Title: The effect of blood contamination on the compressive strength and surface microstructure of MTA

Author: Nekoofar MH et al.

Journal: IEJ 2010; 43:782-91

Reviewer: Ken Lin, D.M.D.

Purpose: To investigate the effects of fresh human blood contamination on compressive strength and surface microstructure of grey ProRoot® MTA Original and tooth-colored ProRoot® MTA (Dentsply).

Materials & Methods:
- Three groups of 10 custom-made cylindrical molds (PTFE – polytetrafluoroethylene) were filled with tooth-colored MTA. In the control group, MTA was mixed with water and exposed to water. In the second group, MTA was mixed with water and exposed to whole, fresh human blood. In the third group, MTA was mixed with and exposed to whole, fresh human blood. These three groups were then duplicated using grey MTA, creating a total of 60 samples (in 6 groups).
- A pre-determined amount of MTA and appropriate liquid were triturated in a plastic mixing capsule then subjected to ultrasonic energy after placement in the molds.
- After 4 days of incubation (in Eppendrof tubes), specimens were subjected to compressive strength testing. The surface microstructure of one extra specimen in each group was examined using scanning electron microscopy (SEM).

Results:
- The mean compressive strength values of both experimental groups, which were in contact with blood, were significantly less than that of the control group. In experimental groups in which MTA was mixed with water and exposed to blood, there was a significant difference in compressive strength between tooth-colored MTA (stronger) and grey MTA (see Figure 3).

![Compressive Strength Values](image)

- The surface microstructure of MTA specimens revealed substantial differences in crystalline formation between control and experimental groups. All experimental, blood-contaminated, groups had more globular formations, rather than the angular crystals seen in the control groups. These groups also demonstrated a clear lack of two main forms of acicular crystals (ettringite).

Discussion/Conclusion:
- The results of this study revealed that both events (when MTA comes into contact with blood and in extreme might become mixed with blood during placement) adversely alter the compressive strength of MTA.
- In the blood-contaminated groups, an absence of acicular crystals, characteristic of hydrated calcium aluminum sulfate hydroxide (ettringite) that have a potential role in forming inter-crystal bonds, was shown by SEM. This lack of interlinking acicular crystals is mostly likely the reason for lower compressive strength values of the groups contaminated with blood. (This might be the cause of one of the most important disadvantages of MTA.)
- Therefore, in clinical situations in which blood becomes incorporated into MTA, its physical properties are likely to be compromised.

LOE: 5
Title: A comparison of the diagnostic accuracy of CBCT images of different voxel resolutions used to detect simulated small internal resorption cavities

Author: K. Kamburoğlu et al.


Reviewer: A. Jayson Tengonciang, D.M.D.

Purpose: To assess *ex vivo* the use of two different cone-beam computerized tomography (CBCT) units at different voxel resolutions for the detection of simulated small internal resorption cavities.

Materials and Methods:
- 60 single-rooted mandibular incisors and canines - 20 central incisors, 20 lateral incisors, 20 canines
- All teeth had radiographically visible root canals and with no restorations, root fillings, pathosis or anomalies
- Teeth were split along the mesiodistal coronal plane into labial and lingual sections using a low-speed saw
- Internal resorption was simulated by drilling with a 0.5-mm-diameter round bur to its full depth under 2.5X magnification at either the cervical or apical portion of the labial wall
- 60 cavities were created (30 cervical and 30 apical), and 60 locations (30 cervical and 30 apical) were left without cavities
- Tooth segments were rejoined using Super Glue and placed in the appropriate alveolar sockets of two dry human mandibles in groups of 6 (two incisors, two laterals, two canines), making a total of 10 groups
- Images were obtained from two different CBCT units: an Iluma Ultra Cone-beam CT Scanner and a 3D Accuitomo 170
  - Iluma system, images were obtained at 120 kVp, 3.8 mA and an exposure time of 40 seconds and were reconstructed at ultra- (0.1 mm³), high- (0.2 mm³) and low-resolution (0.3 mm³) voxel sizes
  - Accuitomo system, images were obtained at 65 kV, 2.0 mA and an exposure time of 30.8 seconds with a 60 × 60 mm FOV (0.125 mm³ voxel size) and at 65 kV, 2 mA and an exposure time of 30.8 sec with an 80 × 80 mm FOV (0.160 mm³ voxel size)
- A total of 5 image sets were obtained
  - Accuitomo, 6 × 6 cm FOV (0.125 m³)
  - Accuitomo, 8 × 8 cm FOV (0.160 mm³)
  - Iluma, ultra-resolution (0.1 mm³)
  - Iluma, high-resolution (0.2 mm³)
  - Iluma, low-resolution (0.3 mm³)
- Each image set was evaluated separately in a random order by two calibrated observers. Image sets were viewed at 1-week intervals, and evaluations of each image set were repeated 1 month after the initial viewings
- The presence or absence of internal resorption (a demarcated widening of the pulpal canal) was scored using the following 5-point scale: 1 = lesion definitely present; 2 = lesion probably present; 3 = uncertain/unable to tell; 4 = lesion probably not present; 5 = lesion definitely not present
- Weighted kappa coefficients were calculated for the observers scores

Results:
- Kappa values for both sets of Accuitomo images and for the ultra- and high-resolution Iluma images were good, whereas kappa values for the low-resolution Iluma images were only fair-to-moderate.
- Accuitomo 0.125 mm³ images were found to have the highest Az values, whereas the Iluma low-resolution Iluma images were found to have the lowest Az values
- No statistically significant differences (*P* > 0.05) were found amongst the Az values of the Accuitomo 0.125 mm³, Accuitomo 0.160 mm³, Iluma ultra-resolution and Iluma high-resolution images
- Statistically significant differences were also found between the Az values of the low-resolution (0.3 mm³) Iluma images and those of the Accuitomo 0.160 mm³ (*P* = 0.0019), high-resolution Iluma (0.2 mm³) (*P* = 0.02) and ultra-resolution Iluma (0.1 mm³) (*P* = 0.0084)

Conclusion: In the *ex vivo* detection of simulated internal root resorption, the highest Az values were obtained with Accuitomo 0.125 mm³ images and the lowest with Iluma 0.3 mm³ images. Ultra-and high-resolution Iluma and Accuitomo 0.125 and 0.160 mm³ CBCT images performed similarly and better than low-resolution Iluma CBCT images.

LOE: 5
Title: Accreditation of postgraduate specialty training programmes in endodontology. Minimum criteria for training specialists in endodontology within Europe.

Author: European Society of Endodontontology


Reviewer: Christian Lehr, D.M.D.

Purpose: To present the requirements of a specialist and of a specialist training program in endodontology within Europe, including the aims, objectives, and curriculum content of a specialist training pathway.

Requirements of a specialist: A specialist is a clinician who excels in their deep understanding of the discipline and also possesses specialist clinical skills beyond simple competence or proficiency. A specialist would be expected to communicate with the referring practitioner to provide a seamless, ethical, high-quality service.

Curriculum for specialist training in endodontology

- **Advanced education** – Advanced educational programs should be organized as graduate programs. They should be integrated with advanced clinical training in a planned sequence of study units or modules and should provide the student with substantive research training in specific areas of science. A quality controlled and peer-reviewed, defendable thesis at Masters-level based on original research should be required to complete the graduate program. An academic Masters Degree, such as Master of Science or Master of Clinical Dentistry may be an appropriate level of study under present regulations.

- **Award of degrees and certificates of completion of training** - An institution offering advanced training in endodontology may award a Masters Degree and/or an equivalent certificate indicating completion of a recognized program of study and specialist clinical training. Special licensing is awarded by the licensing body of the country in which the training took place. Opportunities should be available for participants to complete a thesis and/or to undertake a further research degree such as a PhD (3–5 years), as part of further advanced training in endodontology.

- **Overview and general conditions** – 1) The duration of the graduate specialty program must be a minimum of 3 years full-time formal training (4500 h); 2) The distribution of time spent during training should be approximately 60% clinical activity, 25% academic activity and 15% research activity; 3) The clinical activity may include preliminary laboratory simulation exercises to develop technical skills. The trainees should be exposed to a variety of endodontic techniques. The program must include a system for follow-up evaluation of patients. It is suggested that a minimum of 180 patients are treated over the training period, with a minimum distribution of 60 patients per year; 4) The academic activity must include basic, applied and clinical science relevant to endodontology. This course of biomedical science instruction should be accomplished through formal interactive teaching/learning episodes including tutorials, seminars, conferences, laboratory assignments and should be preceded by self-study; 5) Trainees must be academically and practically exposed to research methodology. Trainees should participate in a research project (clinical, experimental or literature research) and report their findings and conclusions in a formal thesis or equivalent written report, which should be assessed summatively as part of the overall assessment strategy; 6) The majority of the time will be allocated to the core program but may be supplemented by additional activities (electives, special assignments), which will vary according to the individual institution and the needs of the students. Such activities include: extension of the obligatory course work, special courses, additional clinical experience, more teaching engagements, as well as attending guest lectures and scientific meetings; 7) Clinical teaching of undergraduate dental students or general dental practitioners may form a part of the program, provided it is delivered within a proper educational framework and is limited to no more than 10% of the total clinical activity; 8) Summative and formative assessment must be included for all academic and clinical courses to appraise understanding, knowledge and clinical progression; 9) At the end of the program, there must be a final evaluation by a board of examiners, which must include one suitably qualified external examiner (not affiliated with the program or Institute).

- **Syllabus topics** - Upon completion of the program, the trainee should have special knowledge and skills at a considerably more advanced level than those required for a license to practice dentistry. Trainees must have an understanding of the relevant aspects of the following basic and applied sciences in relation to endodontology: 1) Head and neck anatomy; 2) Dental embryology and physiology; 3) Clinical pharmacology and therapeutics; 4) Oral microbiology and immunology; 5) Oral patholgy and medicine; 6) Oral and maxillofacial radiology; 7) Oral cell biology and histology; 8) Biostatistics; 9) Research methodology and science education; 10) Epidemiology; 11) Scientific writing; 12) Cariology; 13) Pulp biology; 14) Periodontology. Trainees must have an in-depth knowledge of the following endodontic topics, as well as clinical skills in: Differential and definitive diagnosis of common pains and diseases of the orofacial region, especially those arising from injury to the pulp and periradicular tissues in both the primary and permanent dentition; 1) Pain management, including prevention and control; 2) Non-surgical endodontic procedures; 3) Surgical endodontic procedures; 4) Emergency management of dental conditions; 5) Evaluation of endodontic treatment; 6) Causes and management of persistent problems; 7) Concepts for dental treatment planning, as well as principles and practice of endodontic and restorative treatment planning; 8) Communication of nature of problems and management to the patient and referring dentist; 9) Use of contemporary techniques such as the operating microscope.

Adjunctive and Multidisciplinary approach to management: 1) The trainee should have competence in the following associated
clinical skills: 1) Dental traumatology and management of traumatic dental injuries; 2) Restoration of the root-filled tooth; 3) Management of the discolored tooth; 4) Interdisciplinary management of problems, such as interfaces between endodontics with periodontics, prosthodontics, orthodontics, pedodontics, oral medicine, special needs and oral surgery; 5) Total dental care for patients; 6) Clinical photography; 7) Clinically relevant IT skills; 8) Extraction with replantation; 9) Management of medically compromised patients; 10) Behavioral sciences as applied to endodontics; 11) Differential diagnosis of lesions of the periodontal tissues; 12) Diagnosis and treatment of periodontal disease; 13) Diagnosis, prevention and treatment of tooth surface loss; 14) Principles and practice of fixed and removable prosthodontics and implant dentistry; 15) Cranio-mandibular function; 16) Practice management.

Faculty: A well-qualified faculty is the primary requirement for an acceptable advanced education training program in endodontology. Faculty who have had advanced training in endodontology, or through their own efforts have achieved advanced knowledge and skills in the discipline, should supervise a major portion of the training. Where appropriate, the faculty members should be on the national Specialist List in Endodontics (and in due course on the ESE specialist list). Specialty training in another dental field is inappropriate. The supervision of Masters Theses and PhD dissertations should only be carried out by faculty with experience as independent investigators and who are members of the faculty of the university that confers the award.

Selection of trainees: The applicant for advanced training in endodontology must be: 1) A graduate of a EU accredited dental school; or 2) A graduate of a non-EU dental school who possesses equivalent educational background and standing to an EU accredited dental school; 3) A possessor of a qualification acceptable to the licensing authority of the country hosting the dental school and also to the country hosting the specialist training; 4) Sufficiently experienced in the general practice of dentistry to have acquired a good level of generic dental and patient management skills over a minimum of 2 years following graduation (In some EU countries, there is no legal requirement for an applicant to demonstrate experience in general dental practice prior to being accepted on a specialist program. In these circumstances, this prerequisite cannot be enforced; however, the ESE is strongly in favor of enrolling on specialist programs only those applicants who have undertaken a minimum 2-year period of general professional training); 5) Able to demonstrate continuous learning and clinical progression, post-qualification, by attendance at approved continuous professional development courses and active adoption of new knowledge, techniques and skills in their dental practice (In view of (d) above this prerequisite cannot be enforced in some EU countries. However, the ESE is strongly in favor of enrolling on specialist programs only those applicants who have undertaken a period of general professional training during which they can demonstrate continuous professional development) 6) Recruited after stringent selection procedures within a competitive framework that assesses both academic and clinical potential. 7) These criteria should be followed to ensure the best quality of recruits to specialist training.
Title: Effectiveness of four electronic apex locators to determine distance from the apical foramen

Author: Stoll R et al

Journal: INJ, Vol. 43 Issue 9:808-817

Reviewer: Sheerin Yusuf, D.M.D.

Purpose: To evaluate the accuracy of four electronic apex locators (EALs) in the apical region (0–3 mm short of the foramen) and to compare precision of the readings on the display with the real file position in the root canal.

Materials and Methods: Twenty single-rooted extracted teeth were used with no severe curvatures and closed apices. The canal orifices were preflared with a rotary file. A size 10 silver point was inserted until the tip became visible at the foramen. The silver points were removed and measured using an endodontic millimeter ruler (VDW) with a measurement accuracy of 0.5 mm. All roots were immersed in saline for at least 1 day. Each root was firmly fixed with acrylic resin in a plastic tube. A copper wire was fixed on the wall of the plastic tube to serve as the ground electrode for the EALs. Electronic length was determined in the region between the major foramen and 3 mm short of it in 0.5 mm steps with the Dentaport ZX, Root ZX mini, Elements Diagnostic Unit Apex Locator and Raypex® 5 using files of size 10 and size 15.

Results: The major foramen was detected by all EALs. For the Dentaport ZX, a better accuracy using the size 15 file for the area 0–1.5 mm short of the apex was found. In linear regression, a good linearity for Dentaport tZX and Root ZX mini and moderate linearity for Elements Diagnostic Unit Apex Locator and Raypex® 5 were found.

Conclusion: All EALs included were able to detect the major foramen with reasonable accuracy. In the apical region (0–3 mm short of the major foramen), the linearity of the measurement curve depended on the device. The Dentaport ZX had the highest linearity and agreement between meter reading and true file position, whereas the Root ZX mini and Elements Obturation Unit had less linearity and a larger variation in the measurement data.

<table>
<thead>
<tr>
<th>File</th>
<th>Electronic apex locators</th>
<th>Valid All (%)</th>
<th>Valid &gt;0 mm</th>
<th>Valid &gt;1 mm</th>
<th>Valid &gt;2 mm</th>
<th>Valid &gt;3 mm</th>
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<tbody>
<tr>
<td>#10</td>
<td>Dentaport ZX</td>
<td>243 (86.8)</td>
<td>37 (13.2)</td>
<td>2</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Root ZX mini</td>
<td>227 (81.1)</td>
<td>53 (19.9)</td>
<td>0</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Elements Diagnostic Unit and Apex Locator</td>
<td>194 (66.7)</td>
<td>96 (34.3)</td>
<td>8</td>
<td>29</td>
<td>39</td>
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<tr>
<td>#15</td>
<td>Dentaport ZX</td>
<td>253 (90.4)</td>
<td>77 (27.2)</td>
<td>0</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Root ZX mini</td>
<td>253 (90.4)</td>
<td>77 (27.2)</td>
<td>0</td>
<td>1</td>
<td>8</td>
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<tr>
<td></td>
<td>Elements Diagnostic Unit and Apex Locator</td>
<td>218 (77.9)</td>
<td>62 (22.1)</td>
<td>0</td>
<td>20</td>
<td>29</td>
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<tr>
<td></td>
<td>Raypex 5</td>
<td>230 (82.1)</td>
<td>50 (17.9)</td>
<td>0</td>
<td>4</td>
<td>27</td>
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<table>
<thead>
<tr>
<th>File</th>
<th>Electronic apex locators</th>
<th>b0 (y intercept)</th>
<th>b1 (slope)</th>
<th>r²</th>
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<td></td>
<td>Elements Diagnostic Unit and Apex Locator</td>
<td>0.346</td>
<td>0.795</td>
<td>0.415</td>
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<tr>
<td></td>
<td>Raypex 5</td>
<td>0.254</td>
<td>0.506</td>
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<td>Raypex 5</td>
<td>0.403</td>
<td>0.366</td>
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</tr>
</tbody>
</table>

Table 4: Results of linear regression analysis: b0 gives the intercept point of the regression line with the y-axis, b1 is the slope of the regression line, and r² is the correlation coefficient.

Table 5: Meter readings (mean and SD) with measurement file positioned at the apical foramen. Accuracy was given in per cent of file positions between 0.5 and 0.5 mm with a meter reading of 0.

<table>
<thead>
<tr>
<th>File</th>
<th>Electronic apex locators</th>
<th>Mean</th>
<th>SD</th>
<th>Accuracy (±0.5 mm) (%)</th>
</tr>
</thead>
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<td>0.20</td>
<td>0.31</td>
<td>97.4</td>
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<td></td>
<td>Root ZX mini</td>
<td>0.21</td>
<td>0.39</td>
<td>95.0</td>
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<tr>
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<td>Elements Diagnostic Unit and Apex Locator</td>
<td>0.08</td>
<td>0.61</td>
<td>86.2</td>
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<td>Raypex 5</td>
<td>0.05</td>
<td>0.16</td>
<td>82.4</td>
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<td>0.34</td>
<td>97.6</td>
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<td>Root ZX mini</td>
<td>0.13</td>
<td>0.28</td>
<td>93.4</td>
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<td>Elements Diagnostic Unit and Apex Locator</td>
<td>0.38</td>
<td>0.42</td>
<td>84.8</td>
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<td></td>
<td>Raypex 5</td>
<td>0.06</td>
<td>0.17</td>
<td>87.2</td>
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LOE: 5
Title: Biofilms and apical periodontitis: study of prevalence and association with clinical and histopathologic findings

Author: D. Ricucci and J. Siqueira

Journal: Journal of Endodontics, 36:8, 1277-1288, 2010

Reviewer: Christian Kecht, D.D.S

Purpose: (1) To evaluate the prevalence of intraradicular and extraradicular bacterial biofilms in untreated and treated root canals of human teeth evincing apical periodontitis through histobacteriologic approach and (2) to look for associations of biofilms with some clinical conditions, radiographic size, and the histopathologic type of apical periodontitis.

Materials and Methods:
- Specimens consisted of sequential biopsies of roots or root tips with surrounding apical periodontitis lesions. A total of 106 roots, from 100 teeth were used.
- One group consisted of 64 untreated roots from 58 teeth (59 roots were extracted with apical lesion still attached, 5 specimens required separate removal of lesion). Records were made of symptoms experienced by patients. A periapical radiograph was available for 33 of these teeth. Teeth with periodontal pockets or longitudinal fractures or cracks were excluded.
- Another group consisted of 42 biopsies of roots/root tips from canal-treated teeth from 42 patients. All cases were categorized as treatment failures on the basis of clinical and/or radiographic follow-ups.
- Immediately following removal by extraction or periradicular surgery, specimens were placed in 10% neutral-buffered formalin for 48hrs, demineralized in 22.5% formic acid and 10% sodium citrate for 3 to 4 weeks, washed in tap water for 24 to 48 hrs, dehydrated with ethanol, cleared with xylene, infiltrated, and embedded in paraffin.
- Roots of multirooted teeth were dissected free and processed separately.
- Microtome set at 4 to 5 µm used to make longitudinal serial sections. Every fifth slide stained with hematoxylin-eosin for screening and assessment of inflammation, along with modified Brown and Brenn technique on selected slides to stain for gram-positive and gram-negative bacteria.
- Slides examined by two evaluators. Evaluations done separately. Disagreement was resolved by joint discussion.
- Examiners looked for presence and location of bacteria in the apical segment of the root canal, including the main canal, lateral canals, apical ramifications, and isthmuses, or within body of apical lesion or adhered to the external apical root surface.
- Examiners also looked for presence and distribution of acute chronic inflammatory cells and epithelium in the inflamed periapical tissues.
- Lesions were diagnosed histologically as apical abscess, (epithelialized or nonepithelialized), granuloma (epithelialized or nonepithelialized), or cyst (true, pocket, unclassified).

Results:
- Bacteria found in all but one specimen (asymptomatic root canal-treated tooth)
- Intraradicular biofilms observed in apical segment of 82 of the 106 (77%) root canals. Of those, 51 of 64 (80%) were from untreated canals and 31 of 42 (74%) were from treated canals. No statistically significant difference.
- Radiographs available for 71 specimens used to check for association between intraradicular biofilms and radiographic size of apical periodontitis. Bacterial biofilm present in 23 of 37 (62%) root canals with small lesions (≤5mm) and 28 of 34 (82%) root canals with large lesions (>5mm).
- All five root canals with very large lesions (>10mm) harbored intraradicular biofilms. Biofilms significantly associated with epithelialized lesions (cysts, granulomas, abscesses).
- Overall biofilms were present in 95% of cyst, 83% of abscesses, and 69.5% of granulomas.
- No correlation between biofilms and clinical symptoms or sinus tract presence.
- Extraradicular biofilms present in only 6% of cases.
Discussion: Parsek and Singh proposed the following criteria to define infections caused by biofilms: (1) the infecting bacteria are adhered to or associated with a surface; (2) Direct examination of infected tissue shows bacteria forming clusters or microcolonies encased in an extracellular matrix; (3) the infection is generally confined to a particular site; (4) the infection is difficult or impossible to eradicate with antibiotics despite the fact that the responsible microorganisms are susceptible to killing in the planktonic state. The following criterion was added by Hall-Stoodley and Stoodley: (5) ineffective host clearance evidenced by the location of bacterial colonies in discrete areas in the host tissue associated with host inflammatory cells. The authors of this article propose a sixth criterion: the elimination or significant disruption of the biofilm structure and ecology leads to remission of the disease process. The authors of this study state that the overall findings are consistent with acceptable criteria to include apical periodontitis in the set of biofilm induced diseases. The study failed to show any biofilm morphological pattern for endodontic infections, as morphologic structure varied from case to case.

LOE: 5
Title: Evaluation of the physical and chemical properties of two commercial and three experimental root-end filling materials

Author: Vivan et al.

Journal: OOOOE 2010; 110:250-56

Reviewer: Daniel Cassis, D.D.S.

Purpose: To evaluate the pH, calcium release, setting time, and solubility of two commercially available mineral trioxide aggregate (MTA) cements (white MTA Angelus and MTA Bio) and of three experimental cements (light-cured MTA, Portland cement with 20% bismuth oxide and 5% calcium sulfate, and an epoxy resin-based cement).

Materials & Methods:
- Materials were mixed precisely to manufacturer’s recommendations; with the light-cured MTA being light cured for 60 seconds in 1 mm increments.
- Polyethylene tubes (1 mm diameter, 10 mm length) with one open end, were packed with the materials. Five specimens were prepared from each material and placed in flasks with 10 mL deionized water.
- The specimens were kept covered at 37°C. Evaluations were performed at 3, 24, 72, and 168 (7 days). After each evaluation, the specimens were removed from the flasks and placed in a new container with the same amount of deionized water.
- The pH was determined using an analog pH meter. As a control, the pH of water in which no samples were immersed was measured.
- Calcium ion analyses were carried out by atomic absorption spectrophotometry.
- Setting time was measured on four of the materials (minus the light-cured MTA) under controlled temperature and humidity. The initial and final setting times were determined using a 113.5 g Gilmore needle and a 456.5 g Gilmore needle, respectively.
- Rings of set cement (3 for each specimen, 15 total) were suspended in 50 mL of distilled water for 7 days. Samples were weighed to .001 g before and after suspension in the water to determine solubility.

Results: All the cements were alkaline and released calcium ions with a declining trend over time. Overall, light-cured MTA and the epoxy resin-based cements had the lowest pH values and the other MTA cements had the higher values. Portland cement + bismuth oxide showed statistical differences compared with light-cured MTA at 3 h and with epoxy resin-based sealer at 24 h. MTA Bio had higher calcium values compared with light-cured MTA and the epoxy resin-based cement at 24, 72, and 168 hours. White MTA Angelus and MTA Bio had the shortest setting time, while Portland cement + bismuth oxide had an intermediate setting time, and the epoxy resin-based had the longest setting time. MTA Angelus and MTA Bio showed the higher solubility values and light-cured MTA and epoxy resin-based cement showed lower solubility values.

Discussion: Ideally you want a root-end filling material that is biocompatible, releasing calcium to raise the pH value of the area to stimulate mineralization. Low solubility is desirable to insure the material will sustain its sealing ability over time. An ideal setting time allows for adequate working time, but sets shortly after to prevent to dissolution of the material. Some of these properties work antagonistically with each other. Calcium release, which is good, causes a high solubility rate, which is undesirable. As a clinician you must select the material with the correct balance in order to give the body its best chance at healing itself.

The white MTA Angelus and MTA Bio had the shortest setting times, higher pH and calcium ion release, and the highest solubility. In contrast, the epoxy resin-based cement and light-cured MTA showed lower values of solubility, pH, and calcium ion release. Portland cement with bismuth oxide showed appropriate values of solubility, setting time, pH and calcium release. Further studies are needed to verify the biocompatibility of these new experimental materials.

LOE: 5

Title: Evaluation of the caries profile and caries risk in adults with endodontically treated teeth

Authors: Merdad, K. and et. al.

Journal: OOO, Vol. 110, No. 2:257

Reviewer: Chaiwing Hsiao, D.M.D.

Purpose: To compare the caries risk Profile of individuals with a minimum 2 root – filled teeth versus individuals without root fillings using the cariogram (this interactive Program analyzes differ caries-related factors and presents the results as a pie chart, illustrating the chance of avoiding carries as a percentage value) and to compare the frequency of recurrent caries in root-filled teeth versus non-root
Materials and Methods: Two hundred patients were selected randomly and divided into 2 groups, each comprising of 100 patients. Individuals allocated to the endodontic group (EG) had a minimum of 2 endodontically treated teeth, whereas individuals in the control group (NEG - non endodontic group) had no endodontically treated teeth. The population represented middle socioeconomic Saudi adult patients greater than 18 years; patients were non-medically compromised and had similar gender distribution between the 2 groups. Each patient was interviewed, intraoral digital photos and bitewings radiographs were taken, after which patients underwent plaque scoring, saliva sampling and clinical caries examination. Plaque Index was scored according to Silness and Loe. Clinical recording of caries and radiographs were carried out by one of the authors using Decayed, Missing and Filled Surfaces (DMFS). Four bitewings were taken to score proximal caries. Salivary tests were done using paraffin stimulated whole saliva. The saliva was analyzed regarding buffer capacity and number of mutant streptococci and lactobacilli. Various caries risk factors were evaluated using a computer based program (cariogram).

Results:
- Caries Profile in endodontic versus Non endodontic group
  - DMFS was higher in EG versus NEG. EG showed higher mean number of surfaces with recurrent caries and fillings
  - Mean number of surfaces with primary caries was lower in EG than NEG.
- Caries risk profiles in endodontic versus non endodontic group
  - Using cariogram analysis the mean percentage of “Chance of avoiding caries” was 35 % in EG compared to 37 % in NEG.
  - The Proportion of caries in filled surfaces was 31.6 % in root filled teeth versus 19.2% in non –filled teeth

Conclusion: Data were not in favor of an association between caries risk profile and presence of root –filled teeth, but was in favor of the notion that root–filling procedure might make the tooth more susceptible to caries.

LOE: 3
Materials and Methods:

- A prospective randomized clinical trial was designed. Single visit root canal treatment was done on eighty volunteer patients with a number of 110 teeth.
- The teeth selected were all single rooted teeth with one canal. The diagnoses were either asymptomatic irreversible pulpitis caused by carious exposure or normal pulp referred for intentional endodontic treatment for prosthetic reasons.
- Patients were randomly allocated to either one of the two groups before the endodontic treatment. Group MP was assigned for treatment with a conventional endodontic needle syringe with Max-i-Probe® and group EV had treatment with EndoVac®.
- All teeth received the same volume of irrigants. (130 ml of 2.5% sodium hypochlorite and 10ml of 17% EDTA). The irrigants for both were dispensed from a mechanical syringe pump.
- A questionnaire was given to the patient to note the Intensity of postoperative pain and the amount of analgesics taken in 4, 24 and 48 hours after the procedure.
- The CR10 Borg list was implemented to quantify the individual pain experience.
- Patients were prescribed to take ibuprofen 200mg every 8 hours if required.

Results:

- For MP group 34.5% of the patients felt no pain during the 0-4 hour time interval, 10.9% felt 1 of 10, 27.3% felt 2 of 10 and 9.1% felt strong to very strong pain.
- In EV group 94.5% felt no to weak pain, 5.5% felt moderate pain.
- There was significantly less overall pain associated with the treatment in the EV group.
- The overall number of analgesic pills was less in the EV group than in the MP group.
- The Pearson correlation coefficient revealed strongly positive and significant relationship for both groups between pain intensity and the amount of analgesics.

Conclusion: The negative apical pressure irrigation system EndoVac® resulted in significantly less post operative pain and necessity for analgesic medication than a conventional needle irrigation protocol using the Max-i-Probe®.

LOE: 2
Title: The operating microscope enhances detection and negotiation of accessory mesial canals in mandibular molars

Author: Karapinar-Kazandag, M. et al

Journal: JOE, vol. 36, no. 8:1289, August 2010

Reviewer: Ferras Mashtoub, DDS

Purpose: The primary purpose was to assess the ability to detect and negotiate the accessory mesial canals in mandibular first and second molars with the aid of magnifying loupes and the microscope. The secondary purpose was to then characterize the detected canals with regard to prevalence, location, negotiability, and pathway.

Materials & Methods:

- Mandibular 1st and 2nd molars collected from Oral Surgery clinics and radiographed in bucco-lingual direction.
- All teeth w/ previous endodontic tx, deficient coronal structure, aberrant anatomy, C-shaped canals, calcified canals, and fused roots were excluded. 48 first and 48 second molars were chosen for the study.
- Teeth were stored in a 0.1% Thymol solution until used
- Teeth were embedded in dentaforms and mounted in mannequins to simulate a clinical situation.
- All teeth accessed with conventional endodontic access using 4.5x loupes
- Each of the first and second molar groups were divided into 3 subgroups and given to 3 endodontists
- Each endodontist worked independently to explore for mesial canals using a standardized procedure as follows:

  **Stage 1**: only loupes used for magnification. Access refined with ultrasonic tips to remove overhangs and on isthmus. Subpulpal groove examined with endo explorer. The number of canal orifices detected was recorded. Tried to negotiate with #06 K file, if unsuccessful, isthmus was troughed deeper with ultrasonic and attempt to negotiate repeated. Troughing continued until 1) accessory canal negotiated, 2) considered too risky to trough further, 3) accessory canal no longer detectable, 4) perforation

  **Stage 2**: Teeth with no detected accessory canal or one that could not be negotiated was submitted for further study under the microscope. Under the microscope, more dentin was removed selectively and along the subpulpal groove with the ultrasonic and negotiation attempts were repeated. Results were recorded.

  **Stage 3**: K-files placed in accessory canals as far apically as possible, teeth were removed from dentaforms, and radiographed from the mesial to show the pathway of the mesial canal.

  **Stage 4**: Teeth stored in 1% Sodium Hypochlorite for 24 hours to remove soft tissue remnants. Teeth then photographed w/ aid of stereo-microscope and location of canal recorded.

  **Stage 5**: Distal roots resected, radiographs taken from mesial, images digitized and depth of dentin removal measured.

  **Stage 6**: Mesial roots sectioned at 1mm, 4mm, and 8mm from apex. Then examined under 30x magnification to detect any additional accessory canals not found in the study.

Results:

- In both 1st and 2nd molars, the use of microscope lead to more accessory canals being found
- All 20 accessory canals located in the mesial subpulpal groove. (45% closer to ML, 30% in middle, 25% closer to MB)
- All 16 negotiated canals were confluent with a main canal, (1st 42% merged with MB, 2nd 55% merged with ML canal)
- Mean depth of dentin removed was 1.1mm in 1st molars and 0.7mm in 2nd molars.

Discussion: The microscope lead to an overall 4% increase in detection of canals (2% in 1st molars and 6% in 2nd molars), as well as improved negotiation of canals. All of the accessory canals were located in the mesial subpulpal groove, with a mean of 1.1mm dentin removal needed in 1st molars and 0.7mm in 2nd molars. All of the accessory canals were confluent with a main canal and none detected by 4mm from apex

LOE: 5
Title: Influence of a passive sonic irrigation system on the elimination of bacteria from root canal systems: A clinical study

Author: Huffaker SK et al.

Journal: JOE 2010; 36(8):1315-1318

Reviewer: Ken Lin, DMD

Purpose: To evaluate whether the addition of EA (EndoActivator), a new passive sonic irrigation system, to standard chemomechanical instrumentation results in a greater elimination of cultivable bacteria from root canals compared with standard irrigation (control) and to compare the ability of one-session treatment to eliminate cultivable bacteria with that of a second session with Ca(OH)₂ disinfection.

Materials & Methods:

- 84 patients (with apical periodontitis) were equally randomized into two groups (sonic & control groups). Patient consent obtained prior to recruitment. All treatment was performed by 1 of 10 endodontic residents.
- Procedure
  1. RDI and each tooth disinfected with 30% hydrogen peroxide and 5% iodine to eliminate all surface containments. A bacteriologic sample (1st) was taken using a sterile paper cones. Access performed and canals pre-flared to allow entrance of paper points for 2nd sampling to confirm presence of bacteria in the canal system. After working length (WL) determination, canals were chemomechanically instrumented (with 0.5% NaOCl with 27 gauge side-vented needle), and the size of master apical file (MAF) was determined by each of the 10 clinicians.
  2. A treatment card with either “EA” or “standard irrigation” printed was given to the clinicians – both residents and sampling operators were blinded as to which treatment group the tooth would be assigned before this point. A 3rd sample was taken following the irrigation.
  3. Following the 3rd sample, each canal was filled with a slurry of Ca(OH)₂ then temporarily restored. A post-medication sample was taken during the 2nd treatment session prior to obturation.
- Six teeth (three for each group) without radiographic periapical inflammation and vital pulps were used for negative controls. Entire experimental protocol (see above) was performed.

Results:

- Bacteria were initially present in the root canals of all 84 teeth treated. After activation of NaOCl with EA, 60% (25 teeth) still harbored bacteria compared with 52% (22 teeth) for the control group. This difference was not significant.
- Comparing one- or two-visit treatment: At the end of 1st session, 56% (47/84 teeth) still harbored bacteria. After Ca(OH)₂ disinfection and a 2nd session of treatment, 27% (20/74 teeth) harbored bacteria. This difference was significant.

Discussion/Conclusion: In the current study, it was not shown that EA improved the ability to eliminate cultivable bacteria from root canal systems. One reason for this might be that EA produces only sonic waves – which was generated by 1 node along the length of the instrument (whereas ultrasonic energy can generate several nodes) – so that any constraint of the instrument will significantly decrease, if not eliminate, the acoustic streaming necessary to dislodge and carry away necrotic debris. This study also supports the recommendation to render treatment of teeth exhibiting signs & symptoms of apical periodontitis in at least 2 sessions with the used of Ca(OH)₂ as inter-appointment medicament.

LOE: 2
Title: Root and canal morphology of mandibular second molars in an Indian population

Author: Neelakantan, P. et al

Journal: JOE vol. 36, 8:1319

Reviewer: A. Jayson Tengonciang, DMD

Purpose: To study the root and canal morphology of mandibular second molars of an Indian population using a canal staining and clearing technique

Materials and Methods:

- 345 mandibular second molars were collected from indigenous Indians:
  - Teeth were immersed in 2.5% sodium hypochlorite, then dried
  - Indian ink was injected into the root canal system and assisted by apical vacuum suction and negative pressure
  - Teeth were dried and decalcified in 10% nitric acid, and dehydrated in ethanol
  - Teeth were rendered transparent by immersion in methyl salicylate, and analyzed under 5x magnification
- Teeth were analyzed for the following features:
  - The number of root canals per root
  - The root canal configuration
  - Additional classes based on the number of orifices, canals, and apical foramina
  - Presence of intercanal communications
  - Number of apical foramina

Results and Discussion:

- Number of roots – most common morphology was two separate roots – 83.4%, C-shaped – 7.5%
- Number of root canals and configuration
  - mesial roots of two-rooted molars showed two canals – 86.1%
  - distal roots of two-rooted molars showed one canal – 77%
  - most commonly found canal configuration in the mesial root was type IV, distal type I
- Intercanal communications – distal root – 81.1%, mesial root – 36.8%
- Apical foramina – all roots exhibiting type IV, V, VII, 3-2, and 4-2 canal configuration showed two separate apical foramina

Conclusion: The most common morphology in Indian mandibular second molars was the two-rooted teeth with three canals (two mesial and one distal). C-shaped canals were found in 7.5% of the teeth, most of which had single canals. The observations made in this study show that Indian mandibular second molars exhibit both Mongoloid and Caucasian traits.

LOE: 5
Purpose: To obtain 8-year postoperative data on patients who had endodontic treatment which was obturated using gutta-percha and a methacrylate resin-based sealer (EndoREZ®)

Materials and Methods:

- 112 patients with 212 root canals were available for the 8-year follow-up examination.
- Radiographic (comparison between preop and follow up) and clinical (percussion) evaluations were conducted in the evaluation.
- All treatments were completed in a single visit, with RDI, hand instrumentation with a crown down and step back technique to an apical size of 30-40.
- 2.5% NaOCl was used as irrigation along with saline. The canal walls were kept slightly moist to take maximum advantage of the hydrophilic properties of the resin sealer.
- The canals were obturated with lateral condensation of gutta-percha cones and EndoREZ® as the sealer.
- The criteria for radiographic success was based on:
  1. Radiographically, the contours and width of the periodontal ligament (PDL) space were within normal limits or slightly widened around an accidental overfill, and the patient was free of symptoms. Slight tenderness to percussion for a brief postoperative period was considered acceptable.
  2. The size of a preoperative radiolucent area decreased by at least 50% and the patient was free of symptoms or the contours and width of the PDL space had returned to normal.
  3. Absence of preoperative periapical radiolucency remained unchanged over time.
- The criteria for radiographic failure was based on:
  1. Periapical radiolucency observed in the preoperative radiograph and remained unchanged or increased in size over time.
  2. Roots that, in absence of preoperative periapical pathosis, developed a radiolucency over time.

Results:

- 46/49 preoperative vital teeth were successful.
- 59/63 preoperative nonvital teeth were successful.
- 43/46 teeth with preoperative periapical radiolucencies showed almost total or total healing.
- 62/66 teeth without preoperative periapical radiolucencies were successful.
- There was no difference in outcome of treatment related to age, gender, preoperative pulp or periapical status, the size of periapical lesions, and the type of permanent restoration.
- The cumulative probability of success was 86.5% at the 8-year recall.

Discussion: In this study, there was a good correlation between radiographic success and histological status of the periapical tissues in humans. The recall rate of 62.22% after 8 years was adequate, but the 8 patients who could not be located may have had no symptoms, had relocated, or had returned to the referring dentist due to problems. These scenarios could have potentially skewed the results. Also, age, gender, vitality of the teeth, or presence of preoperative apical radiolucency did not negatively affect the results of this study. And finally, it must be noted that 2 cases may have failed due to the result of saliva contamination from the loss of coronal protection and not only because of inadequate adaptation of the EndoREZ® material.

Conclusion: Within the limitations of this clinical and radiographic study, the results suggest that EndoREZ® used in conjunction with gutta-percha constitutes an acceptable root canal filling procedure. Patients recalled after 8 years reported being comfortable with the treated teeth, which continued to be functional. The sealer seems to be well-tolerated by periapical tissues even in cases of accidental extrusion beyond the apical foramen. Furthermore, the success rate was comparable to what had been reported previously with different endodontic sealers.

LOE: 4
Title: Biologic marker for odontogenic periradicular periodontitis

Author: Burgener, B. and et. al.

Journal: JOE, vol. 36, no. 8:1307

Reviewer: Nicole Vu, DMD

Purpose: Whether interleukin-1B (IL-1B) and dentin sialoprotein (DSP) from gingival crevicular fluid (GCF) can be used as markers for apical periodontitis

Materials & Methods:
- 40 patients either seeking routine or emergency endodontic treatment were selected
- Selected patients with: Radiographic presence of apical periodontitis; first time RCT, re-treatment, and surgical RCT; either previously or currently use of antibiotics
- Rejected patients with: Pocket of >4mm, bleeding upon probing, and currently on orthodontic treatment
- Experimental and healthy contra-lateral teeth were rinsed with water, dried then isolated
- Filter paper strips (perio paper) were inserted 1-2mm into gingival crevice or until resistance for 30 sec, and then two more times after 5-min intervals
- Strips were placed in tubes containing ice-cold 1M phosphate-buffered saline solution with 0.1 mM/L phenylmethylsulfonyl fluoride
- Blood and saliva contaminated strips were rejected
- Samples were diluted to equalize the protein content and ELISA was used to detect IL-1B and DSP

Results: Non-specific protein level appeared to be higher in diseased group. IL-1B and DSP levels were slightly elevated in the diseased group, but no statistically significant compared to the control group

Discussion: Knowing the status of the pulp and the periapical area prior to RCT is one of the most important determinants of success. The significant increase in non-specific proteins in diseased teeth suggested it to be the marker for periapical disease. The results did not demonstrate a statistically higher level of IL-1B and DSP in the diseased group, this could due to IL-1B and DSP are elevated in the active bone resorption phase rather than the chronic phase of disease. Since IL-1B and DSP are present in periodontal disease and root resorption, contra-lateral endodontically healthy teeth were necessary to rule out false-positive as a result of other inflammation. Anesthesia was not considered in the study even though other paper had shown a much higher level of Interleukin-8 in diseased teeth, and that this level returned to similar level of healthy teeth after anesthesia. Moreover, the antibiotics use of these patients might influence the inflammatory mediators.

Conclusion: Antibiotics and anesthesia should be considered in future research.

LOE: 3B