Title: Comparison of cyclic fatigue resistance of nickel-titanium coronal flaring instruments

Author: Davut Capar I et al.


Reviewer: Raj Shenoy, DDS

Purpose: Fracture of NiTi rotary instruments occurs via 2 different mechanisms: torsional fracture and flexural fatigue. Torsional fracture occurs when part of the instrument binds to the dentin while the file continues to rotate. Flexural fatigue occurs when the instrument rotates freely in a curvature generating tension/compression cycles until fracture occurs. This study compared the cyclic fatigue resistance of coronal flaring instruments.

Materials and Methods: Artificial canals with inner diameter of 1.5mm were created in testing blocks made of stainless steel. Cyclic fatigue testing was performed on 45° and 60° angles of curvature and a curvature radius of 3mm. The cyclic fatigue of the following NiTi instruments was tested: ProTaper Universal SX, HyFlex 25.08 and Revo-S. The working length was standardized at 19mm and special oil was used as lubrication (WD-40). Instruments were used until a fracture occurred. The length and diameter of the fractured fragment and the total area of the fractured surface of each instrument were measured. The data were then statistically analyzed using a 1-way analysis of variance and the post hoc Tukey test (α = .05).

Results:

- At the 60° of curvature: Fatigue resistance (most to least): Revo-S > HyFlex > Protaper Universal SX
- At the 45° of curvature, the Revo-S and HyFlex showed superior cyclic fatigue resistance compared with the ProTaper. The length of the fracture fragment of the ProTaper instrument was longer than that of the other groups at the 60° of curvature.
- At the 45° of curvature, the length of the fracture fragment of the ProTaper and HyFlex instruments was longer than that of Revo-S. The mean diameter and surface area of the HyFlex instruments in the fractured part was higher than that of other groups at both angles of curvature.

Conclusion: The Revo-S SC1 and HyFlex 25.08 instruments showed better cyclic fatigue resistance than the ProTaper

LOE: 5
Title: Evaluation of triple antibiotic paste removal by different irrigation procedures

Author: Berkhoff J et al.

Journal: JOE, Volume 40, Issue 8, 1172

Reviewer: Nadia Liss, DMD

Purpose: Regenerative endodontics aims to re-establish a functional pulp-dentin complex. First, the root canal system is disinfected primarily by irrigants and medicaments. Triple antibiotic paste (TAP), a commonly used intracanal medicament, has been shown to be directly toxic to stem cells at concentrations greater than 0.1 g/mL. Thus, its complete removal is a crucial step in regenerative endodontic procedures. It is hypothesized that currently used irrigation techniques do not completely remove TAP from root canal system. The aim of the study was to evaluate the effectiveness of irrigation techniques for the removal of the two most commonly used intracanal medicaments, TAP and Ca(OH)$_2$, from simulated immature teeth with open apices.

Materials & Methods:

- 36 roots extracted human teeth sectioned from the crown at orifice level to standardized length of 10mm, with apical 3 mm of roots resected
- canal instrumented with 15 K-file and enlarged with ProTaper Finishing File 1 (Dentsply) to 8 mm
- lumen standardized to 1.0 mm in diameter
- TAP was radiolabeled by the incorporation of I125, and calcium hydroxide (Ultracal; Ultradent, UT) was radiolabeled with Ca45.
- intracanal medicaments placed into root segments and incubated for 28 days at 37°C
- canals irrigated with EndoActivator (Dentsply, OK), passive ultrasonic irrigation, EndoVac (SybronEndo, TX), or a syringe/Max-i-Probe needle (Dentsply Rinn, IL) using a standardized irrigation protocol in a closed system
- radioactivity levels measured for each tooth before and after the irrigation protocols
- canals were enlarged and dentin samples collected and evaluated for radioactivity
- data were analyzed with analysis of variance and Bonferroni post hoc testing (P < .05)

Results: Approximately 88% of the TAP was retained in the root canal system regardless of the irrigation technique used (no difference among groups). Furthermore, approximately 50% of the radiolabeled TAP was present circumferentially up to 350 μm within the dentin. Conversely, up to 98% of the radiolabeled intracanal calcium hydroxide was removed, and most residual medicament was found present in the initial 50 μm of dentin.

Conclusion: Current irrigation techniques do not effectively remove TAP from root canal systems, possibly because of its penetration and binding into dentin. However, calcium hydroxide is effectively removed with significant less residual presence.

LOE: 5
Title: *In vitro* cytotoxicity of GuttaFlow® 2 on human gingival fibroblasts

Author: Mandal P et al.

Journal: JOE, Volume 40, Issue 8, Pages 1156–1159

Reviewer: Nadia Liss, DMD

Purpose: The aim of this study was to evaluate the cytotoxic effects of GuttaFlow 2 (Coltène Whaledent, Switzerland) with AH Plus, MTA, and RealSeal on human gingival fibroblasts (HGFs). The hypothesis tested was that the composition of these sealers is a determining factor in their biocompatibility. The rationale for performing the experiment was to evaluate the difference in cell viability according to increasing concentrations of different test materials over time.

Materials & Methods:
- oral gingival biopsies obtained from donors (16–30yo) undergoing gingivectomy
- samples of the test materials GuttaFlow 2, mineral trioxide aggregate (MTA), AH Plus (Dentsply DeTrey, Germany), and RealSeal sealer (SybronEndo, CA) were fabricated in cylindrical nonreactive plastic tubes of 3-mm diameter and 2-mm height
- 24 and 72-hour extracts were prepared in 6-well dishes by immersion of the test materials in modified Eagle medium with 1% penicillin/streptomycin followed by incubation, then sterile-filtered
- 3 concentrations of the extract—0.5 cm²/mL, 1.0 cm²/mL, 1.5 cm²/mL were used in the experiment
- 3 x 10⁴ cells/mL was seeded into 96-well microplates and incubated for 24 hours to allow adherence
- cytotoxicity was determined using the CCK-8 assay. Five replicates of each extract and control (Eagle medium) were analyzed in each test.
- results were analyzed with the independent *t* test and 1-way analysis of variance test (*P* < .05)
- extracts were added to fibroblasts by medium change, and cultured for another 24 hours

Results: At all experimental conditions, the extracts of freshly mixed GuttaFlow 2 were nontoxic. Extracts of freshly mixed and set AH Plus and RealSeal sealers were toxic to HGF cells (*P* < .05). Extracts of set GuttaFlow 2 were toxic at 72 hours (*P* < .05) and nontoxic at 24 hours. Extracts of freshly mixed MTA were nontoxic at both time points. The extracts of set MTA showed 1.5 cm²/mL was toxic at 72 hours and 1.5 cm²/mL and 1 cm²/mL were toxic at 24 hours (*P* < .05).

Conclusion: Both GuttaFlow 2 and MTA evoked a less toxic response to HGF cells than AH Plus and RealSeal sealer. GuttaFlow2 was highly biocompatible showing only minimal cytotoxicity with an increased extraction time in its set form. However, further studies are necessary to understand the overall biologic behavior of GuttaFlow2 in *ex vivo* and *in vivo* scenarios for successful clinical implication.

LOE: 5
Purpose: This study aimed to evaluate the effectiveness of a novel Multisonic Ultracleaning System (Sonendo Inc, Laguna Hills, CA) in tissue dissolution in comparison with conventional irrigation devices.

Materials and Methods: Pieces of bovine muscle tissue (68 ± 2 mg) were placed in 0.7-mL test tubes (height: 23.60 mm, inner diameter: 6.00 mm, outer diameter: 7.75 mm) and exposed to 5 minutes of irrigation by different devices. Endodontic devices included the Multisonic Ultracleaning System, the Piezon Master 700 (EMS, Dallas, TX) ultrasonic system with agitation, the EndoVac negative-pressure irrigation system (SybronEndo, Orange, CA), and a conventional positive-pressure 27-G irrigation needle at a flow rate of 10 mL/min. The systems were tested with 0.5%, 3%, and 6% sodium hypochlorite (NaOCl) at room temperature (21°C) as well as 40°C. Irrigation with sterile water was used as a control. The mass of tissue specimens was measured and recorded before and after the use of each device, and if the specimen was completely dissolved visually within 5 minutes, the dissolution time was recorded. The rate of tissue dissolution (%/s) was then calculated.

Results: The Multisonic Ultracleaning System had the fastest rate of tissue dissolution (P < .05), at 1.0% ± 0.1% per second using 0.5% NaOCl, 2.3% ± 0.9% per second using 3% NaOCl, and 2.9% ± 0.7% per second using 6% NaOCl. This tissue dissolution rate was more than 8 times greater than the second fastest device tested (P < .01), the Piezon Master 700 ultrasonic system, which resulted in a tissue dissolution rate of 0.328% ± 0.002% per second using 6% NaOCl at 40°C. For all irrigation devices tested, the rate of tissue dissolution increased with a higher concentration and temperature of the NaOCl solution.

Conclusion: The novel Multisonic Ultracleaning System achieved a significantly faster tissue dissolution rate when compared with the other systems examined in vitro.

LOE: 3
Response of human osteoblastic and osteoclastic cells to AH Plus and pulp canal sealer containing quaternary ammonium polyethyleneimine nanoparticles.

Barros J et al.

JOE- 40,8: 1149-1155

Saehee Kim, DMD

Quaternary ammonium polyethyleneimine (QPEI) nanoparticles have been incorporated into dental materials like dental cements, resin composite and endodontic sealers to improve antibacterial and antibiofilm properties. The nanoparticles, however, must be compatible with periapical tissues (not disturb local bone regeneration and remodeling process). Bone metabolism involves the coordinated activities of osteoblasts and osteoclasts. Osteoblasts display high alkaline phosphatase (ALP) activity responsible for mineralization. On the other hand, osteoclasts express high levels of tartrate-resistant acid phosphatase (TRAP) in bone resorption. To evaluate the behavior of human bone cells exposed to extracts from commercial and QPEI containing AH Plus and Pulp Canal Sealer ET (PCS).

Material and Methods: QPEI nanoparticles were incorporated into AH Plus and PCS. Establishment of osteoblastic (from human mesenchymal stem cells derived from bone marrow) and osteoclast (from blood of healthy male donors) cell cultures. Osteoblastic or osteoclastic cells were cultured in the presence of QPEI nanoparticles. Bone cells then were exposed to sealers’ extracts from Unmodified AH Plus and PCS also QPEI containing AH Plus and PCS. The positive control included osteoblastic and osteoclastic cell cultures without QPEI particles. The osteoblastic or osteoclastic cells were cultured for 24 hours.

First group: QPEI particles (1%, 2%, 5%, and 10%) were added. During a 21 days period, the cells were characterized for DNA content, ALP or TRAP activities on day 7, 14, and 21.

Second group, cells were cultured in presence of Sealers’ extracts (1:20 – 1:5000). During a 21 days period, the cells were characterized for DNA content, ALP or TRAP activities on day 7, 14, and 21.

Thus DNA content, ALP / TRAP activities assessed, apoptosis quantified. Also the Signaling pathways were analysis by treatment of control group and cultures exposed to sealers’ extract at 1:500 dilution with several signaling pathway inhibitors then assessing ALP, TRAP activities after 21 days.

Results: Bone cell response to QPEI nanoparticles showed no effect by presence of 1 and 2% QPEI nanoparticles. Dose and time dependent inhibition was noted at higher levels of 5% and 10%. Bone cell response to AH Plus, PCS, QPEI containing AH Plus, and QPEI PCS:

- Osteoblastic Cell Response: AH Plus and PCS-Increased DNA content at 1:2500 dilution, QPEI AH Plus-induction of cell growth at 1:2500 and 1:500 dilution, QPEI PCS-no effect on cell growth up to 1:2500 dilution but significant increased ALP activities at 1:2500 and 1:500 dilutions
- Osteoclastic Cell Response: AH Plus and QPEI AH Plus increased DNA content at 1:5000 – 1:500 dilutions. High concentration causes decreased in DNA content; PCS and QPEI PCS: Slight stimulation of DNA at 1:2500 and 1:500. At dilution ≤1:500 results in decrease DNA content and TRAP activities.
- Apoptosis: concentrations of 1:2500 and 1:500 cause the original and QPEI sealers apoptosis to decrease in osteoblastic and osteoclastic cells. More concentrated extracts increases apoptosis.

Intracellular Signaling Pathways: The sealers affected some intracellular signaling pathway,s and QPEI containing sealers further modulate these mechanisms.

Discussion: Incorporation of QPEI nanoparticles into AH Plus and PCS alter extracts’ composition. QPEI by itself at 2% did not affect behavior of osteoblastic or osteoclastic cells. However, QPEI’s positive charged particles when mix with the sealers (AH Plus and PCS) may cause changes in the surface properties of the sealers (increased hydrophilicity and surface charge). This in turn affects the sealers’ interaction with the surrounding fluids and subsequently may alter elution rate, eluents and hydrophilicity or hydrophobicity. This may explain different response of osteoblastic proliferation and differentiation observed when QPEI contains AH Plus vs. QPEI containing PCS. QPEI sealers seem to effect osteoblastic cell behavior more so than osteoblastic cells. It is not known why QPEI sealers does not significantly affect osteoclastic cell compared with osteoblastic cells. Some studies (including this study) suggest osteoblastic cells are more sensitive to surrounding environment.

Conclusion: QPEI at 1 and 2% did not affect behavior of osteoblastic and osteoclastic cells. Incorporation of 2% QPEI into AH Plus and PCS may modulate proliferation and differentiation of bone cells but without increasing sealers’ cytotoxicity.

LOE: 3
Title: Impacts of conservative endodontic cavity on root canal instrumentation efficacy and resistance to fracture assessed in incisors, premolars, and molars

Authors: Krishan R et al.

Journal: JOE, Volume 40, Number 8: 1160-1166

Reviewer: Hao Tran, DMD

Purpose: To determine if conservative endodontic cavity (CEC) improves fracture resistance, cleaning and shaping of extracted human intact maxillary incisors, mandibular incisors, mandibular premolars, and molars.

Material and Methods:

- Sample size - Experimental groups n = 20, Control group n=30 intact teeth
- Teeth were imaged with micro–computed tomographic imaging
- Two experimental groups: conservative endodontic cavity (CEC) and traditional endodontic cavity (TEC) groups (n = 10/group).
- Access with #4 round bur
- Canals were prepared with WaveOne® instruments
- 1.25% sodium hypochlorite irrigation
- Post-operative micro–computed tomographic images obtained.
- Proportion of the untouched canal wall (UCW) and the dentin volume removed (DVR) for each tooth type was analyzed with the independent-samples t test.

Results: The proportion of UCW was significantly higher (P < .04) only in the distal canals of molars with CEC (57.2% +/- 21.7%) compared with TEC (36.7% +/- 17.2%). The mean DVR was significantly smaller (P < .003) for CEC vs. TEC:

- incisors (16.09 +/- 4.66 vs. 23.24 +/- 3.38 mm^3)
- premolars (8.24 +/- 1.64 vs. 14.59 +/- 4.85 mm^3)
- molars (33.37 +/-67.71 mm^3).

The mean load at fracture for CEC was significantly higher (P < .05) vs. TEC:

- no significant difference was seen in the incisors.
- premolars (586.8 +/-116.9 vs. 328.4 +/- 56.7 N)
- molars (1586.9 +/- 196.8 vs. 641.7 +/- 62.0 N)

Conclusions: In CEC, dentin volume removed (DVR) only in the molar distal canals was compromised. However, it conserved coronal dentin in the 3 tooth types and conveyed a benefit of increased fracture resistance in mandibular molars and premolars, but not in incisors.

LOE: 5
Multiple Myeloma (MM), one of the most common hematologic malignancies, is characterized by the proliferation of clonal plasma cells in the bone marrow and production of monoclonal immunoglobulins in the patient’s peripheral blood. About 30% of myeloma patients will experience maxillofacial involvement, especially in posterior region of mandible. Although swelling, bone pain, and tooth mobility are characteristic clinical symptoms, root resorption in association with myeloma infiltrates is extremely rare.

Case report: A 67-year-old male patient was referred for evaluation of progressive tooth loosening, excessive root resorption and radiolucency on periapical radiograph. The patient reported a history of hypertension, an allergy to Ciprofloxacin and denied any skeletal soreness and symptoms (such as night sweats, fever and weight loss).

Clinical examination:

- a non-tender swelling in the area of the right frontal sinus.
- no palpable preauricular or cervical lymph nodes.
- the second right lower molar displayed mobility of grade 3 and not respond to cold thermal testing. The probing depths were within the normal range.

Radiographic examination:

- an extensive osteolytic lesion without a sclerotic border was detected between the right mandibular angle and the right second premolar on a panoramic radiograph.
- the roots of the right second premolar and the first and second mandibular molar showed signs of resorption, the lamina dura was missing.
- further osteolytic lesions between the roots of the first left mandibular molar and in the anterior maxilla were first suspected on panoramic radiograph, later confirmed by computed tomographic (CT) imaging.
- CT also unveiled additional osteolytic areas in the mandible, skull base, frontal bone and cervical vertebrae.

Treatment: The second mandibular molar was extracted and a biopsy was obtained. A histopathological examination discovered clonal plasma cells infiltration and the diagnosis of MM was confirmed by immunohistochemical staining. After induction therapy with bortezomib and dexamethasone, the patient underwent tandem high-dose chemotherapy with melphalan and autologous stem cell transplantation. The bone lesions were treated with intravenous bisphosphonates (Ibandronate 6 mg once per month). The patient remained free of disease recurrence over the entire follow-up of 3 years, with extent of the bony destruction stable and with no signs of bisphosphonate-related osteonecrosis of the jaw (BRONJ).

Conclusion: Only 5 reports of myeloma-associated root resorption have been reported in the literature. In all cases, mandibular premolars or molars were involved and the patients exhibited extensive involvement of the jaw by myeloma. This report highlights the importance of correct interpretation of clinical signs and radiographs by dental specialists in the diagnostic algorithm of systemic diseases.
Title: Mineral trioxide aggregate as apical plug in teeth with necrotic pulp and immature apices: A 10-year case series

Author: Pace R et al

Journal: JOE, Volume 40, Number 8: 1250-1254

Reviewer: Youngsook Chae, DMD

Purpose: This 10-year study evaluated the clinical and radiologic outcomes of teeth with necrotic pulp, immature apices, and periapical lesions treated with the mineral trioxide aggregate (MTA) apical plug technique.

Materials and Methods: Seventeen, single-rooted immature teeth with necrotic pulp and periapical lesion from 17 patients treated between January 2001 and December 2001 were included in this study. Apical obturation on all teeth included in the study was completed in two visits: first using calcium hydroxide as an interappointment intracanal medication and a second visit for the creation of the artificial apical barrier with MTA.

1st visit
- irrigation: 5.25% NaOCl+ 10% EDTA by placing disposable flexible polymer tips to WL (working length) minus 2mm for 10 min until total 10ml of NaOCl was used.
- Ca(OH)2 placement at 1st visit

2nd visit (1 wk later)
- removal Ca(OH)2 by irrigating NaOCl + EDTA, final rinse with NaOCl
- 4mm Apical Plug using Proroot MTA with Messing gun then adapted with endodontic pluggers

3rd visit (1 wk later)
- back filled GP using Obtura with sealer (Pulp Canal Sealer)
- final restoration with resin composite

The outcome, based on clinical and radiographic criteria, was assessed by two calibrated investigators using the periapical index (PAI). Verified the difference with Friedman test.

Results: Of the 17 patients treated, one patient dropped out at 5 years. At the 10-year follow-up, 15 teeth were healed (PAI ≤2), and one tooth had been extracted because of the presence of a longitudinal root fracture. The PAI score exhibited a significant decrease between baseline and one year and between 1 and 5 years. The difference between 5 and 10 years was not significant.

Conclusion: The apical plug with MTA was a successful and effective technique for long-term management of this group of teeth with necrotic pulps with immature root development and periapical lesions.

LOE: 5
Title: Transient apical breakdown and its relationship with orthodontic forces: A case report

Author: Gonzalez O et al.


Reviewer: Christina Lee, DDS

Purpose: To describe the clinical management of a case of transient apical breakdown caused by orthodontic forces and its resolution without the need for root canal therapy

Introduction: Types of external resorption:

- Transient apical breakdown: temporary process, radiographic evidence of resorption at apex of tooth, caused by trauma or application of orthodontic forces, tooth may display color change and variable responses to sensitivity tests, root apex and surrounding bone returns to normal when cause removed
- Physiologic apical resorption: not normally detected clinically or radiographically, self-lmiting response of the root surface to physiologic stimuli, e.g. mastication
- Periapical replacement resorption with ankylosis: commonly occurs after severe trauma, gradual resorption of the root, space is replaced by bone, the root canal is obliterated and the periodontal ligament space is usually lost
- Periapical replacement without ankylosis: usually occurs in anterior teeth being treated orthodontically, PDL space is radiographically present all around the root except for the apical portion where it may be ill-defined

Case Report: A 48 yr old male referred from orthodontist presented with gray discolored upper right central incisor five weeks after placement of braces.

- First appointment: tooth had no response to cold sensitivity tests but positive to vertical and horizontal percussion tests, no decay or restorations and 2mm probing depths, small area of apical radiolucency and widening of the periodontal ligament - result of appointment: orthodontist was asked to lighten the applied orthodontic force.
- Second appointment 4 weeks after initial visit: tooth less gray, no radiographic changes in apical radiolucency, still non-responsive to cold - result of appointment: transient apical breakdown suspected due to regression of discoloration, orthodontist was asked to remove all orthodontic forces
- Third appointment 10 weeks after initial visit: tooth mostly normal color, responded positively to cold, no response to palpation or percussion, apical radiolucency gone and normal PDL space, no radiographic shortening of the root present

Conclusion: Proper diagnosis is very important as well as knowing that no endodontic treatment is needed in cases of transient apical breakdown.

LOE: 5
Purpose: Reciprocating motion has been reported to significantly improve the cyclic fatigue life of the instrument compared with conventional continuous rotation. This study analyzed and compared the root canal shaping ability of Reciproc®, a reciprocating file system, and Mtwo®, a conventional NiTi file system that is morphologically similar to Reciproc, using micro-computed tomographic imaging.

Materials and Methods: Mesiobuccal and distobuccal canals of extracted maxillary molars with complete apices were selected. The teeth used were cleaned and access openings were created with straight-line access. Three groups of 15 canals each were created:

- RR Group – Reciproc used in a reciprocating motion (150 degrees counterclockwise and 30 degrees clockwise)
- MR Group – Mtwo used in a reciprocating motion
- MC Group – Mtwo used in a continuous motion

Only one instrument was used for each canal. The shaping was performed using an electric motor by one clinician. A slow in-and-out pecking motion was used. RC Prep and irrigation with 5.25% NaOCl was used. Micro-CT analysis was used to assess curvature, volume, and surface area of the canals. SEM was also used to observe file before and after canal shaping.

Results: No statistical differences between groups in terms of *time* required for canal shaping or *volume* before and after canal shaping. RR and MR groups exhibited no significant differences in transportation at any of the 3 levels. MC group was statistically different than RR and MR at cervical and apical levels (*P*< 0.5). SEM revealed file deformation, including unwinding of helical structure in 1 file in RR group, 3 in MR group, and 5 files in MC group.

Conclusion: In terms of shaping ability, Mtwo used in a reciprocating motion was not significantly different from the Reciproc system.

LOE: 5
Title: Acquisition of anatomic parameters concerning molar pulp chamber landmarks using cone-beam computed tomography

Author: Azim Aet al.

Journal: JOE- 40,9: 1298-1302

Reviewed by: Saehee Kim, DMD

Purpose: The CBCT radiographic imaging was used to gather data of pulp chamber anatomic landmarks and validate precision of such measurements.

Material and Methods: The CBCT was used in 70 patients to study the morphologic measurements of 118 maxillary and 104 mandibular molars. The list of exclusions was noted such as caries, restorations violation, C-shaped roots, and crowned teeth. All measurements were taken on the coronal plane view. Six lines were placed at six different landmarks on the tooth:

- Cusp tip
- Center of occlusal plane
- Roof of pulp chamber
- Floor of pulp chamber
- First point of separation between roots (furcation)
- Last point of separation between roots (at complete root separation).

Results: Mean values and SD and CV% for maxillary and mandibular molars calculated and noted Tables 1 & 2. Statistical significant difference noted C1 and D1 in maxillary and mandibular molars. Comparison between this study and one done by Deutsch and Musikant noted only E as statistical significant difference. No difference was seen between all other measurements.

<table>
<thead>
<tr>
<th>Teeth</th>
<th>A (cusp to pulp chamber ceiling)</th>
<th>B (cusp to pulp chamber floor)</th>
<th>C (cusp to coronal furcation)</th>
<th>D (cusp to apical furcation)</th>
<th>E (C − B) (pulp chamber floor to furcation)</th>
<th>F (C − A) (pulp chamber ceiling to furcation)</th>
<th>G (pulp chamber height)</th>
</tr>
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<tbody>
<tr>
<td>Maxillary molar n = 118 Mean</td>
<td>6.54</td>
<td>8.66</td>
<td>10.63</td>
<td>11.19</td>
<td>1.97</td>
<td>4.09</td>
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<tr>
<td>SD</td>
<td>0.60</td>
<td>0.91</td>
<td>0.8</td>
<td>1.05</td>
<td>0.58</td>
<td>0.68</td>
<td>0.81</td>
</tr>
<tr>
<td>CV %</td>
<td>9.2%</td>
<td>10.5%</td>
<td>7.8%</td>
<td>9.4%</td>
<td>29.4%</td>
<td>16.6%</td>
<td>38.2%</td>
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<tr>
<td>Mandibular molar n = 104 Mean</td>
<td>6.38</td>
<td>7.92</td>
<td>10.16</td>
<td>10.36</td>
<td>2.24</td>
<td>3.78</td>
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<tr>
<td>SD</td>
<td>0.61</td>
<td>0.75</td>
<td>0.69</td>
<td>0.70</td>
<td>0.47</td>
<td>0.70</td>
<td>0.68</td>
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<tr>
<td>CV %</td>
<td>9.6%</td>
<td>9.5%</td>
<td>6.8%</td>
<td>6.8%</td>
<td>20.1%</td>
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<table>
<thead>
<tr>
<th>Teeth</th>
<th>A1 (fossa to pulp chamber ceiling)</th>
<th>B1 (fossa to pulp chamber floor)</th>
<th>C1 (central fossa coronal furcation)</th>
<th>D1 (central fossa to apical furcation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary molar</td>
<td>Mean</td>
<td>4.69</td>
<td>6.81</td>
<td>8.78</td>
</tr>
<tr>
<td>SD</td>
<td>0.59</td>
<td>0.83</td>
<td>0.79</td>
<td>1.02</td>
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<tr>
<td>CV %</td>
<td>12.6%</td>
<td>12.2%</td>
<td>9.0%</td>
<td>10.9%</td>
</tr>
<tr>
<td>Mandibular molar</td>
<td>Mean</td>
<td>4.75</td>
<td>6.29</td>
<td>8.53</td>
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<tr>
<td>SD</td>
<td>0.56</td>
<td>0.65</td>
<td>0.65</td>
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</tr>
<tr>
<td>CV %</td>
<td>13.6%</td>
<td>10.3%</td>
<td>7.6%</td>
<td>7.8%</td>
</tr>
</tbody>
</table>
Discussion: This study presents two sets of measurements for anatomic landmarks: measurements from cusp tip as previously reported by other studies and measurements from central fossa. The central fossa may be more appropriate reference point instead cusp tip since access preparation is often initiated in center of occlusal surface. Previous study, furcation is referred to as a point where tooth structure ends and roots separate. However, this study noted point of root separation may not always occur at same level along entire furcation area. Different depths noted often in maxillary than mandibular thus furcation should not be referred to as a point but an area. The furcation area was identified at 2 different levels and thus allowing identification of different depth levels (C1 and D1 difference). The crown heights were similar among all molars. Distance from cusp tip to furcation was 0.5 mm more in maxillary molars than mandibular. The height of the pulp chamber had the highest CV for both maxillary (38%) and mandibular (44%). This high variation is due to the ongoing dentin deposition, calcification process at the ceiling of the pulp chamber. This study as well as previous ones suggests that depth of access preparation should not extend beyond 6 mm from central fossa or 7mm from cusp tip to reach pulp chamber of maxillary and mandibular molars.

Conclusion: Information and measurements from CBCT may assist in minimizing iatrogenic perforations in furcation area and also provide quantitative guideline for molar access cavity. CBCT appears to be useful and accurate tool to assist with determining pulp chamber parameters before endodontic treatments.

LOE: 5
Title: A study of root canal morphology of mandibular anterior teeth using cone-beam computed tomography in a Chinese subpopulation.

Journal: JOE, Vol. 40, No. 9, (1309-1314)

Author: Han, T et al

Reviewer: Christopher Adams, DMD

Purpose: The purpose of this study was to investigate the root canal configuration of the mandibular anterior teeth using cone-beam computed tomographic (CBCT) imaging in a Chinese subpopulation.

Materials & Methods: A total of 3,871 CBCT images of mandibular anterior teeth were collected from 648 patients who accepted CBCT projection as a preoperative assessment for implants or orthodontic treatment. The following items were recorded and evaluated: tooth position, root number, canal number, root canal type, the distance between the anatomic apex and the point at which the canal divided into two for mandibular anterior teeth with two root canals (excluding canines with two roots), and the distance between the two root canal orifices. The Fisher exact test was used to analyze the correlation between the number of root canals and tooth position.

Results: All of the incisors in this study had one root, and 1.32% of the canines had two roots. The prevalence of two root canals in the lateral incisors (354, 27.36%) was higher than that in the central incisors (202, 15.71%) ($P < .05$) and the canines (81, 6.27%) ($P < .05$).

Conclusions: There is a high prevalence of two root canals in the mandibular anterior teeth of the studied Chinese subpopulation. This study provides detailed information about the root canal morphology of mandibular anterior teeth in a Chinese subpopulation.

LOE: 5
Title: Treatment outcome of the teeth with cemental tears.

Authors: Lin H, et al

Journal: JOE. 40(9): 1315-20

Reviewer: Hao Tran, DMD

Purpose: Cemental tears are root surface fractures that may cause periodontal and periapical tissue destruction. Aging, trauma, occlusal trauma, and intrinsic structural weakness of the cement-dentinal junction have been suggested to be related to these tears. A radiopaque fracture like image can be detected in 56.3% of the preoperative radiographs with apical involvement in 41.5% of the cases. This study evaluated the clinical characteristics and treatment techniques may affect the prognosis of teeth with cemental tears.

- Males (77.5)
- Older patients >60yr (73.2%)
- Vital Teeth 5.3%)
- Max and mand incisors w/ abscess, sinus track, and the presence of a periodontal pocket (76.1%)

Materials and Methods: A cohort study from May 1987-Oct 2011 was used. Seventy-one teeth with cemental tears were analyzed. Thirty-eight teeth were extracted (53.5%), and 33 teeth (46.5%) were treated by different means listed below.

- Non-surgical treatment (7 teeth, 9.9%)
- Surgical Debridement only (13 teeth, 18.3%)
- Surgical debridement in combination with GTR and a bone graph (13 teeth, 11.8%)

The patients were recalled every three months for one year.

Results: There were three classifications for the cases:

- Healed – complete osseous regeneration and no symptoms or signs other than tenderness o percussion 51.5% (17/33)
- Questionable – absence of any signs or symptoms but without complete osseous regeneration. 42.4% (14/33)
- Failed – with symptoms or signs and without evident bone fill. 6.1% (2/33)

Bivariate analysis indicated a significant difference between treatment outcome and he length (P=.01) and apicocoronal location (P=.02) of the separated root fragments. Healed cemental tear cases located in the apical, middle and cervical third of the roots was 11.1%, 66.7%, and 60.0%, respectively. By surgical management, 57.7% of cemental tears were healed, whereas only 28.6% cases were healed after nonsurgical treatment.

Conclusion: Most teeth with cemental tears can be retained to function by non-surgical and surgical periodontal and endodontic treatment. Clinical diagnosis and treatment of cemental tears should also include consideration of apicocoronal location and the type of treatment technique.

LOE: 4
Title: Histologic comparison between platelet-rich plasma and blood clot in regenerative endodontic treatment: An animal study

Author: Zhang D, et al

Journal: JOE, Vol. 40, number 9;1388-1393

Reviewer: Shin-Chieh Yang, DMD

Purpose: This study compared the histologic differences between using platelet-rich plasma (PRP) and blood clot in regenerative endodontic treatment (RET).

Materials & Methods: Three 6-month-old beagles carrying 9 premolars with double root canals were randomly assigned to a PRP group, blood clot group, or negative control group. Preparation of apical periodontitis:

- in total, there were 18 root canals to be investigated in each group
- all dental pulp of experimental teeth were mechanically exposed
- after disrupt the pulp tissue, cotton pellet presoaked with plaque suspension were sealed temporarily in the pulp chamber with caviton and glass ionomer cement
- apical periodontitis was noticed radiographically after 3 weeks.

Regenerative endodontic treatment (RET) procedure:

- root canals were irrigated with 3% NaOCl and 0.9% sterile saline
- canals were disinfected with antibiotics paste containing metronidazole, ciprofloxacin and minocycline
- 4 weeks later, the antibiotics paste was irrigated.
  - in blood clot group: a sterile #15 hand file was used to induce bleeding before double sealed of ProRoot MTA and glass ionomer cement.
  - in PRP group: PRP was injected into the canal space up to cementoenamel junction.
- Periapical radiography was taken 3 months after RET. The animals were sacrificed for histological studies.

Conclusion: With the ingrowth of cellular cementum-like tissues, the canal wall was thickened and the apical apex was closed in both the PRP group and blood clot groups. However, there is no significant difference in both groups for the average percentage of apical closure, new tissue formation and pulp-like tissue formation. A large number of inflammatory cells were present in some root canals in both groups although the postoperative radiograph revealed the disappearance of periapical radiolucency.

LOE: 5
Title: Effects of epinephrine on lidocaine pharmacokinetics and blood volume in the dental pulp

Author: Hashimoto S, et. al

Journal: JOE – Vol. 40 (9); 1370-1374

Reviewer: Jeffrey Yui, DDS

Purpose: This study investigated the effect of epinephrine on the pharmacokinetics of lidocaine in the maxilla and dental pulp and the pulpal blood volume after infiltration anesthesia.

Materials and Methods: Rats were anesthetized and injected with 20 uL 2% C-lidocaine solution with or without 10 ug/mL epinephrine was injected into the right palatine mucosa proximal to the first molar. The maxilla was divided into 3 sections, minced and dissolved in a solubilizer. Distribution of C-radioactivity in the pulp was measured. The pulpal blood volume also measured using Tc-pertechnetate labeled RBCs.

Results: At 2 minutes after injection, the lidocaine concentration in the section containing the first molar was 4.5 and 5.7 times higher than those in the sections containing the second and third molars, respectively. When injected with epinephrine, concentrations at 10-20 minutes after injection were significantly higher (2.4 times) than lidocaine alone. In the pulp, lidocaine amount 2 minutes after injection was 16.0 and 33.2 times greater than those in the second and third molar pulps, respectively. When injected with epinephrine, lidocaine amount in the first molar pulp significantly increased to more than twice the value of lidocaine alone. Lidocaine and epinephrine significantly decreased the blood volume to 63.1% of the value after the injection of lidocaine alone.

Discussion:
The addition of epinephrine to lidocaine significantly reduces the blood volume in the dental pulps; epinephrine may help to retain the lidocaine in the pulp tissue by reducing blood volume and flow in the pulp.

LOE: 5
Title: A panoramic survey of air force basic trainees: How research translates into clinical practice

Author: Winward, BJ et al

Journal: Journal of Endodontics Vol 40 (9); 1332

Reviewer: Christina Lee, DDS

Purpose: This study examined the following in young adults residing in the United States: (1) the prevalence of teeth with root canal therapy (RCT) and teeth in need of RCT, (2) how frequently treatment practices associated with success as cited in the literature are found in posterior teeth with RCT, and (3) which treatment practices are associated with periradicular pathology.

Materials and Methods: Panoramic radiographs were taken of basic trainees entering the US Air Force in 2011 and were evaluated in a two-part review. A general survey of all radiographs was performed to determine the prevalence of teeth with and teeth in need of RCT. Panoramic images with RCT of posterior teeth were evaluated for the quality of endodontic treatment, presence and quality of cuspal coverage, and periradicular pathology. The evaluation was jointly done by two board certified endodontists.

Results:

- 35,811 panoramic images were evaluated (990,120 teeth)
- 10% of trainees had existing RCT and 5% of trainees needed RCT
- Detailed survey: 7% of trainees had RCT of a posterior tooth
  - 68.9% of those cases had adequate quality
  - about 50% had cuspal coverage
  - 37% of teeth were both adequate and had cuspal coverage
  - Of RCT teeth deemed hopeless, 97.5% had no cuspal coverage restoration present
  - about 75% of teeth with RCT had no periradicular pathology
  - Statistically significant difference was found between presence/quality of cuspal coverage and presence of periradicular pathology = adequate and had no pathology

Discussion: According to this article Air Force basic trainees are an ideal young adult population (17-27 yrs old, U.S. citizen, at least some college, diverse backgrounds) to study. They should have best chance of receiving ideal endodontic treatment. Over 52% of posterior teeth RCT did not meet minimum Air Force treatment standards. The need for quality endodontic care and for improvement on adequate endodontic training.

Conclusion: Factors cited in the literature as being associated with success are lacking in the dental treatment of young adults residing in the United States.

LOE: 5
Title: Comparison of the accuracy of 3-dimensional cone-beam computed tomography and micro-computed tomography reconstructions by using different voxel sizes

Author: Maret, D. et al

Journal: JOE, Vol. 40, No.9; 1321

Reviewer: Raj Shenoy, DDS

Purpose: Cone-beam computed tomography (CBCT) has various fields of view (FOV): Reduced FOV = a limited number of teeth and Wide FOV = jaw or TMJ. Different scanners vary by spatial resolution (acquisition voxel size). Voxel size impacts image resolution and quality. For endodontic diagnosis you want a voxel size of less than 200 micro meters to assess geometric discrepancies among 3-dimensional CBCT reconstructions relative to the micro-CT reference.

Materials and Methods:
- 37 permanent teeth from 9 mandibles were scanned with CBCT 9500, 9000 3D and micro-CT.
- Semiautomatic segmentation was done (separate materials: dentin, enamel, bone on basis of grey level thresholds)
- Reconstructions were obtained from CBCT acquisitions and micro CT
- CBCT voxel size: 76, 200 and 300 micrometers
- Micro-CT voxel size 41 micro meters
- All reconstructions were positioned in the same plane by image registration.
- Topography of the geometric discrepancies was displayed by using a color map allowing the maximum differences to be located.

Results: The maximum differences were found mainly at the cervical margins and on the cusp tips or incisal edges.

Conclusion: This article shows that in order to study hard tissue morphology, CBCT acquisitions require voxel sizes smaller than 300 micro meters. Current recommendations are to select smallest FOV needed to accomplish task. This study may provide answers to questions concerning the capacity of CBCT to serve as a measuring tool. CBCT can be helpful in making measurements (bone loss, root canal anatomy etc.)

LOE: 5

Title: Hypoxia modulates the differentiation potential of stem cells of the apical papilla.

Author: Vanacker J, et. al.

Journal: J Endod. Sep; 40(9):1410-8

Reviewer: Hao Tran, DMD

Purpose: This study evaluated the effect of hypoxia on the fate of stem cells of the apical papilla (SCAP) cells.

Materials and Methods: SCAP were cultured differentiation media. Cellular proliferation, gene expression, differentiation, and protein secretion were analyzed by live imaging, quantitative reverse-transcriptase polymerase chain reaction, cellular staining, and enzyme-linked immune-assay, respectively.

Results: Hypoxia had no effect on SCAP proliferation, but it evoked the up-regulation of genes specific for osteogenic differentiation (runt-related transcription factor 2, alkaline phosphatase, and transforming growth factor-b1), neuronal differenti- enolase, glial cell-derive neurotrophic factor and neurotrophin 3), and angiogenesis (vascular endothelial growth factor A and B). Hypoxia also increased the sustained production of VEGFα by SCAP. Moreover, hypoxia augmented the neuronal differentiation of SCAP in the presence of differentiation exogenous factors as detected by the up-regulation of NSE, VEGFB, and GDNF and the expression of neuronal markers (PanF and NeuN).

Conclusion: Hypoxia induces spontaneous differentiation of SCAP into osteogenic and neurogenic lineages while maintaining the release of the proangiogenic factor VEGFα. This highlights the potential of SCAP to promote pulp-dentin regeneration. Moreover, SCAP may represent potential therapeutic agents for neurodegenerative conditions because of their robust differentiation potential.

LOE: 5
Title: Sealapex Xpress and RealSeal XT feature tissue compatibility in vivo

Author: Silva L, et al.

Journal: JOE,40(9): 1424-1428

Reviewed by: Saehee Kim, DMD

Purpose: Ideal response after endodontic treatment is complete sealing of apical opening. Some endodontic sealers are irritating, inflammatory and cytotoxic to tissues thus delaying inhibiting healing. Recently, sealers based on calcium hydroxide shows favorable properties such as tissue compatibility, antibacterial and anti-exudative actions, mineralization and tissue formation, and anti-bacterial effects. There has been no in-vivo study evaluating tissue response to sealers: Sealapex Xpress (calcium hydroxide based sealer) and RealSeal Sealer XT (methacrylate-based resin sealer). This study evaluated the response of apical and periapical tissues of dogs’ teeth with pulp vitality after root canal filling with sealers Sealapex Xpress and Real Seal XT.

Material and Methods: Thirty-eight root canals (19 teeth) from 2 beagle dogs were prepared (isolated, disinfected, irrigated and instrumented up to # 50 K-file). After preparation, the root canals were divided into two groups, one obturated with RealSeal XT (16) Resilon cones and the other with Sealapex Xpress and gutta-percha (22). After 90 days, animals sacrificed and teeth dissected, sectioned, and stained. Histopathologic analysis was obtained with staining of the root canal and scoring the teeth based on:

- Sealing of apical opening: absent (score 0), partial (score1), or complete (score2).
- Inflammatory cell infiltrate: absent, slight, moderate or severe.
- Root Resorption: absent or present.
- Bone Resorption: absent or present

Immunohistochemistry Evaluation is based on identification of mineralization markers (osteopontin, ALP, RUNX2).

Results: HE staining saw no statistic differences between Sealapex vs. Realseal in terms of sealing, inflammatory cells or resorption. Complete sealing was noted in 50% (Sealapex) vs. 22.7% (Realseal). Partial sealing was noted in 25% (Sealapex) vs. 54.6% (Realseal). Absent of sealing was noted in 25% (Sealapex) vs. 22.7% (Realseal). No inflammatory cells were noted in 75% of Sealapex vs. 90.9% in Realseal. Mild inflammatory was noted in 25% (Sealapex) and 9.1% (Realseal). No resorption was seen in either group. Immunohistochemical Evaluation saw positive staining for osteopontin, ALP, and RUNX2 seen in both groups.

Discussion: Sealapex and RealSeal shows periondontal ligament without inflammatory cells in majority of cases. In addition, there was no resorption of mineralized tissues. Sealing, showed different results with Sealapex presenting complete sealing of apical opening in 50% of the cases but this was not statistically significant. The higher rate of sealing property can be attributed to Sealapex’s calcium hydroxide presence in promoting repair and antimicrobial potential. RealSeal XT sealer is a prototype of a new material not name by manufacture. On immunohistochemical analysis, staining noted for osteopontin, ALP, andRUNX2. This indicates suitable microenvironment for bio-mineralization in the presence of sealers.

Conclusion: There is no statistically significant difference between cements RealSeal XT and Sealapex Xpress. Results above highlight good tissue tolerance to these two sealers and both allow for sealing of apical opening by deposition of mineralized tissue.

LOE: 4
Title: Efficacy of needle irrigation, EndoActivator, and photon-initiated photoacoustic streaming technique on removal of double and triple antibiotic pastes

Authors: Arslan H et. al

Journal: JOE Vol. 40 (9); 1439-1442

Reviewer: Jeffrey Yui, DDS

Purpose: This study evaluated the effect of needle irrigation, the EndoActivator system, and photon-initiated photoacoustic streaming (PIPS), on the removal of double antibiotic pastes (DAP) and triple antibiotic pastes (TAP) from artificial grooves in root canals.

Materials and Methods: Eighty-four single-rooted human teeth were decoronated and instrumented up to size #40 using Protaper Rotary. The roots were split longitudinally and grooves were cut in canal walls 2-5 mm from apex and 9-12 mm from the apex. Application of antibiotic pastes:

- DAP and TAP placed in the grooves for 4 weeks and root halves were reassembled
- Needle irrigation, the EndoActivator system, and PIPs were used for the removal of the antibiotic pastes
- Needle tip and EndoActivator was inserted within 2 mm of working length; PIP placed in coronal portion
- 6 mL 1% NaOCl was used in all groups along with 60 seconds of irrigation time
- Root segments were disassembled and evaluated under 20X magnification using a 4-grade scoring system:
  - (0)Groove was empty
  - (1)Antibiotic paste present in less than half of the groove
  - (2)Antibiotic paste covered more than half of the groove
  - (3)The groove was completely filled with antibiotic paste

Results: PIPS removed significantly more antibiotic paste than the EndoActivator and needle irrigation. The EndoActivator was superior to needle irrigation in removing the pastes. No statistically significant differences between DAP and TAP and between coronal and apical thirds in their removal from grooves.

Conclusion: PIPS was more effective in removing both DAP and TAP from artificial grooves in root canals than the EndoActivator System and needle irrigation. The EndoActivator was also more effective than needle irrigation. It is difficult to completely remove antibiotic paste from root canals.

LOE:5
Purpose: The purpose of this study was to analyze the relation of tooth length and distal wall thickness of mesial roots in mandibular molars at different locations.

Materials and Methods: Forty-five mandibular first molars were taken, and the length of each tooth was measured. Specimens were divided into three groups according to their length: group I–long (24.2 mm ± 1.8), group II–medium (21 mm ± 1.5) and group III–short (16.8 mm ± 1.8). The mesial root of each was marked at two levels: 2 mm below the furcation as well as at junction of apical and middle third of roots. The minimum thickness of the distal root dentine associated with the buccal and lingual canals of the mesial roots was measured. The distance between the buccal and lingual canals and the depth of concavity in the distal surface of the mesial roots were also measured.

Results: Statistical analysis was performed by using analysis of variance and the Student-Newman-Keuls test. The minimum thickness of the distal wall of the mesiobuccal canal was significantly different ($P < .001$) between groups 1 (long) and 3 (short).

Conclusions: Distal wall thickness of the mesiobuccal root and distal concavity of the mesial root of mandibular first molars were found to be thinner in longer teeth compared with shorter teeth.

LOE: 5
Purpose: This study tested calcium aluminosilicate cements in vivo in pulpotomy procedures.

Materials and Methods: Three materials were tested: calcium aluminosilicate cement and two mineral trioxide aggregates (ProRoot MTA and MTA Plus). Pulpotomies were done on rats and these three cements were used at pulp capping agents. The inflammatory, biocompatibility and nociceptive responses were measured after placement of these cements. Inflammation was measured by looking at the pro-inflammatory cytokines (IL)-1β and IL-1α in the pulp of the treated teeth. Histology was performed to assess dentinal bridging at 30 and 60 days, presence of bacteria, and to check pulp vitality. Nociceptive response was measured by using a behavioral assay (rat’s meal duration- the longer the meal correlates to orofacial pain).

Results: IL-1β and IL-1α concentrations were reduced in the capped teeth, but no differences were observed among the 3 cements. Dentinal bridging could be detected at both 30 and 60 days with each of the 3 cements, and the pulps were still vital 60 days after capping. Meal duration significantly shortened after placement of the 3 different cements, indicating a nociceptive response, but there were no differences among the materials.

Conclusion: Calcium aluminosilicate cement had similar properties to mineral trioxide aggregates and is a viable option for pulpotomy procedures.

LOE: 5
Title: Debris remaining in the apical third of root canals after chemomechanical preparation by using sodium hypochlorite and Glyde: An in vivo study

Authors: Cruz A, et al.


Reviewer: Nadia Liss, DMD

Purpose: The objective of this study was to evaluate whether the use of a paste containing EDTA during cleaning and shaping of the root canal helps to eliminate debris. During chemomechanical instrumentation, several liquid or paste substances are used to ease the action of the files and to eliminate debris and the smear layer.

Materials and Methods: Twenty root canals, selected from dog's premolars and upper and lower incisors were included in the study.

- RDI, teeth disinfected with iodine, access rinsed with sodium hypochlorite (5.25%), pulp removed
- 5 upper and 5 lower teeth assigned randomly to each of the 2 treatment groups
- root canals instrumented by a crown-down technique by using nickel-titanium rotary files
- in 10 root canals (group A), NaOCl used, final irrigation with 17% liquid EDTA
- in another 10 canals (group B), NaOCl, and Glyde File Prep paste used with every instrument, and a final irrigation with EDTA
- two teeth (positive controls): instrumentation with K hand files to a 40-K size, no irrigation.
- two teeth in the same dog (negative control): after pulp extirpation with a barbed broach, no instrumentation, irrigated with 5.25% NaOCl for 20 minutes with a 30-gauge needle positioned at full WL as determined by a radiograph
- jaws prepared for histologic evaluation and statistical analysis

Results:

- Group A (Glyde was not used during cleaning and shaping)- little or no debris was found in the apical third of the instrumented root canals
- Group B (Glyde File Prep paste was used) - moderate to high accumulation of debris was observed in the apical third.
- Both positive controls – presence of abundant debris in all thirds of instrumented root canals; negative controls – absence of debris in all thirds of the root canal

Conclusion: The use of Glyde File Prep paste during rotary mechanical instrumentation favors the accumulation of debris in the apical third of the root canals. Irrigation with NaOCl and a final flush with EDTA by means of a small-gauge needle with simultaneous aspiration led to less accumulation of debris than in the Glyde File Prep group (P < .05).

LOE: 5