Title: Clinical Diagnosis of Pulp Inflammation Based on Pulp Oxygenation Rates Measured by Pulse Oximetry

Author: Setzer, FC et al


Reviewer: Marisa Zarchy, DMD

Purpose: To evaluate pulp oxygenation rates in teeth with clinical diagnoses of reversible pulpitis (RP), irreversible pulpitis (IP), or pulp necrosis (PN) in order to correlate the clinical diagnoses of pulp inflammation with pulse oximetry (PO) results obtained by using an improved pulse oximeter probe.

Background: Thermal and electrical sensitivity tests have shown to be helpful but they do not indicate the degree of pulpal disease. This is largely due to thickness of enamel, which prohibits a comparison of teeth due to the difference in electrical resistance. Pulse oximetry, however, has been shown to measure pulp vitality well since it can determine blood flow and oxygenation in teeth. However, currently there is no data supporting the differences of PO between the stages of pulpal inflammation.

Materials and Methods:
- 60 patients were grouped by either RP, IP, or PN (n=20 per group)
- The tooth was classified based upon having 2 signs or symptoms fulfilled
- The diagnoses were based on the patient’s dental history, PA radiographs, clinical inspection, and percussion and thermal sensitivity testing
- Pulse oximetry was used to determine pulse oxygenation rates (PO) on both the patient’s index finger (control) and teeth
- For further controls, each patient had one additional RCT tooth (negative control:NC) and one additional healthy tooth (positive control:PC) evaluated with the PO
- Statistical analysis was performed using the Tukey HSD test and the Student t-test to measure variance

Results:
- The mean % SpO2 levels were as follows:
  - RP: 87.4% [SD = +/- 2.46]
  - IP: 83.1% [SD = +/- 2.29]
  - PN: 74.6% [SD = +/- 1.96]
  - PC: 92.2% [SD = +/- 1.84]
  - NC: 0% [SD = =/- 0.0%]
- There were statistically significant differences between RP, IP and PN (P<0.01)
- There were also statistically significant difference between RP, IP, PN and PC and NC

Conclusion: Overall, the evaluation of the pulp oxygenation rates by PO may be a useful test to determine the different inflammatory stages of the pulp to aid in endodontic diagnosis. This can be especially helpful in cases of dental trauma since it evaluates direct pulp vitality rather than indirect evaluation of nerve fibers.

LOE: 4
Title: Antimicrobial substantivity over time of chlorhexidine and cetrimide

Author: Pilar Baca et al.


Reviewer: Kevin Baweja, DDS

Purpose: To evaluate the antimicrobial substantivity against Enterococcus faecalis of a dentin-volumetric unit exposed for 1 minute to chlorhexidine (CHX) and cetrimide (CTR)

Materials and Methods:

- Dentin blocks randomly assigned to 1 of 2 groups, with or without collagen and subdivided into the following three groups: 0.2% CHX, 2% CHX, 0.2% CTR
- All specimens were dried and submerged for 1 minute in 17% EDTA for smear layer removal
- “without” collagen group were then dried and submerged for 1 minute of 2.5% NaOCl
- All dentin blocks were dried and immersed for 1 minute in 180µ/L of the different antimicrobial solutions tested
- Dentin blocks were dried and transferred to a microtiter plate with 180µ/L well of bacterial solution
- Every 48 hours a 2µL sample was tested for the presence the of E. faecalis
- Follow – up time was 60 days

Results:

- Paired comparisons showed longer survival overall of the samples with collagen than without collagen with statistically significant differences between 2% CHX and 0.2% CHX
- Direct relationship observed between CHX concentration and survival time with the highest survival value for 2% CHX with collagen (statistically significant compared to other groups) followed by 2% CHX without collagen, 02% CTR with collagen, 0.2% CTR without collagen (no significant difference among these 3 groups) 0.2% CHX with collagen and 0.2% CHX without collagen (both significantly different than other groups)

Discussion:

- Use of CHX and CTR as final irrigating agent can fully inhibit E. faecalis growth for a substantial time
- The relationship between concentration and substantivity time is consistent with previous studies
- Significant differences in survival between specimens with and without collagen treated with CHX can be explained CHX – dentin bonding facilitated by EDTA
- The similar survival values obtained for 0.2% CTR and 2% CHX could also stem from CTR – dentin bonding however it does not explain the lack of difference between specimens with and without collagen

LOE: 4
Purpose: Identify a novel quality standard for pulp regeneration.

Methods & Materials:

- 3 distinct human CD105+ stem/progenitor cells from dental pulp, bone marrow and amnion were quantitatively compared for peptide & protein expression using 2-dimensional electrophoresis, nano liquid chromatography-mass spectrometry & computational analysis.
- High expression of a distinct protein (vimentin) in normal pulp tissue was confirmed in comparison to a variety of human tissue & regenerated pulp, using real-time reverse transcription – polymerase chain reaction (RT-PCR) & immunohistological analysis.
- Knock down of vimentin mRNA expression with small interfering RNA (siRNA) was done to evaluate vimentin function in regenerated tissue after pulpectomy.

Results:

- Quantitative analysis of dental pulp, bone marrow & amnion CD105+ cells resulted in the detection of nine protein spots only in pulp CD105+ cells, of which vimentin was one of them.
- Vimentin messenger RNA expression was highest in pulp CD105+ cells.
- Regenerated pulp & normal pulp expression of vimentin were similar.
- Migration activity of pulp CD105+ was significantly reduced after vimentin mRNA expression knock down.

Conclusions: Since vimentin was confirmed as being highly expressed in pulp tissue & has a role in migration of pulp stem cells, it may be used as a quality standard for pulp regeneration & pulp cell function.

LOE: 4
Title: The effect of detergents on the antibacterial activity of disinfecting solutions in dentin

Author: Wang Z, et al

Journal: Journal of Endodontics, 38(7), 948-953

Reviewer: Ashley Gonsky DMD

Purpose: To evaluate the effectiveness of dentin disinfection by different antibacterial solutions in the presence and absence of detergents through use of a novel dentin infection model and confocal laser scanning microscopy (CLSM).

Materials and Methods: A cylindrical root dentin block was sectioned from 11 extracted single-rooted teeth and root canals were enlarged to 1.5mm with a Gates Glidden drill. Twenty-two semicylindrical halves were vertically fractured from the dentin blocks and refined to a size of 4x4x2 mm. Smear layer was removed by immersion in 5.25% NaOCl and 6% citric acid for 4 minutes. Specimens were placed canal side up on a microfiltration tube and the gaps between the inner tube and specimen were sealed with composite. The dentin was infected with Enterococcus faecalis isolated from a case of persistent apical periodontitis, cultured, centrifuged into dentinal tubules, and then incubated at 37°C in BHI broth for 24 hours.

Disinfection of Dentin
- Specimens were freed of composite, removed from filter, and rinsed in sterile water for 1 minute followed by air drying.
- Cemental sides were closed with nail varnish.
- 22 were randomly divided into 11 groups with 2 specimens each:
  1) sterile water (control)
  2) 0.1% cetrimide (CTR)
  3) 2% NaOCl
  4) 2% NaOCl + 0.1% CTR
  5) 6% NaOCl
  6) 6% NaOCl + 0.1%CTR
  7) Chlor-Xtra
  8) 2% CHX
  9) CHX-Plus
  10) 2/4% iodine potassium iodide (IPI)
  11) IPI + 0.1% CTR
- 50 microliters of each medicament was placed on the root canal side of each dentin specimen for 1 or 3 minutes
- Specimens were rinsed in sterile water for 1 minute, vertically fractured, and analyzed with CLSM.

CLSM Examination
- 44 specimens were stained with the fluorescent LIVE/DEAD BacLight Bacterial Viability stain.
- Fluorescence was viewed using CLSM. The volume ratio of red fluorescence to green and red fluorescence indicated the proportion of killed cells for each medicament.
- Post hoc multiple comparisons were used to produce a significance level of P < 0.05.

Results: A higher percentage of dead bacteria were detected in the detergent containing groups. Solutions with detergent (except for 6% NaOCl) were equally as effective in killing bacteria in dentin in 1 minute as the same solutions without detergent in 3 minutes (P > .05). After 1 minute of treatment 6% NaOCl + 0.1% CTR was the most effective but with a nonsignificant difference to regular 6% NaOCl and the Chlor-Xtra.

Table 1. Proportion of Dead E. faecalis Cell Volume in a Dentin Infection Model Treated by Different Disinfection Solutions

<table>
<thead>
<tr>
<th>Medicaments</th>
<th>1 min</th>
<th>3 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile water</td>
<td>0.03 ± 0.01a</td>
<td>0.04 ± 0.02a</td>
</tr>
<tr>
<td>0.1% CTR</td>
<td>0.24 ± 0.13b</td>
<td>0.36 ± 0.13de</td>
</tr>
<tr>
<td>2% NaOCl</td>
<td>0.26 ± 0.11bc</td>
<td>0.34 ± 0.14e</td>
</tr>
<tr>
<td>2% NaOCl + 0.1% CTR</td>
<td>0.38 ± 0.13de</td>
<td>0.47 ± 0.12fg</td>
</tr>
<tr>
<td>6% NaOCl</td>
<td>0.45 ± 0.13dg</td>
<td>0.65 ± 0.08h</td>
</tr>
<tr>
<td>6% NaOCl + 0.1% CTR</td>
<td>0.48 ± 0.14fg</td>
<td>0.70 ± 0.07h</td>
</tr>
<tr>
<td>Chlor-Xtra</td>
<td>0.46 ± 0.14dg</td>
<td>0.68 ± 0.13h</td>
</tr>
<tr>
<td>2% CHX</td>
<td>0.24 ± 0.10b</td>
<td>0.33 ± 0.09ce</td>
</tr>
<tr>
<td>CHX-Plus</td>
<td>0.36 ± 0.14de</td>
<td>0.45 ± 0.12g</td>
</tr>
<tr>
<td>IPI</td>
<td>0.29 ± 0.10b</td>
<td>0.39 ± 0.15de</td>
</tr>
<tr>
<td>IPI +0.1% CTR</td>
<td>0.41 ± 0.13 dg</td>
<td>0.55± 0.12f</td>
</tr>
</tbody>
</table>
Discussion: Using a novel dentin infection model, viability staining, and CLSM, the results showed that with the exception of 6% NaOCl, the addition of a detergent in the disinfecting solution can increase the antibacterial effect against bacteria in infected dentin. Detergents facilitate the medicaments’ entry into places of difficult access, destabilize cohesive forces, and facilitate destruction of extracellular polymeric substance matrix and bacterial cell membranes.

LOE: 5

Title: A prospective randomized controlled study of mineral trioxide aggregate and super-benzoic acid as root-end filling materials in endodontic microsurgery.

Author: Song M et.al


Reviewer: Anil Reddy Manda DMD

Purpose: The purpose of the present study was to evaluate the clinical outcomes of endodontic microsurgery when super ethoxy-benzoic acid (Super EBA) and mineral trioxide aggregate (MTA) were used as root-end filling materials in a prospective randomized controlled studies (RCT)

Materials and Methods: Of the 420 teeth confirmed to be eligible for endodontic microsurgery, 32 patients (32 teeth) chose not to participate. Of the 388 teeth on which endodontic microsurgery was performed, 128 teeth were excluded from the study because of through-and-through lesion or due to the presence of the endo-perio lesion. 260 teeth were randomly assigned to either the super EBA group or the MTA group with equal numbers using the “minimization method”. Endodontic microsurgical procedures were performed according to the Yonsei protocol and were carried out by a single operator. The patients were followed up at 3, 6 and 12 months. The primary outcome measure was the change the apical bone density at 12 months using the criteria used by Molven et al(1.Complete healing with reestablishment of the lamina dura 2.Incomplete healing/scar tissue 3.Uncertain healing 4.Unsatisfactory healing), and the secondary outcome measures were the presence of clinical symptom or abnormal findings at 12 months.

Results: A total of 192 teeth were examined at the 12 month follow-up; 102 teeth were in the super EBA group, and 90 were in the MTA group. The overall success rate was 94.3%, with a success rate of 95.6% (86/90 teeth) for MTA and 93.1% (95/102 teeth) for super EBA. The statistical analysis of the success rate results did not show any significant difference between the groups.

Conclusion: In this prospective randomized controlled study, there was no significant difference in the clinical outcomes of endodontic microsurgery when super EBA and MTA were used as root-end filling materials.

LOE: 2
Title: Efficacy of endodontic treatment for endotoxin reduction in primarily infected root canals and evaluation of cytotoxic effects

Author: Dias DeOliveira et al

Journal: JOE, Vol. 38, No.8:1053-1057

Reviewer: Marisa Zarchy, DMD

Purpose: To investigate the effects of biomechanical preparation by using different combinations of irrigation agents and intracanal medication on endotoxins in root canals with pulp necrosis and apical periodontitis and to evaluate the cytotoxic effects of the root canal content in macrophages.

Background: Endotoxins consist of lipopolysaccharide (LPS) complexes which initiate inflammatory and immunological responses. A positive correlation between the endotoxin concentration in the root canal and the presence of signs and symptoms has been shown. Sodium hypochlorite and chlorhexidine have shown antimicrobial activity but little or no effect on LPS. An in vitro study, however, did show that limewater (0.14% calcium hydroxide) and polymixin B as irrigation agents significantly reduced the level of endotoxins in canals. As a result, it would be interesting to do an in vivo study.

Methods and Materials:
- 36 single-rooted teeth with pulp necrosis and radiographic apical periodontitis were selected
- Samples were collected before (S1) and after (S2) instrumentation
- The root canals were divided into 3 groups (n=12) according to the irrigant combination used:
  - Group 1: 2% CHX gel + apyrogenic saline, followed by limewater (LW) (0.14% Ca(OH)2)
  - Group 2: 2% CHX gel + apyrogenic saline, followed by polymixin B (PmB)
  - Group 3: 2% CHX gel + apyrogenic saline (control)
- The third sampling was performed after EDTA (S3) and the fourth after intracanal medication (CHX gel + calcium hydroxide for 14 days)
- Endotoxins were quantified by chromogenic Limulus amebocyte lysate assay and cytotoxic effects were evaluated by the production of cytokines (IL-1B, TNF-alpha) in macrophages stimulated with the root canal content

Results:
- Endotoxins were detected in all root canals before instrumentation (S1).
- Group 1 with CHX gel and LW presented the greatest endotoxin reduction after instrumentation (99.18%) which was similar to Group 2 with CHX gel + PmB (96.42%) [P>0.05]
- The control group was 90.78% which was significantly different from Group 1 and Group 2 (p<0.05)
- The intracanal medication promoted important endotoxin neutralization with a reduction of 99.2% to 100%
- The root canal content induced a higher production of TNF-alpha and IL-1B in S1 samples compared with sample obtained after treatment

Conclusion: The combination of CHX gel and limewater as an irrigant was the most effective in reducing endotoxins in root canals and intracanal medication was important to neutralize the cytotoxic effects.

LOE: 3
Title: Endodontic clinical management of a dens invaginatus case by using a unique treatment approach: A case report

Authors: Narayana, P. et al.

Journal: JOE 2011; Vol.38, No. 8: 1145-1148

Reviewer: Hector M. Garcia, DMD

Purpose: Provide an overview for using CBCT scans in diagnosis and treatment planning as well as providing a step by step clinical technique for the endodontic management of a dens invaginatus case

Introduction: Dens invaginatus has been described as a tooth within a tooth or as an invagination of enamel lined tract extending into the root, with or without exposure of the dental pulp. For endodontic treatment to be successful, it is necessary to successfully debride and disinfect the entire root canal system

Case Report:

- 11 year old male patient referred for treatment of tooth #7. Patient reports that he was presently unable to bite food with #7, and the tooth was tender to touch. Clinical exam revealed that #7 was tender to percussion. Tooth did not respond to cold test. The shape of the crown was wider in a labial-lingual direction, with the presence of a lingual cusp.
- PA radiograph revealed presence of a dens in #7, with the invagination inside the tooth extending the entire length of the root
- A CBCT scan was ordered to better visualize the complexity of the dens in 3 dimensions. The scan revealed that he invagination was entirely embedded in the pulp space. A periapical radiolucency was also seen.
- Consent was obtained to perform a revascularization procedure on #7
- Lingual access was done
- Caries indicator dye was used to locate the outline of the dens in the access cavity
- The dens was carefully troughed by using a CT4-D ultrasonic tip to separate the dens from the main root trunk. Once the dens was separated, it was engaged with a SS file and gently removed
- After dens removal, canal was irrigated w/ 5mL of 5.25% NaOCl using the Endovac® system
- Root canal was dried, and a triple antibiotic paste (ciprofloxacin, metronidazole, and minocycline) was placed along the entire length of the root canal space w/ a lentulo spiral
- Access cavity was then sealed with a glass ionomer cement (Ketac-Cem™) and the patient was scheduled to return in 2 weeks
- Patient returned 2 weeks later and the tooth was asymptomatic
- Access cavity was reopened and tooth was irrigated w/ NaOCl and a size #20 SS file to remove the triple antibiotic paste
- Tooth was then thoroughly irrigated w/ 5.25% NaOCl and dried by using paper points
- A SS file was extended beyond the apical foramen to initiate bleeding into the pulp canal space. Blood was allowed to fill the entire canal space and given time to form a clot.
- White MTA was prepared and then placed in direct contact with the clot. MTA was left undisturbed for 15 minutes to allow initial setting.
- A glass ionomer cement (Vitrebond™) was then directly placed on top of the MTA and light cured
- Access cavity was then etched and then sealed w/ a light cured composite
- Patient was scheduled for follow up at 5 and 12 months. At each of these visits the patient was asymptomatic, but the tooth did not respond to either thermal or electric stimuli. At 12 month, the periapical lesion appears to be completely healed and showed normal trabeculation. No radiographic evidence of increase in root wall thickness was seen.

Discussion:

- CBCT is a good tool in identifying complicated morphology, so that appropriate treatment planning can be done
- Pulp revascularization is a technique that should be considered for treatment of teeth w/ wide open apices and a necrotic pulp (concept is based on the presence of pluripotential cells in the periapical region)
- One of the main goals of revascularization is to regain vitality of the tissues present in the canal space, so that there will be an increase in the thickness of the root canal wall
- On the present case, no increase in root wall thickness was seen in 12 months. The author believes that usage of 5.25% NaOCl on the second visit, could have affected the viability of the stem cells of the apical papilla. Saline, EDTA or CHX are some other options to be considered as a final irrigant

LOE: 5
Title: One vs. two visit endodontic treatment of teeth with apical periodontitis: A histobacteriologic study

Author: Vera, Jorge et al

Journal: JOE, Vol 38, No. 8, 1040

Reviewer: Ricky González López DMD

Purpose: To analyze the in vivo microbial status of the middle and apical segments of the root canal system of mesial roots of human mandibular molars with primary apical periodontitis after 1 – or 2- visit endodontic treatment.

Materials & Methods: Teeth selected for this study were mandibular molars with necrotic pulps and radiographic evidence of apical periodontitis that were extracted because of non-restorability or periodontal disease. Thirteen (13) teeth were selected and randomly assigned to either of experimental groups by using a coin toss. Only the two mesial canals were included in the experiment. All clinical procedures were carried out by one experienced endodontist.

Two visit group

- This group included the mesial canals of 7 mandibular molars
- Disinfection of tooth and the rubber dam with 5% NaOCl prior to access.
- Access done and were profusely irrigated with 5% NaOCl, calcium hydroxide was placed at the entrance of the distal canal and the distal aspect of the access cavity was separated from the mesial one by building a mechanical barrier with Block-out resin.
- Working length was determined with the aid of an electronic apex locator.
- Mesiobuccal canals were instrumented by using the ProTaper system up to F2 with copious irrigation using 5% NaOCl for 45 minutes.
- They were also rinsed with 5 ml of 17% EDTA, followed by 5 ml of saline solution and a final rinse with 5ml of 2% aqueous chlorhexidine solution. The canals were then dried with sterile paper points.
- All canals were subsequently medicated with a freshly prepared paste of calcium hydroxide, access closed with IRM for a period of one week.
- The after one week, repeating instrumentation with the last instrument operated with 10 ml of 5% NaOCl as irrigant. Rinsed with 10 ml of EDTA and then 2% chlorhexidine.
- Root canals obturated with guta-percha and pulp canal sealer and sealed with IRM
- Teeth were immediately extracted and immersed in a chilled fixative solution.

One visit group

- This group included the mesial canals of 6 mandibular molars treated exactly as described for those in the 2-visit group.
- No interappointment dressings with calcium hydroxide were used.
- Teeth were extracted 7 days after the intracanal procedures without reentering the canal.

Results: Sections that stained positive for microorganisms demonstrated various different bacterial morphotypes (cocci, rods, and filamentous form). They were found in the middle, and/or apical third of 11 of the 13 root canals (all of the 6 roots of the 1-visit group and 5 of the 7 roots of the 2-visit group. Bacteria were present in the isthmus and within dentinal tubules in 5 of 6 specimens of the 1-visit group. In the 2-visit group 2 teeth had their root canal systems rendered free of bacteria, however bacteria were also present in the isthmuses in 4 of the 7 cases, but no bacteria were seen in the dentinal tubules from all 7 roots. Debris were present in both groups but in more areas of the canal in the 1-visit group.

Conclusion: This study demonstrated that the 2-visit protocol with an interappointment medication with calcium hydroxide resulted in improved microbiological status of the root canal system when compared with a single-visit protocol.

LOE: 3
Title: Comparison of heat-testing methodology

Author: Bierma M, et al

Journal: Journal of Endodontics, 38(8): 1106-1109

Reviewer: Andrew H. Chang, DMD

Purpose: To compare electronic heat-testing instruments with more traditional heat-testing methods for consistency, safety, and potential for clinical effectiveness.

Materials and Methods:

- 4 non-restored, fully formed, extracted maxillary premolars were used.
- 4 different operators repeated each test 4 times for a total of 16 trials for each heat source.
- Heat test was applied for 60 secs using one of 5 heat-testing sources:
  - Elements Unit: Gutta percha loaded onto tip, and heat activated to 200\(^\circ\) C.
  - System B\(^{TM}\): Gutta percha loaded onto tip, and heat activated to 599\(^\circ\) C at 10 power.
  - Gutta Percha Pellet: Heated until slumping.
  - Ball Burnisher: Heated until glowing red, removed for 5 secs.
  - Water: Heated to 60\(^\circ\) C and injected to rubber dam isolated tooth using monoject syringe.
  - Negative Control: System B\(^{TM}\) using same method, only heated to 200\(^\circ\) C.
- Temperature was measured using a K-type thermocouple inside the pulp chamber on the buccal wall secured with cyanoacrylate.
- These were placed by drilling a 2 mm diameter hole in the middle of the coronal pulp from the lingual side of the crown, without attempting to remove pulp tissue.
- Teeth were then mounted at the CEJ in a water bath maintained at 37\(^\circ\) C to simulate periradicular tissues.

Results:

- For temperature and heating consistency, the Elements unit, heated gutta percha, System B\(^{TM}\), heated ball burnisher, and water were most consistent to least consistent respectively.
- More operator variance was seen between heated ball burnisher, water, and heated gutta percha compared to the electronic units.

<table>
<thead>
<tr>
<th></th>
<th>Max Increase ((^\circ)C)</th>
<th>Avg Increase ((^\circ)C)</th>
<th>Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gutta Percha</td>
<td>4.5</td>
<td>2.6</td>
<td>26</td>
</tr>
<tr>
<td>Ball Burnisher</td>
<td>14.2</td>
<td>7.9</td>
<td>53</td>
</tr>
<tr>
<td>Elements Unit</td>
<td>3.9</td>
<td>2.8</td>
<td>60</td>
</tr>
<tr>
<td>System B(^{TM})</td>
<td>7.6</td>
<td>4.7</td>
<td>60</td>
</tr>
<tr>
<td>Hot Water</td>
<td>17.4</td>
<td>13.3</td>
<td>58.5</td>
</tr>
<tr>
<td>Negative Control</td>
<td>0.06</td>
<td>0.4</td>
<td>55.5</td>
</tr>
</tbody>
</table>

Discussion/Conclusions:

- The Elements unit was shown to be most consistent in heating and temperature; however this may not be enough if the patient’s chief complaint is to extremely hot coffee. A faster, more potent test such as hot water or a ball burnisher would better elicit a response.
- If the patient is very sensitive to heat, the Elements system may be good, whereas using hot water or a heated ball burnisher could be too much for this patient.
- The operator needs to be mindful that applying hot water or ball burnisher for too long can raise the pulp tissue above 42\(^\circ\) C, which is when pulpal damage can begin.

LOE: 5
Title: In Vivo evaluation of the Raypex® 5 by using different irrigants

Author: Gomes S. et al

Journal: JOE, Vol. 38, No.8:1075-1077

Reviews: Sean Nguyen, DMD

Purpose: The aim of this in vivo study was to evaluate the accuracy of the Raypex® 5 apex locator in determining the WL in the presence of 2.5% NaOCl, 2% CHX, and 17% EDTA.

Materials and Methods:

Teeth Selection
- 30 maxillary and mandibular single-rooted teeth with mature apices in 14 patients were selected.
- These teeth were planned to be extracted due to periodontal, prosthetic, endodontic, or orthodontic reasons.
- Teeth with metallic restorations, fractures, root resorption, or open apices were not included.

Teeth Preparation
- The cusps of the teeth were flattened and marked to obtain a stable reference point for all measurements.
- Endodontic access was obtained and the pulp tissue was removed with a barbed broach.
- The canal was irrigated with saline solution and dried using paper points.
- Measurements were taken in turn after the canals had been irrigated with 1 ml of 2.5% NaOCl, 2% CHX, and 17% EDTA. Excess fluid was removed, but no attempt was made to dry the canal.

WL Determination
- The Raypex® 5 was used in accordance to manufacturer’s instructions with the electrode connected to a #15 K-file to obtain WL measurements.
- After all measurement had been made, each tooth was extracted.
- The reference WL (RWL) was established by inserting a #10 K-file into each canal until the tip of the file became visible, tangent to the major foramen under a stereomicroscope. 0.5mm was subtracted from this measurement to obtain the RWL.

Results:
- In each case, RWL was subtracted from the electronic measurements. Positive values indicated measurements that exceeded the RWL. Negative values indicated measurements that were shorts of the RWL.
- The mean distance from the RWL to the file tip:
  - -0.26 ± 1.14 mm with EDTA
  - -0.03 ± 0.92 mm with CHX
  - 0.22 ± 0.93 mm for 2.5% NaOCl
- No significant differences were found among the experimental groups (P=.18)

Conclusion: Under the conditions of this in vivo study, the Raypex® 5 performed equally well irrespective of the irrigant used.

LOE: 5
Title: Cyclic fatigue of nickel-titanium rotary instruments in a double (S-shaped) simulated curvature

Author: Al-Sudani et al.


Reviewer: Marisa Zarchy DMD

Purpose: To test the fatigue resistance of nickel-titanium rotary files in a double curvature (S-shaped) artificial root canal and to compare those results with single curvature artificial root canals.

Background: Although NiTi has enabled endodontic instruments to be more flexible, they still have a higher risk of fracture. Reasons for fracture include the variations in root canal anatomy, merging, re-curving, dilacerating, or dividing canals. Fracture of rotary files occurs through two mechanisms: torsion and cyclic fatigue. Torsion occurs when the instrument becomes locked in a canal while the shank continues to rotate. Cyclic fatigue measures the number of cycles before the file breaks. These factors are even more significant when a rotary file operates through a double curve also known as an “S” shape.

Materials and Methods:
- Both ProFile and Vortex instruments with a constant 0.06 taper and #25 file (0.25 tip diameter) were tested.
- Each file was tested for fatigue inside an artificial canal with a double and single curve (total of 4 groups)
  - Double curve
    - 1st curve – 60º, located 8 mm from the tip of the instrument, radius = 5 mm
    - 2nd curve – 70º located 2 mm from the tip of the instrument, radius = 2 mm
  - Single curve
    - Curve – 60º located 5 mm from the tip of the instrument, radius = 5 mm
- 10 instruments for both ProFile and Vortex were examined in each group until fracture in continuous rotary motion at 300 rpm
- The number of cycles to failure (NCF) was calculated to the nearest whole number and the length of the fractured fragment was measured in millimeters
- Data was statistically analyzed using a Tukey and one-way analysis with a level of significance set at 95% confidence level
- A student’s t-test was also performed between data recorded for fragment lengths in different groups in the same root canals

Results: The NCF value was always statistically lower in the double curved artificial canal when compared with the single curve (p<0.05) in both the apical and corona curvatures. Statistically significant differences (p<0.05) were noted between instruments of the same size of different brand only in the single curve. Profile registered a mean of 633.5 +/- 75.1 NCF whereas Vortex registered a mean of 548 +/- 48.9 NCF.

Conclusion: The results suggest that the more complex the root canal anatomy, the more adverse are the effects on the cyclic fatigue resistance of the instruments. It is important to recognize that many teeth may have a single or double curve that may or may not be visible on a radiograph. Also, this study supported that rotary was more likely to break in the apical curve rather than the coronal curve. This may be due to the degree of curvature as well as the radius of the canal (which was smaller in the apical curve). Therefore, the suggestion is for instrumentation to be limited inside complex curvatures/anatomies.

LOE: 5
Title: Bacterial flora and extraradicular biofilm associated with the apical segment of teeth with post-treatment apical periodontitis

Author: Wang, J. et al

Journal: JOE, Volume 38, Number 7, 983

Reviewer: Quan Nghiem, DMD

Purpose: Verify the presence of extraradicular biofilm by scanning electron microscopy and Brown and Benn modified gram staining and investigate the diversity of extraradicular microbial community in persistent periapical lesions using a 16S ribosomal RNA gene based, broad range, polymerase chain reaction-denaturing gradient gel electrophoresis (PCR-DGGE)

- Brown and Benn modified gram staining – Identify and differentiate staining bacteria into two primary groups – Gram negative, and Gram positive.
- Polymerase Chain Reaction (PCR) – Biochemical technology to amplify a single or a few copies of a strand of DNA across several orders of magnitude, generating thousands to millions of copies of a particular DNA sequence
- Denaturing generating gel electrophoresis (DGGE) - a Molecular fingerprinting method that separates PCR generated DNA products

Methods and Materials:

- 23 patients with previously received root canal therapy on upper incisor over a 1 year ago and showed periapical radiolucent area (diameter < 1 cm). These teeth were clinically judged as having a persistent periapical infection and required root end surgery. 8 out 23 teeth had sinus tracts
- Root end surgery was done and the apical 3 mm of the root was resected perpendicular to the long axis of the tooth with a sterile, tapered, diamond bur under sterile saline cooling.
- The roots of 10 additional single rooted teeth extracted for orthodontic reasons with intact crowns, no periodontal lesions, and normal radiograph were resected perpendicular to long axis of tooth. These teeth were the controls in the scanning electron microscopic and histological experiments
- 5 periapical samples and 5 control group samples were examined under the SEM
- 5 periapical samples and 5 control group samples were stained using the Brown and Benn-modified Gram staining procedure then observed under light microscope
- 13 isolated samples without sinus tracts had microbial DNA extracted using a Bacterial Genomic DNA extraction kit. PCR amplification was then performed in a DNA thermocycler
- DGGE was performed to separate the previously described PCR products.

Results:

- Scanning Electron Microscope
  - Control group: has cementum covered with large quantity of collagen fibers running in various directions without area of exposed cementum or bacteria.
  - Experimental group: The apex surfaces contained varying amounts of amorphous extracellular material and almost no fibers. The roots were denuded and a mature biofilm with majority of cocci, bacilli, and filaments were observed
- Brown and Benn modified gram staining
  - Control group: Yellow stained dentin, cementum and periodontal tissue
  - Experimental group: Red stained-gram negative and violet stained-gram positive bacteria were observed in the extraradicular biofilm. The bacteria were predominately rods and filaments. In dentin, the bacteria were visible within the tubules from the pulp chamber to the deep dentin. There were some superficial and deep cementum resorption areas on the root surfaces. In areas of resorption, we found a large number of microorganisms.
- Polymerase chain reaction-denaturing gradient gel electrophoresis
  - All of the 13 samples yielded an ampicon of the expected size after 16s rDNA gene-based broad ranged PCR, which indicates the presence of bacterial DNA. All samples presented several bands which indicate a polymicrobial community. The isolated bands consisted of facultative anaerobic bacteria, obligate anaerobic bacteria, and aerobic bacteria. The majority of detected bacteria belonged to gram negative obligate or facultative anaerobic rods. The Predominant genera included Actinomyces, Propionibacterium, Prevotella, Streptococcus, Porphyromonas endodontalis, Burkholderia,
Conclusion: The samples examples in this research exhibited an extraradicula biofilm in persistent periapical lesions. A high prevalence of Actinomyces species was also found in the microbial flora residing at the apical portion of the infected root canals. A multibacterial community including *Actinomyces* and *Propionibacterium* seems to participate in the maintenance of persistent periapical pathology

LOE: 4
Title: Comparison of endotoxin levels found in primary and secondary endodontic infections.

Author: Gomes, Brenda P.F.A and et al.

Journal: JOE, Vol 38, No. 8, 1082

Reviewer: Arnav R. Mistry DMD

Purpose: To compare the levels of endotoxins found in primary and secondary/persistent endodontic infections with apical periodontitis by correlating their LPS contents with clinical/radiographic findings and to investigate the presence of target gram-negative anaerobic bacteria by using the PCR.

Methods:

- Samples were taken from 15 root canals with primary infections and 15 with secondary infections by using paper points.
- Paper points were immediately placed on a pyrogen-free glass tube and frozen at -80 °C for limulus amebocyte lysate assay (LAL) to quantify endotoxins.
- PCR technique was used for bacterial investigation.
- Patients who had antibiotics or who had any disease were excluded.
- All teeth were single rooted, 1 canal and absence of any periodontal pockets > 4 mm.

Results:

- Sterility samples taken from the external and internal surfaces of the crown and its surrounding structures, tested before and after entering pulp chamber, showed no bacterial growth.
- Endotoxins were detected in 100% of the root canal samples collected from primary (15/15) and secondary (15/15) infections with median values of 7.49 EU/mL and 3.96 EU/mL.
- Endotoxins value found in presence of clinical symptoms was significantly higher than in asymptomatic teeth with primary infections.
- Endotoxin level was significantly higher in teeth with size of radiolucent area >3 mm.
- Following bacteria were detected, Prevotella nigrescens (10/15, 4/15), Fusobacterium nucleatum (5/15, 1/15), Treponema denticola (3/15, 1/15), and Treponema socranskii (5/15, 1/15), with primary and secondary infections, respectively. P. endodontalis was present only in teeth with primary infections (5/15).

Conclusions: Teeth with primary infections contain higher levels of endotoxins and a greater incidence of gram-negative bacteria than with secondary infections. Positive correlation between higher contents of endotoxins and a larger area of bone destruction as well as the presence of specific clinical features found in primary infections. This study found higher levels of endotoxins in teeth with larger radiolucent areas, thus elucidating the role of endotoxins in bone resorption present in apical periodontitis.

LOE: 3