position of the tooth in the arch. Since one of the main factors responsible for the increased fracture susceptibility of endodontically treated teeth is extensive tissue loss, so a

comprehensive clinical assessment of each case in terms of endodontic, periodontal, bio-mechanical and esthetic evaluation should be carried out to select the appropriate restorative technique that capable of maintaining the integrity of the restored tooth, meeting all criteria of durable outcomes.

Key Learning Points

• Understanding different changes in the provided dental tissues post endodontic treatment.

• Recognizing different clinical solutions for restoring endodontically treated teeth.

• Correlating the most reliable evidence with the different restorative modalities for more durable clinical outcomes.

3:06

A systematic review and meta-analysis of survival of ceramic onlays on root canal treated teeth

*Rahim N, Austin R, Foschi F, Mannocci F

Tissue Engineering and Biophotonics, King's College London, London, UK

Aim This systematic review aims to assess the survival of ceramic onlays or overlays on root canal treated teeth examining clinical studies from 1983 to 2017.

Summary One reviewer searched the database in PUBMED, EMBASE, COCHRANE Central Register of Controlled Trials for articles from 1980 – 2017. This was followed up by a search on selected journals. The inclusion criteria were: clinical studies related to ceramic inlays, onlays or overlays placed on root canal treated teeth; composite inlays, onlays or overlays on endodontically treated teeth; prospective, retrospective or randomised clinical trials conducted in humans; studies with a dropout less than 30% and studies with a follow up more than 2 years. The outcome measured was clinical failure of the restoration and or tooth. A total of 99 articles were noted from which 7 met the inclusion criteria and 6 provided data for the meta-analysis. The results show that ceramic onlays have a high survival rate but failed more in non vital teeth compared to vital teeth.

Key Learning Points

• Survival of ceramic onlays is very high irrespective of the study design, follow up period, material used.

• These restorations survived longer on vital teeth compared to endodontically treated teeth.

• The main failure seems to be fracture of the tooth/ restoration.

3:24

Restoration of the endodontically treated tooth

*Karunanayake GA

Department of Endodontics, UNC Adams School of Dentistry, Chapel Hill, US

Aim To discuss how the restoration of a root filled tooth promotes endodontic success and tooth survival

Summary Reasons for restoring a root filled teeth include the provision of a coronal seal and to distribute functional forces in a manner that prevents a root filled tooth from fracturing. Questions arise as to why root filled may be weaker than their vital counterparts and what evidence supports this notion? Evidence links the survival of root filled teeth with the provision of a crown - but at what point in time should a crown be placed following root canal treatment on a tooth with a periapical radiolucency? Do all root filled teeth require crowns and what restorative solutions are there for teeth with inadequate tooth tissue for a crown restoration? Can root filled teeth be used successfully as abutments for fixed or removable partial dentures? How can minimally invasive techniques promote the survival of root filled teeth?

Key Learning Points

• An understanding of the evidence that eludes to root filled teeth being weaker than their vital counterparts.

• Factors associated with increased fracture susceptibility of root filled teeth.

• How pre-operative, peri-operative and post-operative restorations may affect success and tooth survival.

3:42

Relationship between post and the survival of endodontically treated teeth: A retrospective cohort study.

*Çelik G[1], Eroglu E [2], Üreyen Kaya B[3], Yaylalı İ [4]

[1] Department of Endodontics, İzmir Demokrasi University, Faculty of Dentistry, İzmir, [2]Department of Prosthodontics, Suleyman Demirel University, Isparta, [3]Department of Endodontics, Suleyman Demirel University, Faculty of Dentistry, Isparta, [4]Department of Dentistry, Sparta Military Hospital, Isparta, Turkey

Aim The purpose of this retrospective, non-randomised cohort study was to evaluate the survival rate of 53368 endodontically treated teeth depending on the restoration type.

Summary University of Suleyman Demirel of Dentistry treatment patient database was used to identify permanent teeth that had undergone non-surgical root canal therapy (NSRCT) between January 1, 2006, and December 31, 2018. The teeth defined based on composite, crown and/or post placement after NSRCT. Previous root canal treatment was excluded from the study. The associations between post application and extraction were tested by using chi-square analysis.O f the 53 368 teeth analyzed in this study, 4.22% (n = 2250) were extracted. Of the 18 318 single-rooted, 4.09% (n: 749) were extracted. Of the 16 367 single-rooted teeth with composite, 3.49 % (n: 571) were extracted. Of the 3 636 single-rooted teeth with composite and post-reinforced, 4.15% (n: 151) were extracted. Of the 4 179 single-rooted teeth with crowns, 5.86% (n: 245) were extracted. Of the 1 999 single-rooted teeth with crown and post-reinforced, 5.05% (n: 101) were extracted. Of the 35 050 multi-rooted, 4.28% (n: 1501) were extracted. Of the 32 001 multi-rooted teeth with composite, 3.73 % (n: 1 195) were extracted. Of the 3 603 multi-rooted teeth with composite and post-reinforced, 3.52% (n: 127)

were extracted. Of the 4 463 multi-rooted teeth with crown, 4.48% (n: 200) were extracted. Of the 1 588 multi-rooted teeth with crown and post-reinforced, 3.59% (n: 57) were extracted.

Key Learning Points

• Post application did not make a difference in multi-rooted teeth with composite while causing more tooth loss in multi-rooted teeth with crowns.

• In single-rooted teeth, post restoration does not make any difference in the number of extraction, whether it is with a composite or with a crown.

Hall 5

Canal filling – general

9:00

An international survey on the use of hydraulic calcium silicate-based sealers in nonsurgical endodontic treatment

*Guivarc'h M[1], Jeanneau C[2], Giraud T[3], Pommel L[4], About I[2], Azim AA[5], Bukiet F[3]

[1]EFS/CNRS, ADES. Department of Endodontics, Aix Marseille Université, Assistance Publique des Hôpitaux de Marseille, Marseille, France; [2]CNRS, ISM, Inst Movement Sci, Aix Marseille Université, Marseille, France, [3]CNRS, ISM, Inst Movement Sci. Department of Endodontics, Aix Marseille Université. Assistance Publique des Hôpitaux de Marseille, Marseille, France, [4]Department of Endodontics, Aix Marseille Université, Assistance Publique des Hôpitaux de Marseille, Marseille, France, [5]Department of Periodontics & Endodontics, School of Dental Medicine, University at Buffalo, Buffalo, US

Aim To gain insight on the current clinical usage of calcium silicate-based root canal sealers by general dental practitioners (GDPs) and endodontic practitioners (EPs) and to determine if the clinical application is in accordance with the best available evidence.

Summary Given the fact that calcium silicate-based sealers grow in popularity, an international survey was set up using an online questionnaire proposed to 2335 dentists via a web-based educational forum. Participants were asked about socio-demographic data, clinical practice and their motivation for using calcium silicate-based sealers. A statistical analysis was performed, as appropriate, to assess the association between the variable categories ($p < 0.05$). The response rate was 28.91%. Among respondents, 94.8% knew calcium silicate-based sealers (EPs more than GDPs, $p<0.05$) and 51.70% were using the latter. The primary reason for using this type of sealer was the belief of its improved properties (87.7%). Among the users, single cone technique (SCT) was the most employed obturation method (63.3%) which was applied more by GDPs ($p<0.05$); EPs utilized more of the thermoplasticized obturation techniques ($p<0.05$). A proportion of 38.4% of the users indicated SCT usage with calcium silicate-based sealers regardless of the root canal anatomy (GDPs more than EPs $p<0.05$) and 55.6% considered that calcium silicate-based sealers may influence their ability to re-establish apical patency during retreatment (GDPs more than EPs $p<0.05$).

Key Learning Points

• This study highlights wide variation in the clinical use of calcium silicate-based sealers which is not in accordance with the current literature.

• The participants of this international survey tend to rely on their clinical habits rather than considering the manufacturers' recommendations or the best available evidence on these sealers.

• The inconsistency among EPs and GDPs on calcium silicate-based sealers usage requires further clarifications to better standardize their use and improve their future evaluation.

9:18

Thermal obturation of root canals under standardized conditions: An *in vitro* study.

*Wolf TG[1], Tennert C[1], Willems L[2], Briseño Marroquín B[1]

[1]Department of Restorative, Preventive and Pediatric Dentistry, School of Dental Medicine, University of Bern, Bern, Switzerland, [2]Department of Periodontology and Operative Dentistry, University Medical Center of the Johannes Gutenberg University Mainz, Mainz, Germany

Aim Thermoplastic filling methods enhance the morphological flowability, thus, adaptation of gutta-percha. The aim of this investigation was to determine the capability of thermoplasticized gutta-percha to obturate standardized lateral canals in an in vitro model.

Summary Nine lateral standardized lateral canals (Ø 0.2 ± 0.02mm) were prepared in 130 transparent plastic blocks along a 15mm simulated root canals. A total of 1170 lateral canals (at 1, 2.5, 4, 6, 7.5,9, 11, 12.5 and 14 mm from apical) were prepared in the simulated root canals. 100 blocks were filled with the vertical condensation (BeeFill, VDW, Munich, Germany) and 30 blocks with the lateral condensation which was used as the control method. 50% of the canals were prepared with Reciproc and Reciproc Blue (R40 / VDW, Germany) respectively. 2Seal easymiX (VDW,) was used as sealer. The vertical condensation results showed that 50.3% of the lateral canals were completely obturated with gutta-percha and 40% were completely obturated with gutta-percha and sealer. The results obtained with the lateral condensation showed that only 61.1% of the lateral canals were completely filled; yet, only with sealer. The lateral canals at 7.5 and 1.0 mm from apex showed the highest and lowest filling degree with the vertical condensation, respectively. The highest and lowest filling frequency with the lateral condensation was observed at 11 and 1 mm from the apex, respectively. With the vertical condensation a significant difference between Reciproc blue (35 out of 50) and Reciproc (18 out of 50) was observed only at the 1 mm level. Only sealer fillings could be observed with both preparation instruments and the lateral condensation.

Key Learning Points

• Thermoplasticized gutta-percha has a higher flowing capability.

• Lateral canals and irregular root canal morphology can be more effectively obturated with thermoplasticized gutta-percha.

• A specific root canal preparation system will not enhance the adaptation of cold gutta-percha.

9:36

Influence of Diode and Er,Cr: YSGG Laser use on the push-out bond strength of a bioceramic-based root canal fillings

*Çiftçioğlu E[1], Barut G[2], Işık V[1], Arıcan Öztürk B[1], Karagöz-Küçükay I[1]

[1]Department of Endodontics, Faculty of Dentistry, İstanbul Okan University, [2]Department of Endodontics, Faculty of Dentistry, Yeditepe University, İstanbul, Turkey

Aim To assess the influence of laser-activated final irrigation compared with contemporary irrigation protocols on the push-out bond strength of a bioceramic-based root canal filling.

Summary Sixty extracted single-rooted teeth with size 15 apical sizes were instrumented with EndoSequence rotary files up to size 40, .04 taper. The teeth were randomly divided into four groups (n=15), according to the final irrigation regimen as follows: Group 1: 5 mL 5.25% sodium hypochloride (NaOCl), Group 2: 2 mL 17% ethylenediaminetetraacetic acid (EDTA) and 5 mL 5.25% NaOCl, Group 3: 980 nm Diode laser-activated 2 mL 17% EDTA and 5 mL 5.25% NaOCl, Group 4: Er,Cr: YSGG laser irradiation. After rinsing with distilled water, teeth were obturated with single-cone technique using Endosequence BC points and BC sealer. 1-mm thick slices were obtained from the apical, middle and coronal thirds of each root. The bond strength was measured for each test specimen using a universal push-out testing machine. The slices were then examined under a dental microscope at 40x magnification to determine the mode of the bond failures. The data were analysed by two-way ANOVA and Tukey's test with significance set at $p<0.05$. The type of final irrigation regimen showed no significant differences in the push-out bond strengths of the root canal fillings among the groups ($p>0.05$). In terms of root segments, the apical specimens had the highest bond strength values compared with those of the middle and coronal specimens in all groups ($p<0.05$). However, the laser-activated groups had significantly higher bond strength values in the middle specimens with regard to

coronal specimens ($p<0.05$). Examination of the specimens revealed the bond failure to be predominantly cohesive in all groups. Laser-activated final irrigation did not seem to have a positive influence on the bond strength of Endosequence BC filling material in comparison with the contemporary irrigation groups.

Key Learning Points

• How does laser-activated irrigation influence push-out bond strength of bioceramic-based root filling?

• Is there any significant difference between contemporary irrigation and laser-activated irrigation in terms of root segments?

9:54

Endodontic filling technique: comparative study of manual vs mechanical lateral condensation

Diemer F, Tchorowski-Pellizzari Y, Baldé I3, Peli JF, *Hamdan R, Georgelin-Gurgel M

Department of Endodontics, Toulouse University, Toulouse, France

Aim For a long time, the technique of cold lateral condensation (CLC) remains the most learned and used technique. This technique can be modified using a rotational motion favouring an easier use to implement and less expensive for a dental office that is often already equipped. Therefore, our study aims to compare this technique with CLC using two types of spreaders: a heat treated one (T-Wire) and one untreated.

Summary 64 resin simulators with two lateral canals were used. Each canal was filled with gutta-percha and sealer (MM-Seal colored with one drop of Indian ink). Lateral condensation was performed manually or in continuous rotation with two kinds of spreader: heat treated or not (4 groups at least). Radiographs and transversal sections of each simulator were done. The criteria analyzed were: the gutta-percha/cement ratio, the time to perform the root filling, the radiological density, the depth of penetration of the spreaders and the penetration of gutta-percha and sealer in the lateral canals. The

MLC shows better results concerning the time to perform the filling, the penetration depth of the spreaders and the penetration of sealer and gutta-percha in the lateral canals and thus a better three-dimensional filling. MLC reduces the time by 20.24% vs CLC and the T-Wire spreader by 12.06% ($p<0.001$). MLC increase the penetration of the spreader by 19.98 % for the first penetration and by 26.11% for the second ($p<0.001$). Moreover, MLC multiply the penetration of gutta-percha by 2 and 3 respectively for the first and second lateral canals. However, our model shows some weakness concerning the resin blocks we use. That's why, in spite of the good results that MLC showed, other studies have to be conducted maybe with extracted natural teeth to confirm these results.

Key Learning Points

• Mechanical Lateral Condensation (MLC): a new obturation technique in rotational motion.

• Better results for MLC vs Cold Lateral Condensation (CLC) with several parameters: time to perform the filling, penetration depth of spreaders in canal and penetration depth of sealer and gutta percha in lateral canals.

• Further studies are necessary with new models to confirm our conclusion.

10:12

Do heated pluggers show the exact temperature?

*Bakırcı T [1], Yaltırık H [2], Baştürk FB [1], Günday M [1]

[1]Department of Endodontics, Marmara University, Başıbüyük / Maltepe / İstanbul, [2]Department of Mechanical Engineering, Marmara University, Göztepe / İstanbul, Turkey

Aim The main objective of our study was to evaluate the actual temperature rise on the surface of Buchanan pluggers. Moreover, we aimed to show the laboratory settings of our experimental study, compare two different evaluation techniques (thermocouples and thermal camera) and reveal the graphs of temperature rise for each setting of the carrier-system.

Summary The heat carrier system 'Elements Free' (Sybron Endo, EIE/Analytic Technology,USA) and Buchanan heat pluggers (XF, F, FM, M ML) were used for this study. The heat generated on the surfaces of Buchanan heat pluggers was assessed using both Type K thermocouples and infrared thermography imaging camera (Testo 875, Sparta, NJ). The temperature was set to 200°C on the digital display and activated in the continuous mode in order to evaluate actual temperature of the pluggers. The temperature at the tip of each plugger was measured with 8 repetitions to get more accurate and consistent results. Measurements were also taken at 3 mm and 6 mm from the tip of each plugger. Besides, the maximum temperature of Buchanan heat plugger with 0.10 taper (medium size) was measured during activation (heating). The M-10 plugger was set to 140°C , 150°C and 200°C modes to investigate the temperature changes in these modes. The thermal profiles were similar in all three modes. The maximum temperature of the plugger was 225°C. The highest temperature rise was observed at the instrument tip. The time passed for each plugger to reach to the highest temperature was different from one another.

Key Learning Points

• The actual temperature on the surface of the pluggers does not correlate well with the temperature set on digital display.

• Heat concentrates around the tip.

• The temperature is constantly decreasing from the tip to the shank.

11:00

Evaluation of the root canal tridimensional filling with warm vertical condensation, carrier-based technique and single cone with bioceramic sealer: a micro-CT study

*Moccia E [1], Dell'Acqua A [1], Alovisi M [1], Carpegna G[1], Comba A[2], Pasqualini D[1], Berutti E[1]

[1]Department of Endodontics, [2]Department of Operative Dentistry, Dental School, Università degli Studi di Torino, Torino, Italy

Aim The aim of this micro-CT study is to evaluate the quality of the tridimensional (3D) filling and the presence of radiographic translucencies after root canal obturation with three different techniques: warm vertical condensation, carrier-based technique and single cone with bioceramic sealer.

Summary Thirty single-rooted human teeth extracted for periodontal reasons were selected. For each tooth glide path was performed with ProGlider and shaping with ProTaper Next (PTN) X1, X2 and X3, up to working length (WL). All specimens were randomly divided into three groups (N=10) basing on the obturation technique used: warm vertical condensation, carrier-based technique and single cone with bioceramic sealer. All teeth were analyzed using X-ray computed micro-tomography (micro-CT) scans and the obtained slices were tridimensionally reconstructed with standardized parameters. Afterwards, the obturation area and the associated radiographic translucency areas were computer-isolated using the software Materialise Mimics Medical, and finally their volumes were calculated with the software Geomagic Qualify. The statistical analysis was done using one-way ANOVA and the post-hoc Student-Newmann-Keuls ($P<0.05$). The mean percentage of translucency areas in the warm vertical condensation group was 1.23%, whereas in the carrier-based group was 4.22% and in the single cone with bioceramic sealer group was 10.44%. The differences between the three groups were statistical significant ($P=0.029$). The null hypothesis of a superimposable 3D filling quality between groups was refused. Within the limitations of this study, all the obturation techniques provided an adequate 3D root canal filling. The single cone technique with bioceramic sealer represented a viable clinical alternative, although seemed more operator-dependent than the others.

Key Learning Points

• The amount of radiographic translucencies seemed higher in the canals filled with single guttapercha cone and bioceramic sealer.

• The single cone technique with bioceramic sealer seemed a viable clinical alternative, although more operator-dependent.

Canal filling – MTA/calcium silicate cements

11:18

Interaction of MTA-based cements and tissues

*Marciano MA, Pelepenko LE, Gomes BPFA, Soares AJ, Almeida JFA, Ferraz CR, Zaia AA

Department of Restorative Dentistry, State University of Campinas, Piracicaba, Brazil

Aim To discuss the interaction between MTA-based materials and tissues.

Summary Mineral trioxide aggregate (MTA) based materials have been widely used for a variety of procedures in Endodontics. These materials are applied directly in contact with tissues and remains for a long period interacting with the host. The interaction of components from cements and cells is important. Recently, it has been demonstrated the migration of components from MTA into local tissues occurs. This migration and interaction with tissues might be the responsible for reparative process, however, the effects of this migration is unclear and should be thoroughly investigated.

Key Learning Points

• MTA and its interaction with host tissues.

• Migration of components from MTA-like materials.

11:36

Dentinal tubule penetration of AH Plus, BC Sealer and a novel tricalcium silicate sealer: a confocal laser scanning microscopy study

*El Hachem R

Department of Endodontics, Saint Joseph University, Beirut, Lebanon

Aim The aim of this *in vitro* study was to assess the dentinal tubule penetration of three different sealers, AH Plus, BC Sealer and a novel tricalcium silicate sealer (NTS)

Summary Ninety-six human maxillary central incisors were divided into three experimental groups (n = 32) and were filled with gutta-percha using a single-cone technique in conjunction with one of the three sealers: AH Plus, BC Sealer or NTS. The roots in each group were cross-sectioned at 1 and 5 mm from the root apex, and the surfaces were examined under confocal laser scanning microscopy (CLSM). The sealer penetration depths were measured at their maximum depths and at four circumferential depths (12, 3, 6 and 9 o'clock) and were evaluated using ImageJ software (ImageJ, NIH). Results showed that the maximum and mean penetration depths were significantly higher at 5 mm compared to 1 mm from the apex in the AH Plus ($p < 0.001$), BC Sealer ($p < 0.001$) and NTS groups ($p < 0.001$). No significant difference was observed between the groups at 1 mm for both parameters. The maximum and mean penetration depths were significantly lower at 5 mm for AH Plus compared with the other two groups ($p = 0.012$). Within the study limitations, BC Sealer and NTS demonstrated better tubule penetration results than AH Plus.

Key Learning Points

• A new experimental novel tricalcium silicate (NTS)-based sealer composed of tricalcium silicate, tantalum and calcium oxide has been recently developed.

• The importance of sealer penetration in dentinal tubules.

• Although no study has confirmed a relationship between the penetration depth of root canal sealers and the prevention of apical periodontitis, dentinal tubule sealer penetration may improve obturation quality.

11:54

Single cone obturation in Endodontics: What is new and what is true?

*Shehabeldin I

Department of Endodontics, School of Dentistry, University of Ain Shams, Cairo, Egypt

Aim To briefly discuss, based on a review of the literature, the current status of the single-cone filling technique using calcium silicate-based sealers, as well as to present the attitude of the members of the Editorial Board of ENDO-Endodontic Practice Today towards adopting this technique.

Summary Complete and adequate filling of root canals is one of the main challenges of the root canal treatment to ensure long-term success. A standard filling method is to use a gutta-percha core material in conjunction with a sealer to fill the remaining irregular spaces between the gutta-percha cone and surrounding dentinal walls. Several filling techniques have been used to achieve this objective; however, a single-cone filling method has been considered inferior to lateral or continuous wave filling techniques. Recently, with the introduction of calcium silicate-based sealers, an interest in the single-cone method is recommenced. It is fast, less technique sensitive and does not require any special equipment. Moreover, the new material showed biocompatibility, induction of biomineralization, a good antimicrobial activity, a strong bond strength to dentin, and a seal superior to or on equal terms with epoxy resin-based sealers. Therefore, would adopting the single-cone filling technique using calcium silicate-based sealers provide a reliable method for filling of root canals ?

Key Learning Points

• Clinical advantages of calcium silicate-based sealers.

• Concerns for calcium silicate-based sealers.

• Comparing the obturation quality of single-cone filling to other filling techniques.

• Need for independent validated clinical research.

12:12

Dislocation resistance of three different tricalcium silicate cements

*Ruiz Durán C, González Losada C, Vera González V

Department of Conservative Dentistry, Complutense University, Madrid, Spain

Aim To compare the mechanical resistance in filled dentine cavities of three milimetres of different tricalcium silicate cements: Biodentine™ (BD) , Totalfill Root Repair Material® Paste (TRRM) and ProRoot MTA® White (MTA).

Summary 78 dentine slices of 3 milimetres of thickness were cut. Then, cavities of 1.3 mm were performed with a cylindrical diamond bur. These slices were centred and included in hard resin using a device designed to position the specimen always at the same location. Then they were distributed randomly into three groups (26 specimens) that were filled with B, T, P. After twenty one days stored in an ambient humidity the slices were included in hard resin and placed in the centred device. Afterwards a push-out bond strength test was performed. The force of dislodgement was recorded in Newtons and the resistance was calculated dividing the force by the area of the bonded interface. Data were analyzed statistically using a Kruskal-Wallis test. TRRM paste had significantly lower resistance to dislodgement than BD and MTA ($p<0.05$). The highest mean value for dislodgement resistance was obtained from the MTA group but there was no significant difference between BD and MTA ($p>0.05$). BD showed similar mechanical resistance to MTA in plugs of 3 mm. TRRM had the lowest bond strength to root canal dentine in 3 mm of thickness.

Key Learning Points

• Thickness of bioceramic cements.

• Resistance of bioceramic cements to the dentine.

• Variability of tricalcium silicate materials.

• Clinical application of bioceramic cements.

2:30

Biocompatibility and osteogenic potential of different bioceramic materials in endodontics: a comparative study

*Mola V[1], Annaratone L[2], Carpegna G[1], Comba A[1], Berutti E[1], Pasqualini D[1]

[1]Surgical Sciences, Dental School, Department of Endodontics, [2]Medical Sciences, University of Turin, Turin, Italy

Aim Bioceramic materials are used in dentistry to repair root defects, perforations or apecifications. Recently, new biocompatible pre-mixed bioceramic formulations have been introduced as an alternative to Mineral Trioxide Aggregate. The present study was conducted to investigate the osteogenic potential of MTA, the current gold standard in clinical practice; Biodentine™ and Root Repairing Material Putty (RRMPU), Root Repairing Material Paste (RRMPA) and Root Repairing Material Putty Fast Set (FSP).

Summary For each tested material standardized discs were created and cultured with MG-63 human osteoblastic-like cells to assess biocompatibility, activity of alkaline phosphatase (ALP) and calcium deposits with Alizarin Red Staining (ARS) to determine the osteogenic potential. Unexposed cells acted as the control group. The biocompatibility was evaluated at baseline and after 24 and 48 hours, while the osteogenic differentiation was assessed after 15 days of culture. Collected data were statistically analyzed with one-way ANOVA test and significance was defined as NEJM: 0.12 ns (not significant), 0.033, 0.002 e <0.001.

Key Learning Points

• Bioceramics bioactivity and biocompatibility.

• Osteogenic induction capability of new bioceramics compared to MTA.

2:48

Micro-CT analysis of the marginal adaptation and porosity associated with ultrasonic activation of Biodentine, NeoMTA Plus and ProRoot MTA.

*Dincer AN [1], Guneser MB [1], Sisli SN [2]

[1] Department of Endodontics, Bezmialem Vakif University, Istanbul, [2] Department of Endodontics, Baskent University, Adana, Turkey

Aim To evaluate the effect of ultrasonic activation on coronal marginal adaptation and microporosity of ProRoot MTA, Biodentine and NeoMTA Plus materials on simulated immature teeth model.

Summary Sixty freshly extracted human maxillary lateral incisor teeth were used for this study. First, teeth were instrumented with ProTaper Next X2 files and then to simulate immature teeth with an open apex, root canal enlargement was performed using sizes 1 to 5 Peeso-Reamer burs. The specimens were randomly divided into 6 six groups (n=10). Group 1: Biodentine + hand condensation, Group 2: Biodentine + ultrasonic activation, Group 3: NeoMTA Plus + hand condensation, Group 4: NeoMTA Plus + ultrasonic activation, Group 5: ProRoot MTA + hand condensation, Group 6: ProRoot MTA + ultrasonic activation. All tested materials were mixed by mechanical mixing of powder and liquid and placed on the blood-embedded Spongostans 2 mm underneath the cement-enamel junction by hand condensation or indirect ultrasonic activation. The samples were scanned using micro-CT imaging. Volumetric analysis of the voids between the dentine walls and coronal barrier material and the porosity inside the material was evaluated. Results were evaluated statistically with Kruskal Wallis and Mann Whitney-U test. There were no significant difference in marginal adaptation among the 6 groups. Ultrasonic activation is effective in reducing the microporosity volume in the material, but this reduction is not statistically significant except for the Biodentine groups ($p<.001$).

Key Learning Points

• Ultrasonic activation has a positive effect on the reduction of microporosity in Biodentine, ProRoot MTA and NeoMTA Plus materials.

• All tested materials in this study have a good marginal adaptation and can be considered as a coronal barrier material in regenerative endodontic procedures.

3:06

Compressive strength of MTA mixed with distilled water at different temperatures

*Deniz Sungur D, Eymirli A, Uyanık Ö, Nagas E

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

Aim To evaluate the effect of temperature of distilled water on compressive strength (CS) of mineral trioxide aggregate (MTA) cement

Summary To evaluate the effect of temperature of distilled water on compressive strength of MTA, ProRoot MTA (Dentsply Sirona, Switzerland) was prepared with ratio of 3:1 using 4 °C, 24 °C and 37 °C distilled water according to the recommendations of the manufacturer (n=10). Cements were inserted into moulds in 3, 5 mm diameter and 3 mm height and stored in an incubator at 37 C and 100% humidity for setting. After 24 hr and 30 days, the samples were removed from the moulds and CS was measured using an universal test machine (Instron, Lloyd Instruments Ltd., Fareham, UK) at a crosshead speed of 0.5 mm/min until failure. Maximum load was recorded in Newton (N) and converted to megapascals (MPa). The data were analyzed with two-way ANOVA and Post Hoc with Bonferroni correction with the significance of p<. 05. The compressive strength values were ranked as follows; 37° C> 24 °C = 4°C at 24 h and 30 days measurements. Compressive strength when using 37 °C water was significantly higher than the others at both time intervals ($p < 0.05$). No time dependent difference was observed amongst the groups ($p > 0.05$). Within the limitations of this study it can be concluded that mixing MTA with distilled water at body temperature provides a higher compressive strength.

Key Learning Points

• Low compressive strength is a drawback of MTA.

• Mixing MTA with a distilled water at body temperature may be a practical clinical method to enhance the compressive strength of MTA.

Canal filling - sealers

3:24

An *in vitro* micro-CT study of void presence in single-rooted 3D printed teeth obturated with Bioceramics and hydraulic condensation with four different sealer dispersion techniques

Sarvestani M[1], Sturrock C[2], Seoudi N[3], Almasri M[3], *Prichard J[3]

[1]School of Health, BPP University, London, [2]Dentistry, Nottingham University, Nottingham, [3]Dental School, College of Medicine and Dentistry, Birmingham, United Kingdom

Aim By using Micro-Computed Tomography (µCT) the purpose of this study is to investigate how four different Bioceramic (BC) sealer dispersion techniques, influence the presents of voids in a single rooted three-dimensional (3D) printed teeth, when hydraulic condensation is employed with a single cone obturation technique (SCOT).

Summary Twelve 3D printed teeth were randomly allocated into 4 equal groups (n=3 per group) and instrumented in a standardized manner. Hydraulic condensation was carried out in all experimental groups but utilising different dispersion methods (size 15 K file, Sensipast, EndoActivator and XP-endo Finisher). Teeth were then scanned in a µCT scanner and the computer software VGStudioMAX (Volume Graphics GmbH, Germany) was used for the volumetric analysis. For each tooth the total percentage of the volume of voids (TPVV) was calculated from the Cementoenamel Junction (CEJ) to the apex of the tooth. The results showed no statistically significant differences in median void formation among the four groups of sealer dispersion in total sections, apical, middle and coronal sections. EndoActivator achieved the lowest median porosity when the whole Region of Interest (ROI) as well its subdivided apical and coronal ROI were investigated.

Key Learning Points

• None of the BC sealer dispersion techniques appeared to be superior.

• It was observed that EndoActivator yielded the lowest median percentage of volume of voids when the whole as well as sectional (apical and coronal) parts of the root canal were investigated.

• Further research is required to investigate the impact of different BC sealer dispersion techniques on prevalence of voids within the root canal filling and understand the clinical influence of these voids for endodontic treatment failure.

3:42

Effectiveness of different irrigation techniques on dentinal tubule penetration of bioseramic-based endodontic sealer

*Atav Ateş A, Ciftcioglu E, Arıcan Öztürk B, Küçükay S

Department of Endodontics, Faculty of Dentistry, Istanbul Okan University, Istanbul, Turkey

Aim To evaluate the efficacy of different irrigation techniques on dentinal tubule penetration of bioseramic-based endodontic sealer.

Summary Sixty-four single-rooted extracted human permanent mandibular insicors were used in the study. After instrumentation with EndoSequence rotary files up to size 30, .04, teeth were randomly divided into four groups (n=16), according to the following final irrigation techniques: Group 1: Conventional endodontic needle (control), Group 2: EndoActivator, Group 3: Er,Cr:YSGG Laser, Group 4: XP-endo Finisher. The root canals were finally irrigated with 5.25% sodium hypochloride (NaOCl) and 17% ethylene diamine tetra-acetic acid (EDTA), respectively for one minute using the technique used in each group. Teeth were then obturated with Endosequence BC points and rhodamine B dye-labeled BC sealer. 1mm-thick transverse sections cut at 2 and 5mm from the root apex were examined using confocal laser scanning microscope at 5X and 10X magnification.Total percentage,sealer penetration area and maximum depth of sealer penetration were measured.Data were analysed by Kruskal-Wallis, Dunn's Multiple Comparison and Wilcoxon tests with significance set at $p<0.05$. At 2mm-levels,no significant differences were detected in total percentage, sealer penetration area and maximum depth of sealer penetration among any of the groups ($p>0.05$). At 5mm-sections, XP-endo Finisher group showed significantly higher total percentage and sealer penetration area in comparison

with Er,Cr: YSGG Laser and control groups, respectively ($p<0.05$), and EndoActivator group showed significantly higher results with regard to Er,Cr: YSGG Laser group ($p<0.05$). In terms of maximum depth of sealer penetration, Er,Cr:YSGG group revealed significantly lower results than the EndoActivator ve XP-endo Finisher.In this study,using XP-endo Finisher for final irrigation appeared to improved the total percentage, sealer penetration area and maximum depth of sealer penetration rather than the other techniques used, at the 5-mm levels of the root canals.

Key Learning Points

• Different irrigation techniques have various consequences on dentinal tubule penetration of bioseramic based sealer.

• XP-endo Finisher improved maximum depth and dentinal tubule penetration at 5 mm level of the root canal.

Hall 6

Instruments – cyclic fatigue and fracture

9:00

Parametric design analysis: a new tool for instruments design optimization

*Galal M

Department of Endodontics, National Research Center, Cairo, Egypt

Aim Optimizing instruments design using Finite Element Analysis to study the effect of different design features and thermomechanical treatments on the mechanical behavior of rotary files.

Summary Instrument fractures during root canal preparation have been attributed to torsional and flexural fatigue during preparation of narrow curved root canals due to accumulation of residual stress within the instrument. Nowadays, various modifications have been made for enhancing the mechanical performance of NiTi instruments such as improving the manufacturing processes, metallurgy and the geometric design. Various studies have shown that the Geometric design dictates

the mechanical performance of NiTi rotary instruments. So, what is the best design, the best alloy, and which is the superior file? Using a research tool for biomechanical analyses such as finite element analysis (FEA) allows modeling the complex structure of NiTi files and analyzing its mechanical behavior during different clinical situations. Finite element analysis (FEA) is the method of choice for theoretical analysis of the mechanical response of NiTi files with different designs and different alloys as it creates controlled conditions and offers the advantage of combining of variables in a way that is not possible experimentally. Numerical analysis of different design features such as cross-sectional design, surface area, taper, pitch and off-centered cross-section allows studying their effect on the stress distribution in nickel-titanium rotary instruments. The manufacturers claimed that a new design feature such as off-centered cross-section design decrease the stress generated during rotational motion inside the canal by decreasing the instrument contact with the canal wall. Thermomechanical treatments of NiTi files consider a modern technique of developing new endodontic instruments with improved mechanical properties. Thus, analyzing the effect of different design features and different metallurgy on the fracture resistance of endodontic files allows development of new file with improved mechanical properties.

Key Learning Points

• Causes of failure of rotary files (Flexural and Torsional fatigue).

• Factors affecting the mechanical response of rotary files.

• Effect of different geometric design features on the mechanical behavior of rotary files.

• Effect of thermomechanical treatments on mechanical behavior of rotary files.

• Development of new file design with optimum mechanical properties.

9:18

WITHDAWN

9:36

How apical torsional loads influence the cyclic fatigue resistance of NiTi instruments

*Iacono F [1], Pirani C [1], Peters OA [2], Bianchini C4 [1], Zamparini F [1], Prati C [1]

[1]School of Dentistry, Endodontic Clinical Section, Master in Clinical Endodontology, Department of Biomedical and Neuromotor Sciences,, University of Bologna, Bologna, Italy, [2]Department of Endodontics, University of the Pacific, Arthur A. Dugoni School of Dentistry, San Francisco, University of the Pacific, San Francisco, US

Aim To describe an innovative device to simultaneously simulate cyclic fatigue and torsional stress and to investigate how different torsional loads can influence the resistance in cyclic fatigue of NiTi instruments.

Summary Resistance tests were performed using a custom-made device designed (Solid Edge ST9, Siemens CAD software) to apply a bending moment and load on endodontic files during rotation. An endodontic handpiece (VDW, Germany) was mounted and fixed on a mobile apparatus that approached or separated in a standardized position from a second platform with an adjustable steel wall with different angles of curvature (0°-30°-60°). A plexiglass cylinder of 10 mm diameter was used as a plunger to simulate torsional loading, pressing the instruments against the plate on the apical 5 mm. The adjustable cylinder was connected and controlled by an apparatus that provided a uniform and constant real-time load set at different values of apical load. The intensity of the force was measured by amplified load cell and expressed in Newton (Omron K3MA-J-A2 Kyoto, Japan). Thirty-three conventional NiTi instruments size 25, .04 taper (F360 Komet/Gebr. Brasseler, Germany) were tested with an angle of curvature of 30° under 3 (n=11) different settings of apical torsional load; Group A 2.5 N; Group B: 5 N; Group C: 10 N. The speed was set at 300 rpm for all groups. Instruments were rotated until fracture, video-recorded with a digital camera and time to fracture was calculated. Fractured instruments were evaluated by SEM to investigate the fracture pattern. A significant inverse

correlation (-0.721) was observed between time and apical torsional load evidencing that by increasing load, time to fracture decreases.

Key Learning Points

• A novel custom-made device was developed to evaluate NiTi rotary file fracture under simulated cyclic fatigue and torsional stress simultaneously.

• Collected data demonstrated that the new device could overpass limitations of the existing methods of testing NiTi, simulating in a more reliable way the *in vivo* conditions.

• A significant correlation was observed between the increase of apical torsional load and time to fracture during cyclic fatigue tests.

9:54

A new flat side design instrument: pros and cons

*Seracchiani M, Morese A, Gambarini G, Testarelli L

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

Aim To expose the advantages and disadvantages of side flat design and of the proprietary thermal treatment of Fanta Dental.

Summary Since the introduction of Nickel-Titanium rotary instruments manufacturer focused on a way to improve mechanical characteristics of the instruments. The use of heat treated nickel titanium alloy and the development of different cross-section were directed to improve the cutting efficiency and the cyclic fatigue resistance of rotary instruments. The F-One (FantaDental, Shangai, China) is a recently commercialised rotary nickel titanium instruments with a side flat design. This instrument present a patented side flat design not deeply cut to increase flexibility without compromising strength. Moreover, according to manufacturer, vertical blades can sweep the debris from flutes to the relieved area, resulting in better cutting of flutes and less stress. The flat surface enhance also the space for irrigation which may lower the rate of smear layer formation.

Key Learning Points

• Influence of side flat design on cyclic fatigue.

• Influence of side flat design on cutting efficiency.

• Influence of side flat design on operative technique.

10:12

Effect of glide path creating on cyclic fatigue resistance and preparation time of Reciproc Blue nickel-titanium files

*Miçooğulları Kurt S, Serefoglu B

Department of Endodontics, Faculty Of Dentistry, Ege University, Izmir, Turkey

Aim To compare the cyclic fatigue resistance and preparation time associated with Reciproc Blue instruments that were used in curved root canals with and without glide path preparation.

Summary Forty-eight curved root canals of extracted maxillary molar teeth (with a degree of 30-40) were divided into two groups (n=24) according to glide path preparation. In Group I. glide path was created with Path File and canals were shaped with Reciproc Blue 25. In Group II. glide path was not performed and the canals were only shaped with Reciproc Blue 25. In each experimental groups twelve Reciproc Blue 25 files were used to shape 2 root canals and root canal preparation times were recorded in both experimental groups. A stainless steel artificial canal with a 90 angle and a 3-mm radius of curvature was used for the cyclic fatigue testing process. Time to fracture was recorded in seconds by means of a digital camera (Sony HDR-XR260; Sony Corporation, Japan) which was positioned on the top of the cyclic fatigue test device. For each instrument, the number of cycles to failure was calculated, and the length of the fractured fragment was measured. The data were analysed using t test (α=0.05). There was no significant difference between the cyclic fatigue resistance of Reciproc Blue files with and without glide path ($p>0.05$). The mean length of the fractured fragments of the instruments was similar in both groups ($p>0.05$). The time required for canal

preparation using Reciproc Blue after glide path preparation was significantly shorter than without glide path preparation group ($p<0.0001$).

Key Learning Points

• Creating a glide path with Path File does not affect the cyclic fatigue resistance of Reciproc Blue files.

• Glide path creation reduces the preparation time for Reciproc Blue files.

11:00

Assessment of torque life of rotary endodontic instruments in torque sensitive reciprocation kinematics using an indigenous dynamic load model

*Suresh N , Haritha JS , Natanasabapathy V

Faculty Of Dental Sciences, Dept of Conservative Dentistry, Meenakshi Academy of HIgher Education and Research, Chennai, India

Aim To develop an indigenous testing device to deliver the dynamic torsional load and to assess the torsional life of rotary endodontic files in rotary and torque-sensitive reciprocation kinematics (TSR).

Summary A custom fabricated indigenous dynamic torsion device was used to assess the torsional failure of endodontic rotary instruments. Repetitive locking of files to deliver the dynamic load was generated by a metal jig that opens and closes at a controlled timing with 4N of force. Twisted File Adaptive (size 23, .06 taper) with equilateral triangular cross section and 2Shape (size 25, .06 taper) with asymmetrical and triple helical angle were selected (n=20) The files were rotated in either continuous rotation or TSR kinematics as per manufacturer instructions. Instruments were allowed to rotate in the model until the fracture occurred. A high-speed camera (RED: Epic camera with HR Zoom Lens) was used to record the rotating file at 216 frames per second. The resulting moves were analyzed using editing software(Adobe Premier Pro). The videos were analyzed to determine the time taken for the file to fracture. The fractographic analysis of the fractured instruments was performed using Scanning electron microscopy. The overall analysis was done using Kruskal Wallis test and intergroup

analysis was performed using Mann-Whitney U test (SPSS version 16). torsion sensitive reciprocal kinematics enhanced the torsional life of rotary files in comparison to rotary motion. The 2shape and Twisted File Adaptive performed 1.5 and 1.3 times better in TSR kinematics in comparison to continuous rotary motion respectively. The fractographic analysis confirmed the fracture pattern consisting of catastrophic failure and ruptures at various level, which correlated to the repetitive loading force endured by the rotary files.

Key Learning Points

• ISO 36301-1 testing method for torsion may not be suitable for current reciprocating file kinematics.

• The indigenous novel dynamic device fabricated delivered a torsional force similar to clinical scenario.

• TSR kinematics improved the torsional resistance of all rotary files tested.

11:18

Comparison of the cyclic fatigue resistance of nickel-titanium rotary instruments manufactured using controlled memory wire

Ibrahim MM, *El-Tantawi AR, Badr AE

Department of Endodontics, Mansoura University, Mansoura, Egypt

Aim To evaluate the impact of three controlled memory files (Hyflex CM (HCM), Hyflex EDM (HEDM), One Curve (OC)) on cyclic fatigue resistance compared to shape memory files (2Shape (2S), ProTaper gold (PTG)).

Summary A total of 50 files were rotated in simulated stainless steel curved canals reproducing size and taper of the files with 45 angle of curvature and 5 mm radius of curvature. The time to fracture (TTF) was recorded in seconds; the number of cycles to fracture was calculated (NCF) and the length of the fractured fragments was measured. Data was statistically analysed using IBM SPSS software package version 20.0. Quantitative data were described using mean and standard deviation for

parametric data after testing normality using Kolmogrov-Smirnov test. Significance of the obtained results was judged at the 5% level. When comparing the TTF of all the tested files, the data obtained from statistical analysis showed that the resistance to cyclic fatigue of tested files arranged from highest to lowest was HEDM, HCM, PTG, 2S and OC respectively. When the NCF values were taken into consideration HEDM and HCM reported a significant higher cyclic fatigue resistance than PTG ($p<0.05$), OC and 2S reported the lowest resistance to cyclic fatigue among the tested files with no significant difference between OC and 2S ($p>0.05$). There was no significant difference between PTG and OC when comparing NCF ($p>0.05$). No significant difference was found in the length of the fractured fragments ($p>0.05$).

Key Learning Points

• Controlled memory wire and heat treatment to the alloy increase resistance to cyclic fatigue of NiTi files.

New clinical techniques and materials

11:36

From Lussi's non-instrumental technique to GentleWave: facts, challenges and the future.

*Ibrahim MS

Department of Endodontics, School of Dentistry, Marquette University, Milwaukee, US

Aim To review and critically analyze the literature since Lussi *et al*. (1993) introduced the non-instrumental technique until the introduction of the Gentlewave system to guide clinicians to make realistic decisions in cleaning and disinfection strategies, as well as allowing us to better inform our students, patients and referring dentists of the current clinical situation.

Summary Endodontists have long since dreamed to debride and disinfect the root canal system without the use of a single instrument. A multitude of factors were beyond this ambition: shaping errors and file separation, limitations of file systems to clean and disinfect the complex root canal

system, the amount of removed dentine that may relate to increased susceptibility to tooth fracture. While advancements in technology have continued to decrease the number of files used during RCT procedures and provide different activation protocols to disinfect beyond the instruments limits, a true non-instrumental technique remains a dream.

Key Learning Points

• Discuss and critically analyze methods used for evaluating cleaning and disinfection of the complex root canal system.

• Assess the validity of outcome studies of the different cleaning and disinfection protocols.

• Review evidence based tips and procedures that allow for the successful root canal cleaning and disinfection.

11:54

Big shapes don't create better outcomes: Minimally invasive endodontics

*Hassan NH

Department of Endodontics, Faculty of Dentistry, Cairo University, Cairo, Egypt

Aim Provide an overview of the concept of "Minimally Invasive Endodontics" and the new strategies developed to concur with this concept.

Summary The principal goal of endodontic therapy is the long-term retention of a functional tooth by preventing or treating apical periodontitis. In endodontics it has been historically advocated that in order to obtain proper visual and tactile control; straight-line access and early coronal enlargement and pre-flaring is mandatory. However, the success of root canal therapy depends on various factors such as the quality of the restoration and the structural integrity of the tooth after root canal preparation. Recent technological advances in imaging, magnification, instruments and materials paired with research guided towards a better understanding of the dentin behavior with aging and function; has led to the emergence of the concept of minimally invasive endodontics.

Key Learning Points

• Preserving structural integrity.

• Various conservative access cavity designs.

• The “Working Width”.

• Reinforcing the root, Myth or Fact?

12:12

A new endodontic Navigation system: pros and cons

*Morese A, Stefanelli L, Di Carlo S, De Angelis F, Seracchiani M, Gambarini G

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

Aim To introduce the pros and cons of Navident (ClaroNav) system in endodontic practice, illustrating the mechanism of function, the “why to use”, the “how to use” and the “when to use” of this innovative system.

Summary In the last 10 years the development of Computer Aided Surgery (CAS) grew exponentially. Starting from neurosurgery, the use of computerized technology to plan and guide the surgical procedure has increased the success rate of micro-surgical procedures. The first approach in dentistry, was the Computer Aided Implantology (CAI) in order to place dental implants basing the procedure on a 3D CBCT image of the jaw. This approach promises to deliver many benefits. Two different approaches to CAI have been developed: static and dynamic. In the dynamic approach the software provides a on-screen real-time guidance to the surgeon, who operates free-hand. The recent progresses in endodontics focused on a minimal invasive approach in both orthograde and retrograde endodontic treatment. In order to better answer to these needs of “Minimally Invasive Dentistry”, the introduction of Endodontic Navigation system has been proposed and started to be evaluated in both surgical and non surgical endodontic therapies.

Key Learning Points

• Explanation of a new endodontic navigation system.

• Pros and cons of Navident.

Other

2:30

Secret power of endodontic therapy

*Gokmen E [1], Kartal N [2]

[1]Neurology, Private practice, [2]Department of Restorative Dentistry, Faculty of Dentistry, Marmara University, Istanbul, Turkey

Aim To present the relationship between endodontic originated problems with some of severe headaches, can be controlled by successfully endodontic treatment.

Summary Nine cases reporting several daily attacks resistant to treatment assigned by neurologists and algologists (pain specialists). The cases which will be presented categorized by according to ICHD-3 (The International Classification of Headache Disorders 3rd edition- 2018) as follows: A-Migraine (1.1), B-Trigeminal-Autonomic Cephalalgias (3.1) C-Idiopathic Trigeminal Neuralgia (13.1.1.3). Clinical findings are unilateral severe pain and autonomic dysfunctions. The pain is limited to trigeminal nerve and related area. Responsible teeth can be diagnosed by patient anamnesis, clinical examinations and dental radiography. Most of the cases point that the pain originates from the tooth and share a history of recent root canal treatment. It is noteworthy that there is no symptoms or toothache in cases treated endodontically for the first time due to profound caries. In all cases, clinically headache changed positively in the following days after the root canals were cleaned & shaped and haven't been repeated in the following 4-6 years. The condition in related tooth with endodontic therapy: missed canals, insufficient obturation, limited periapical lesions with no symptoms. We observed that when the root canal system in the related tooth was cleaned effectively, some of the treatment resistant headaches, disappeared. In this paper, the importance of interdisciplinary collaboration on pain

therapies and the benefits of endodontic treatment will be presented. Cooperation between neurologists and endodontists may restore these patients' quality of life.

Key Learning Points

• Importance of diagnosis to find responsible teeth.

• Importance of root canal system cleaning and pain treatment.

• Patients with some severe headache can be treated within the cooperation of neurologists and endodontists due to successfully endodontic treatment even by teeth without any symptoms.

2:48

The effect of surgical and nonsurgical root canal treatment on inflammatory mediators and risk of cardiovascular diseases

*Bakhsh A [1], Mannocci F [1], Moyes D [2], Niazi S [1]

[1] Department of Endodontics, [2]Centre for Host-Microbiome Interactions, King's College London, London, UK

Aim To highlight the effect of surgical and non-surgical root canal retreatment on the serum level of inflammatory markers including (IL-1β, IL-6, IL-8, hs-CRP, Pentraxin 3 (PTX-3), TNF-α, prostaglandins E2 (PGE2), CXCL12, MMP2, MMP8, MMP9, E-selectin, VCAM-1, ICAM-1 and FGF-23).

Summary Inflammation has a major role in the pathogenesis of atherosclerosis and its systemic complication. Several studies have shown that levels of inflammatory markers are an indicator of cardiovascular disease risk. It has been found that C-reactive protein (CRP), tumor necrosis factors (TNF), and IL-6 are associated with a risk of future myocardial infarction, stroke, peripheral vascular disease, and cardiovascular death among healthy population. This presentation will be showing results of an ongoing study on the effect of surgical and non-surgical root canal retreatment on the inflammatory markers. Patients undergoing endodontic treatment were compared with fit and healthy controls who have never had any root canal treatment done. In the treatment group, patients

with chronic inflammatory condition, smokers, pregnant women, teeth with pocket >4mm, unrestorable teeth, or patients who have had an antibiotics in the past month or have had a surgical procedure in the last three months were excluded. Healthy controls included fit and healthy non-smoker individuals who had no periodontal and endodontic disease, and no previous root canal treatment done. Blood samples were collected before and after the treatment for patients undergoing endodontic treatment and on a random time point for healthy controls. Serum was analysed using Luminex multiplex microbead assays.

Key Learning Points

• Oral hygiene and systemic health.

• Root canal treatment and the risk of cardiovascular diseases.

• The effect of surgical and non-surgical root canal retreatment on the inflammatory markers.

3:06

Connections between apical periodontitis and systemic diseases

*Guex DG

General Praticioner specialising in Endodontics, Villié Morgon, France

Aim To describe the connections between apical periodontitis and systemic diseases (rheumatoid arthritis, articular deseases, AVC, diabetes, etc …), to review the literature, and show personal cases.

Summary We are receiving more requests for dental checkups from clinical or hospital surgeons before surgery. The most common related surgical procedures are focussed on joint prosthesis. In fact, general medecine realised that periodontal disease and apical disease can affect general health. When we read the litérature, we can be surprised about the many connections we can find with systemic disease associated with oral diseases: arthritis, polyarthritis, tendinitis, diabetes mellitus, hypertension, coronary artery disease, cardio-vascular diseases, intracranial aneurysm, aortic aneurysm, pulmonary disease, skin disease (purpura), pancreatic disease, kindney disease, liver

abcess, pre-term delivery of low birth weight infants, neurodegenerative diseases such as Alzheimer and Parkinson, brain abcess etc. We know that personal behavior can have an impact on apical inflammation. For example, chronic alcohol consumption increases inflammation and osteoclastogenesis in apical periodontitis. Certain pathogens demonstrated a predilection for specific target tissues (theory of 'elective localization or dissemination'). In endodontic infections, inflammatory mediators such as cytokines are released, recruited and retained until the infection is eradicated. So, the links between general diseases, personal attitudes, endodontic infections, inflammatory mediators are complex but existing. What is more difficult is non painfull apical periodontis. Furthemore, retroalveolar radiographs and panoramics cannot show an existing granuloma, CBCT shows granulas but sometimes, we can have a root inflammation without CBCT signs. That's why, the role of the Dental Surgeon is central for diagnosis including their experience and analysis. We can suspect apical inflammation without any signs. Modern technology can bring us important progress towards discovering apical pathosis, but the critical sense of Dental Surgeons can detect apical inflammation in order to avoid general complications, because we do not have technology which can discriminate an apical inflammatory site by searching inflammatory markers *in vivo*.

Key Learning Points

• The role of lipolysaccharide with Gram negative species.

• Cascade of inflammatory cytokynes, host response, predilection for specific target tissues, systemic circulation, adverse effects in distant organs, chronic inflammatory diseases.

3:24

Effect of sodium hypochlorite volume on postoperative endodontic pain in asymptomatic necrotic mandibular molars in single visit endodontics: A prospective double blind clinical trial

*Ali A

Department of Conservative Dentistry and Endodontics, Pacific Dental College and Hospital, Udaipur, India

Aim Pain following endodontic treatment is the most common problem precepted by the patients. Its prevalence rate ranges between 3-58%. Several studies have evaluated associations between postoperative pain and preoperative clinical factors. The most likely predisposing clinical condition for its occurrence is pulp necrosis. The aetiology of this pain is multi-factorial and depends on the interaction between the host immunological response, infection, and physical damage. Extrusion of debris during root canal treatment is one of the aetiologic factors. The purpose of this prospective, double-blind study was to evaluate postoperative pain following root canal treatment in patients with necrotic pulps using two different irrigant volumes and Neolix Neoniti single file rotary instrumentation techniques.

Summary Following endodontic management pain is usually encountered with the prevalence ranging between 3-58%. The aetiology of this pain is multifactorial and debris extrusion could be the one cause. In patients with asymptomatic mandibular molar teeth with necrotic pulp, the preparation of the root canal system with the Neolix Neoniti single-file instrumentation technique resulted in significantly less postoperative pain and less analgesic consumption than the multi-file rotary instrumentation techniques.

Key Learning Points

• The severity of postoperative pain decreased substantially during the first 2 days after treatment.

• The number of patients with moderate or severe pain levels decreased over time, and the number of patients with mild and no pain levels increased.

3:42

WITHDRAWN

Hall 7

Case report or case series

9:00

Actinomycosis of the maxillary sinus leading to reinfection in treated root canals

*Aggarwal SD [1], Bhatavadekar NB [2]

[1]Department of Conservative Dentistry & Endodontics, Dr.D.Y.Patil Dental College & Hospital, [2]Clarus Dental, Pune, India

Aim To diagnose and treat a case of Actinomycosis of the maxillary sinus, that led to failure of treated root canals.

Summary A patient reported to the clinic with a symptomatic previously treated root canal. Investigations led to the conclusion that the patient was suffering from an Actinomycosis infection of the maxillary sinuses. There was bilateral involvement of the sinuses. There was substantial bone loss in the side being treated. A CBCT revealed that there were infectious masses seen in both the sinuses. Also a small lesion, which was radiographically opaque was detected on the angle of the mandible on the right side. An infectious diseases specialist was consulted alongwith an Oral & Maxillofacial Surgeon. This led to a treatment plan where local treatment was done along with systemic medication for the cure of the infection. Locally, the tooth which was symptomatic was debrided. The patient was put on long term systemic antibiotics for the Actnimycosis infection.

Key Learning Points

• Thorough investigations are needed whilst considering the cause of failed root canals.

• Lesions of non-odontogenic origin are to be considered in the differential diagnosis.

• An endodontist has to be vigilant in deciphering the details thrown up.

9:18

Regenerative endodontic treatment of avulsed Immature permanent incisors with apical pathosis: 7 years follow up

*Ismail AG

Department of Endodontics, National Research Centre, Misr International University, Cairo, Egypt

Aim To present and discuss the different clinical and radiographic long term outcomes of regenerative endodontic treatment procedures of avulsed immature upper central incisors with necrotic pulps and apical pathosis.

Summary Trauma of developing teeth may lead to pulpal necrosis with subsequent arrestment of root development, rendering them susceptible to fracture. Apexification has traditionally been the clinician's first choice till the breakthrough of regenerative endodontic procedures. The magnitude of clinical success of the above-mentioned concept is measured by long-term observations, as was the case with this report. This case study reports history of trauma of a 10-year-old boy which led to the avulsion of immature upper central incisors. Reimplantation was followed by recurrent swellings denoting prescence of apical pathosis. Radiographic diagnosis of both incisors revealed immature apices with periapical radiolucencies and short thin dentinal walls together with a mid-root horizontal fracture in the upper left central incisor. Regenerative Endodontic procedure (REP)was attempted in both teeth by creating a sterile blood clot in pulpal space of each. At twelve months, clinical and radiographic examination (CBCT) demonstrated the recovery of sensitivity, continued root development (elongation and thickening) in addition to periapical healing in the upper left central incisor. On the contrary, the upper right central incisor showed only healing of the periapical radiolucency without apical closure nor elongation. Since the latter was questionable, further REP trial was done using platelet rich fibrin. After 7 years of follow up the upper left central incisor revealed excellent results whereas the upper right incisor revealed apical closure without elongation.

Key Learning Points

• Judge the traditional treatment modalities in immature teeth with pulp and periapical pathosis.

• Apply different regenerative endodontic procedures in different clinical situations.

• Assess the biological tissue reaction towards regenerative endodontic treatment.

• Recognize the importance of long term follow up in pulp revascularisation procedures.

9:36

Endodontic management of complex root canal anatomies using unconventional treatment modalities- A series of case reports.

*Mahajan S

Department of Endodontics, Make My Smile Multi Speciality Dental Hospital, Moradabad, India

Aim 1.To demonstrate the importance of 3 dimensional visualisation, cleaning and filling for a successful endodontic treatment. 2. To elaborate various techniques of finding hidden root canal complexities. 3. To demonstrate the role of magnification and CBCT in management of complex cases. 4. To present the morphological variations in root canal systems found in a North Indian population.

Summary One of the biggest challenge in non surgical management of teeth is to comprehensively understand the variations of tooth root canal anatomy. A thorough knowledge of the root canal anatomy and its variations is necessary for successful endodontic management. CBCT plays a major role in the diagnosis and treatment planning for various clinical situations which are otherwise difficult to successfully treat with traditional diagnostic aids. Minimally invasive endodontics with predictable and reproducible technique is the need of the hour. With the evolution of new heat treated endodontic instrumentation, conservative approach towards root canal shaping is possible even in severely complex root canal system. Newer agitation devices and thermoplasticized obturation techniques helps in three dimensional cleaning and obturation of a well prepared root canal systems. My cases will show a systematic approach from diagnosis with magnification and three dimensional imaging to three dimensional obturation in the non surgical management of complex root canal

anatomies. Each set of population has some special and characterstic variations in the root canal morphologies, my cases will be showing uncommon root canal situations found in a North Indian population and their management with a minimally invasive approach.

Key Learning Points

• Importance of clinical diagnosis in conjunction with advanced diagnostic aids to perform a successful endoodntic procedure.

• Minimally invasive approach to manage even complex clinical situations.

• Presentation of rare clinical situations and their management with advanced endodontic materials and techniques.

Root canal retreatment

9:54

Evaluation of 2 shaping systems and 2 ultrasonic irrigation devices in removing root canal filling material from mesial roots of mandibular molars assessed by Micro-CT

*Kaloustian MK [1], Nehme W [1], Zogheib C [1], Naaman A [1], Diemer F [2]

[1] Department of Endodontics, Dental School-Saint Joseph University, Beirut, Lebanon, [2] Department of Endodontics, Dental School-Université de Toulouse, Toulouse, France

Aim To compare the efficiency of 2 shaping file systems followed by 2 passive ultrasonic irrigation devices in the removal of filling material from mesial canals of mandibular molars during retreatment procedure.

Summary The mesial canals from 44 extracted mandibular molars were prepared and filled (n = 88). The teeth were randomly divided into two groups, and then one group was retreated with Reciproc R25 (VDW, Germany) and the other group was retreated with 2Shape (TS, Micro Mega, France). A micro-computed tomography (CT) scan was taken before and after the retreatment to assess the volume of the filling material remnants. The teeth were then divided into four groups to test the effect

of 2 different PUI devices: Irrisafe (Satelec Acteon Group, France) and Endo Ultra (Vista Dental Products, USA). The teeth in the first group were retreated with 2Shape to test the Endo Ultra (n = 22) device, the teeth in the second group were retreated with 2Shape in order to test the Irrisafe (n = 22) device, the teeth in the third group were retreated with Reciproc to test the Endo Ultra (n = 22) device, and the fourth group was retreated with Reciproc to test the Irrisafe (n = 22) device. A third micro-CT scan was taken after the retreatment to compare all groups. The percentage of Gutta-Percha (GP) and sealer removed was 94.75% for TS2 ($p < 0.001$) and 89.3% for R25 ($p < 0.001$). The PUI significantly enhanced the removal of the filling material by 0.76% for the first group ($p < 0.001$), 1.47% for the seoncd group ($p < 0.001$), 2.61% for the third group ($p < 0.001$), and by 1.66% for the fourth group ($p < 0.001$).

Key Learning Points

• None of the systems was able to completely remove the GP and sealer during retreatment.

• 2Shape was more effective than Reciproc ($p = 0.018$) in removing GP and sealer.

• The supplementary approach with PUI significantly improved filling material removal, with no statistical difference between all groups ($p = 0.106$).

10:12

Effect of third dimension on fractured instrument decision making

*Ghobashy A

Department of Endodontics, Misr International University, Cairo, Egypt

Aim To explain the effect of using 3D imaging, reconstruction, and printing in managing retreatment cases with separated instruments.

Summary Exploring the third dimension using cone beam computed tomography can have a great influence on the steps of evaluation, decision making and management of fractured instruments. Various parameters such as canal anatomy, morphology, dentine thickness, angle of curvature,

presence or absence of periapical radiolucencies can be evaluated using 3D imaging, reconstruction, and printing. Management of fractured instruments can range from instrument bypass or retrieval to surgical management according to different factors that should be evaluated carefully before decision making; these factors will have a major influence on the survivability and longevity of the tooth and resisting fracture after loading. Many techniques are being proposed for fractured instrument management: ultrasonic instruments of different designs, holding techniques, retrieval forceps. The ideal techniques for each case should be determined only after proper diagnosis and evaluation of each case and what is ideal for one case may be detrimental to the other.

Key Learning Points

• Detection of the fractured instruments should not be done using CBCT scans especially in filled canals.

• No attempts of retrieval should be done in asymptomatic cases with apically located fractured instrument with no signs of apical periodontitis in the CBCT scan.

• The use of CBCT in management of fractured instruments is mandatory for the conservation of the tooth structure for long term survival under functional loading.

• CBCT measurement tools are extremely beneficial in the retrieval attempts of fractured instruments.

11:00

Saving incisors with a large periapical lesion by non- surgical retreatment: a case report

*MammadlI M, Bücher K, Diegritz CH, Hickel R

Department of Conservative Dentistry and Periodontology, Ludwig-Maximilian University of Munich, Munich, Germany

Aim This case presentation describes a persistent apical periodontitis associated with the maxillary incisors managed successfully by conservative root canal retreatment.

Summary A 35 y old male patient presented at the dental emergency department complaining of progressive pain in the upper left region. The upper left central and lateral incisor were both tender to percussion, and apical palpation as well as having a negative response to sensibility testing. The clinical and radiographic diagnostic revealed a confluent periapical lesion with incomplete root canal treatment for both roots, most probably associated with a history of trauma in childhood. Same day emergency intervention comprised removal of the present root canal filling material (gutta-percha), irrigation protocol and placement of calcium hydroxide dressing. In addition, antibiotics were prescribed for seven days to prevent a flare up. After a period of ten days, pain decreased. The following appointment, performed three weeks after first show up, comprised a complete root chemo-mechanical debridement and placement of calcium hydroxide of the clinically asymptomatic teeth. Final root canal filling was performed using warm -vertical obturation. At the 1-year follow-up, the teeth were clinically asymptomatic and radiographically had almost complete remission of the periapical lesion. The prognosis appears for a complete healing appears promising - in case of persistent apical pathosis, apical microsurgery is a remaining option to achieve a long-term tooth preservation. A prosthetic treatment of the teeth was recommended.

Key Learning Points

• non-surgical retreatment of root canals can serve to reduce apical lesions significantly.

• non-surgical retreatment of root canals are the first choice for periapical lesions and will improve long term prognosis for tooth preservation.

11:18

3D retreatment: efficiency and effectiveness

*Dhaimy S

Restorative Dentistry and Endodontics, hassan II university, faculty of dentistry of casablanca, casablanca, Morocco

Aim To present the various instruments used during root canals retreatment, using reciprocating or continuous rotation, along with reviewing the scientific evidence of their effectiveness and cleaning capacity. Via several cases reports, we will explain the different steps of the 3d retreatment protocol.

Summary Root canal retreatment is a complex therapy; it requires a specialized technical platform and a clinical approach with several steps, allowing meticulous cleaning and correct shaping of the canal. The most important step resides in the time devoted to the removal of the previous filling material, using efficient instrumentation with reciprocating or continuous rotation, allowing access to the canal and its appropriate irrigation. The use of the magnification in retreatment as well as ultrasonics have had a significative impact on the success of this therapy. The aim of this talk is to present the various instruments used in the process of root canal retreatment, using reciprocating or continuous rotation, along with reviewing the scientific evidence of their effectiveness and cleaning capacity. Through several cases reports, the multiple steps of a 3d retreatment protocol will be explained.

Key Learning Points

• Root canal retreatment

• Filling removal

• Continuous and reciprocating motion

• Root canal disinfection

11:36

Demographic, clinical and radiographic data of patients referred for root canal retreatment

*Keles A, Askerbeyli Ors S, Uzunoglu Ozyurek E

Department of Endodontics, Faculty Of Dentistry, Hacettepe University, Ankara, Turkey

Aim To evaluate the demographic, clinical and radiographic data of patients referred for endodontic retreatment.

Summary Patients referred for root canal retreatment between 01/10/2018 - 15/02/2019 were evaluated clinically and radiographically. Data including patients age, gender, where/when was the first treatment done, findings of intraoral and extraoral examination, results of radiographic evaluation and subjective symptoms of patients were obtained and analyzed with chi-square tests. Total number of referred patients were 100 (Female: 69 and male: 31). The mean age of the patients was 36.76 (age of patients was between 16-71 y). Sixty-four percent of the previous treatments were performed in state hospitals, while 26% were performed in private clinics and 10% were performed in University Hospitals ($p < 0.001$). Seventy-two of the retreated teeth were molar, 22 were premolar and 6 were anterior teeth ($p < 0.001$). Fifty-five percentage of the referred teeth were mandibular teeth, while 45% were maxillary ($p > 0.05$). In 71% of the patients, the first treatment was performed in the last 5 years; 29% were performed more than 5 years ago ($p < 0.001$). There were amalgam restorations in 38% of the patients, while 32% of them had composite restoration ($p > 0.05$). Nineteen patients had crowns; 7 had temporary filling and only 4 patients did not have any post-endodontic restorations. Forty-six percentage of the coronal restorations were insufficient and 16 patients had secondary caries. While 54% of the patients had pain, 46% had no pain ($p > 0.05$). Eighty-two patients had a periapical lesion. 43.9% of the patients with periapical lesion reported that they did not have pain ($n = 36$). Sixty-seven percentage of patients had short root canal filling and 4% had over filling. In 62% of the patients, there were insufficiently condensed root canal fillings or untreated root canal.

Key Learning Points

- Molar teeth were retreated more frequently.
- Chronic painless lesions are quite high.
- Teeth which had short fillings were refereed for retreatment more frequent compared to overfilling.

11:54

Comparative evaluation of the treatment outcomes after single- versus two-visit retreatment: a clinical study.

*Kandemir Demirci G

Department of Endodontology, Ege University, İzmir, Turkey

Aim To evaluate the outcome of single-visit and 2-visit non-surgical root canal retreatments of teeth with asymptomatic periapical lesions and the influence of various predictors on treatment outcome.

Summary A total of of 40 patients with asymptomatic root canal-treated teeth in need of retreatment were randomly divided into 2 groups (n=20). Patients in group 1 were treated in a single visit. Patients in group 2 were treated in two visits using calcium hydroxide as an intracanal medicament for one week. For each included tooth the gender of the patient, length of the root canal filling and restoration type were recorded. Treatment outcomes were assessed radiographically according to the Periapical Index (PAI). One tooth was lost to follow-up, and the remaining 39 teeth were assessed by two calibrated examiners for outcome as healed (periapical index score-PAI≤2; no signs and symptoms) or diseased (presence of apical periodontitis-PAI >2; signs or symptoms). The follow-up period was 12-24 months in both groups and the last follow-up data were analysed using the chi-square tests and Fisher tests. The Kaplan-Meier analyses were used to analyse the cumulative survival time. All tests were performed at a significance level of 0.05. Thirty-nine of the 40 patients were available for final analysis. In the one-visit group, 14 (70%) teeth were considered as healed, 6 teeth were considered as diseased (30%). In the two-visit group, one tooth was lost to follow-up and 15 (79%) teeth were considered as healed, and 4 teeth (21%) were considered as diseased. Mean observation time for one-visit group was 15.9 months and two-visit group was 14.8 months. There were no significant differences in success and survival rate among the groups after the follow-up periods ($p>0.05$). Gender did not have a significant impact on treatment outcome ($p>0.05$). Length of root canal filling and restoration type had significant effect on the retreatment outcome ($p<0.05$).

Key Learning Points

• This study showed that one-visit and two-visit retreatment had similar treatment outcomes.

• Due to the advantage of decreased treatment time, one-visit retreatment appears as an efficient alternative to two-visit retreatment in asymptomatic teeth with periapical lesions.

12:12

Selective root canal retreatment - case series and decision making

*Guerreiro Viegas O, Jautze AA, Thé WTH

Department of Endodontics, Academic Centre for Dentistry Amsterdam (ACTA), Amsterdam, Netherlands

Aim To present the option of a “selective” root canal retreatment as a minimal invasive approach to treat persistent apical periodontitis

Summary Several potential reasons are known to cause persistent apical periodontitis on previously endodontically treated teeth. Treatment options for retention of these teeth usually include nonsurgical retreatment, surgical treatment or a combination of both procedures. The non-surgical approach, includes retreatment of all canals, assuming that contamination has spread throughout the canal system. Such an endodontic retreatment has potential risks such as the weakening of the tooth structure and iatrogenic errors. Periapical radiography is the technique of choice for diagnosing, controlling and assessing periapical lesions. However, presence or absence of apical lesion can be more accurately detected by CBCT allowing the clinician to make more predictable decisions about which of the roots are associated with apical periodontitis. In this way, retreatment could be considered only for the involved root or roots rather than the whole root canal system. Limited evidence is available regarding the outcome of this “selective” treatments but successful case reports were published and some cased will be demonstrated and discussed.

Key Learning Points

• Considerations for selective root canal retreatment.

• Impact of CBCT in selective retreatment. Is CBCT really necessary?

• Advantages and disadvantages of selective root retreatment.

2:30

Comparative evaluation of effectiveness of contemporary instrument retrieval systems and its effect on fracture resistance of teeth

Talwar ST, *Nawal RR, Malhotra A

Department of Endodontics and Operative Dentistry, Maulana Azad institute of Dental Sciences, Gurgaon, India

Aim To comparatively evaluate contemporary instrument retrieval systems for their clinical effectiveness and prognostic impact on teeth. To assess the present status and discuss possibilities for future developments

Summary Instrument separation is a troublesome incident during endodontic treatment that besides compromising the prognosis of endodontic treatment, is psychologically traumatic both for the patient and the practitioner with medicolegal implications. Successful retrieval of these instruments is the preferred treatment of choice . However the potential difficulty and unpredictability of the procedure makes it complex .Different devices and techniques have been developed for instrument retrieval, but none are consistently successful or predictable. Very few studies have comparatively evaluated the differences in clinical performance and success of these techniques. In this study, we evaluated the standard and newer Instrument retrieval systems including Single frequency Ultrasonic Tips (Proultra, Dentsply) , Terauchi File Retrieval Kit (TFRK) and Endo Removal System-Pro (Cerkamed) for clinical performance including Success rate, Time taken. Pre and Post treatment CBCT scans and Image Processing software were used for determining the Intracanal Dentinal Loss for the successfully retrieved cases for all systems . These roots were then subjected to Fracture Resistance testing .

Key Learning Points

• Objective systems for prognostic evaluation of teeth , for successful instrument retrieval is vital.

• Comparative clinical evaluation revealed merits and demerits of contemporary Instrument Retrieval systems available in market . Systems with micro-sized instruments for final retrieval, affected the overall prognosis of tooth favourably.

• The amount of intra canal dentinal loss is a critical parameter to evaluate for determining “success” of instrument retrieval . Measures to reduce loss ofd dentine will be discussed objectively using pre and post CBCT image analysis.

• A future direction for possible innovation in instrument retrieval systems that can affect the prognosis favorably discussed .

Trauma and root fractures

2:48

WITHDRAWN

3:06

Sandwich technique for wire-splinting of traumatized teeth: Preliminary clinical experience

*Kaur A, Logani A, Ramnani H, Moidu N

Department of Conservative Dentistry and Endodontics, All India Institute of Medical Sciences, New Delhi, India

Aim To investigate the viability of sandwich technique using type VII (pink) glass ionomer cement (GIC) for splinting of traumatized teeth

Summary Eight patients with luxation and subluxation injuries were divided into two groups. Pre-operative clinical photographs were taken with a DSLR camera under standardized conditions. In Group A (n=4) standardized protocol for acid etch composite wire splint was followed. In Group B

(n=4), protocol for wire splinting using sandwich technique was followed. The tooth surface was pre-conditioned using 10% polyacrylic acid for 10 seconds, rinsed with a copious air/water spray for 10 seconds and blot dried using sterile cotton leaving the surface visibly moist. GIC (type VII) was mixed according to the manufacturer's instructions and a blob was placed on the mid labial surface of the tooth. A 23-gauge wire was adapted over the GIC blob which was stabilized by tooth colored matching composite resin under magnification. Post-operative clinical photographs were taken. The patients were recalled after a period of two weeks for splint removal. In group A, the splint was removed with the help of a 12-fluted diamond bur whereas in group B, it was removed with a spoon excavator using a jerk motion. The degree of demineralization was quantified using Diagnodent pen (laser fluorescence). The present clinical study demonstrated no development of white spot lesions/demineralization after the removal of the wire splints placed with the sandwich technique as opposed to the acid etch wire composite splints at the end of two weeks.

Key Learning Points

• Sandwich technique for splinting has no adverse effects on the underlying tooth structure.

• It has the advantage of high fluoride release and easy removal.

• It is a viable alternate technique for splinting of traumatized teeth.

3:24

Interdisciplinary approach for the management of subgingival crown fracture : Case reports

*Chauhan S

Department of Conservative Dentistry & Endodontics, Kalka Dental College & Hospital, Meerut, India

Aim To describe an interdisciplinary approach involving orthodontic extrusion, conservative periodontal surgery, and cast post and core with porcelain-metal crown prostheses for the management of subgingival crown fracture.

Summary Traumatic fracture of the maxillary incisors and its sequelae impair the aesthetics, function, and phonetics. For a clinician, on the other hand, they pose a challenge for the establishment and accomplishment of an adequate treatment plan. A subgingival fracture line may involve biologic width resulting in restorative difficulties, where preservation of healthy attachment apparatus becomes paramount for a successful outcome. Among all the treatment options, such as periodontal crown lengthening, surgical extrusion, intentional replantation and extraction, orthodontic extrusion is the most conservative method. The aim is to obtain both a sound tooth margin which offers adequate crown ferrule and a sustained biologic width by bringing the periodontal apparatus along with it. This study concludes that a multidisciplinary treatment approach with cooperation among specialists to manage such a type of dental injury is essential for favorable esthetic and functional rehabilitation.

Key Learning Points

• Dental trauma in children and adolescents not only affects biological tissues, but they also have psychosocial influence as well.

• Technical knowledge and clinical experience are crucial to ascertain an accurate diagnosis and provide an appropriate treatment plan.

• A combined endodontic, orthodontic, and periodontic approach is desirable for successful esthetic and functional rehabilitation.

3:42

Mouthguards use in prevention of sport-related traumatic teeth injures

*Dydyk, NM

Department of Prosthetic Dentistry, Danylo Halytsky Lviv National Medical University, Lviv, Ukraine

Aim To present data on mouthguards use and current strategies of prevention of sport-related teeth injuries by athletes practicing contact sports.

Summary Traumatic dental injuries are common occurrences with significant esthetic, functional and psychological impact. A great number of athletes dental trauma cases result from contact sports due to direct physical contact between participants, falls, collisions, contact with hard surfaces or sport equipment. The most reliable preventing strategy for sports-related teeth trauma is wearing protective mouthguard during sport activities. The benefits of sports mouthguards protection has been well documented. A properly fitted mouthguard works by separating the maxillary and mandibular dental arches, absorbing or redistributing shock and/or stabilising the mandible during violent jaw closure. Custom-fabricated mouthguards provide athletes with the highest level of protection. A survey was conducted by questioning professional athletes engaged in boxing, American football and rugby. The study group consisted of 120 athletes aged from 17 to 28 years old. The survey questionnaire contained a list of questions regarding individual experience and preferences in mouthguards use. Only half of the professional athletes used mouthguards during training. The majority (96%) of athletes choose “boil and bite” type of mouthguards mainly for competitions when mouthguard use is mandatory. Only 4% used custom-fabricated mouthguards despite the high level of comfort and protection. Scientific evidence support the contribution of mouthguards to a lower prevalence of dental trauma among athletes of contact sports. Teeth injuries can be significantly reduced if athletes wore custom-made mouthguards.

Key Learning Points

• Sport-related dental trauma can be significantly reduced with well-fitted mouthguards of appropriate thickness used by athletes while playing contact sports.

• 97% of athletes use over-the counter "boil and bite" type of mouthguards.

• 67% of athletes consider mouthguard use as uncomfortable, that impaires speech, breathing, etc.

• 49% of athletes in contact sports do not use mothguards during trainings neglecting the risk of dental trauma.

• It is crucial to motivate athletes to preserve their teeth by wearing custom-fit mouthguards.

Session Chairs

HALL	TIME	Thursday	Friday	Saturday
Hall 4	**09:00 - 10:30**			Mariano Pedano and Ozge Erdogan
Hall 4	**11:00 - 12:30**			Hugo Roberto Munoz and Athina Christina Georgiou
Hall 4	**14:30 - 16:00**			Noushad Rahim and Gül Çelik
Hall 5	**09:00 - 10:30**		Benjamín Briseño Marroquín and TBC	Thomas Gerhard Wolf and Tülay Bakırcı
Hall 5	**11:00 - 12:30**		Elif Delve Baser Can and Betül Aycan Alim	Professor shehabeldin ismael and TBC
Hall 5	**14:30 - 16:00**		Vinisha Pandey and Panos Panopoulos	Asiye Nur Dinçer and James Pritchard
Hall 5	**16:30 - 18:00**		Moatazbellah Ahmed Mohamed Alkhawas and TBC	
Hall 6	**09:00 - 10:30**	Claire El Hachem and Peter Kiefner	Loai Alsofi and Atieh Sadr	Manar Galal andFrancesco Iacono
Hall 6	**11:00 - 12:30**	Sadia A Niazi and Ayce Unverdi Eldeniz	Yoshio Yahata and Mahima Tilakchand	Nandini Suresh and Nermine NH Hassan
Hall 6	**14:30 - 16:00**	Casper Kruse and Stéphane Simon	Pietro Palopoli and Roeland De Moor	Abdulaziz Bakhsh and David Guex
Hall 6	**16:30 - 18:00**	Burçin Arican Öztürk and TBC	Mostafa Elkholy and Ahmad S. Al-Hiyasat	
Hall 7	**09:00 - 10:30**	Taher MNT AL Omari TBC	Cristina Bucchi and TBC	Amira Galal Ismail & Marc-Krikor Kaloustian
Hall 7	**11:00 - 12:30**	Jean-Philippe Mallet and António Ferraz	Reham Hassan and TBC	Said Dhaimy and Olavo Guerreiro Viegas
Hall 7	**14:30 - 16:00**	Chiara Pirani and Munoz-Sanchez	Ashraf F Fouad and Shalu Mahajan	Amandeep Kaur and TBC
Hall 7	**16:30 - 18:00**	Lora Mishra and TBC	Emre Iriboz and TBC	

/ PLATINUM SPONSOR

COLTENE
MicroMega

/ GOLD SPONSORS

Dentsply Sirona

VDW

/ SILVER SPONSORS

FANTA DENTAL MATERIALS

FKG swiss endo

WOODPECKER

/ BRONZE SPONSORS

angelus

Carestream DENTAL

EDGEENDO

Eighteeth

Fotona choose perfection

Leica MICROSYSTEMS

PLANMECA GROUP

septodont

EXHIBITORS

/ Acadental, Inc.
/ Alltion (Wuzhou) Co., Ltd
/ American Dental Systems GmbH
/ Aquarius Health & Wellness
/ B&L Biotech, Inc.
/ Bio Composants Médicaux
/ CJ-Optik GmbH & Co. KG
/ COXO Medical Instrument Co., Ltd
/ DEMED Dental Medizin Technik
/ DHM-dental BV
/ DRSK Group AB
/ ENDOSTAR
/ Forumtec
/ FragRemover GbR
/ Global Surgical
/ Innovative material and devices, Inc
/ J. MORITA EUROPE GMBH
/ JADENT GmbH
/ Karl Kaps GmbH & Co. KG
/ Kohdent Roland Kohler Medizintechnik GmbH & Co. KG
/ Komet Dental Gebr. Brasseler GmbH & Co. KG
/ Laschal
/ MANI, INC.
/ Maruchi
/ Medcem GmbH
/ Medident Italia
/ Meta Biomed Europe GmbH
/ NEOLIX SAS
/ ORODEKA SRL
/ P.P.H. CERKAMED WOJCIECH PAWŁOWSKI
/ Produits Dentaires SA
/ Quality Endodontic Distributors Limited (Q.E.D Ltd)
/ Quintessence Publishing Co. Ltd
/ S.C. Doctor Tools SRL
/ Sanctuary Health Sdn Bhd
/ Sendoline AB
/ SHENZHEN SUPERLINE TECHNOLOGY CO., LTD.
/ SHENZHEN PERFECT MEDICAL INSTRUMENTS CO., LTD
/ SICAT GmbH & Co. KG
/ SS White Dental
/ Stoma / Storz am Mark
/ Swiss Endo Academy
/ Tri Hawk S.A.
/ United Dental Changzhou
/ VELA-Medical
/ ZEISS
/ Zumax Medical Co,.Ltd.