Title: Antibacterial effectiveness of two root canal irrigants in root-filled teeth with infection: A randomized clinical trial

Author: Zandi. H et. Al

Journal: JOE, Vol 42, (9) 1307

Reviewer: Salar Sanjari DDS

Purpose: To evaluate the antibacterial effects of 1% sodium hypochlorite (NaOCl) and 2% chlorhexidine digluconate (CHX) during retreatment of teeth with apical periodontitis.

Materials and Methods: Root canal–treated teeth with apical periodontitis were randomly distributed into two groups. Samples were taken from the canals before (S1) and after (S2) preparation using either NaOCl or CHX irrigation and after calcium hydroxide medication (S3).16S ribosomal RNA gene-based real-time quantitative PCR was performed to quantify total bacteria, streptococci, and Enterococcus faecalis.

Results: Forty-nine teeth were available for analysis (NaOCl, n = 20; CHX, n = 29). Bacterial DNA occurred in all S1 samples: streptococci in 57% and E. faecalis in 6%. The total bacterial counts decreased from S1 to S2 in both groups (P < .01) but were higher in S3 than S2 (P < .01). Thirty-five percent of the teeth in the NaOCl group were positive in S2, decreasing to 20% in S3. Forty-one percent were positive in CHX S2 group, decreasing to 31% in S3. The bacterial load in S1 influenced the incidence of bacteria in S2 (P < .01). Streptococci were significantly reduced in both groups, and E. faecalis was found in only 1 S2 sample and not in S3. No significant difference between NaOCl and CHX was found.

Conclusion: NaOCl and CHX both reduced bacterial counts and the number of infected canals. Intracanal medication with calcium hydroxide reduced the number of canals with persistent infection but resulted in overall larger bacterial counts in the cases positive for bacteria. The effectiveness of antimicrobial treatment can be influenced by the initial bacterial load.

LOE: 3
Title: Does liposomal bupivacaine (Exparel) significantly reduce postoperative pain/numbness in symptomatic teeth with a diagnosis of necrosis? A prospective, randomized double-blind trial

Authors: Glenn B, et al.

Journal: Journal of Endodontics, Vol 42(9) 1301-1306

Reviewer: Salome Masrani DDS

Purpose: Liposomal Bupivacaine (Exparel) is a longer-acting bupivacaine formulation. The bupivacaine is stored in lipid-based chambers that allow for continued drug release for 72 hours. This study compares bupivacaine with liposomal bupivacaine (Exparel) in controlling postoperative pain in patients experiencing moderate to severe postoperative pain due to pulp necrosis.

Materials and Methods:
- 100 patients, >18 years old, ASA I or II, with a moderate to severely symptomatic tooth due to pulp necrosis
- Rated scale of anxiety with Corah Dental Anxiety Scale and pain with Heft-Parker visual analog scale (VAS)
- For treatment, approximately 1.5ml 2% Lidocaine (w/ 1:100,000 epi) was administered to attain anesthesia in the form of infiltrations for maxillary teeth or inferior alveolar nerve block for mandibular teeth
- After endodontic treatment, either 4ml of liposomal bupivacaine was administered by infiltration or 4ml of 0.5% bupivacaine (w/ 1:200,000 epi)
- Patients were prescribed course of Penicillin 500mg or Clindamycin 300mg to take for 7 days if not already on a regimen
- Patients were given a 5-day supply of Ibuprofen 600mg, and Acetominophen 500mg to take as needed for pain, as well as a prescription for an escape medication (hydrocodone/acetaminophen)
- Recorded soft tissue numbness and pain on the evening of the appointment and 5 days postoperatively according to VAS pain scores
- Data collected and statistical analysis performed

Results: No statistical differences between groups according to age, sex, pain, anxiety, tooth location or jaw. Patients who had received liposomal bupivacaine had more soft tissue numbness initially (day 1-2), but numbness decreased for both groups over 5 day period. No significant differences between two groups; 29% success for liposomal bupivacaine treatment group versus 22% for bupivacaine. Moderate to severe pain was still experienced on the night of treatment by 51-59% of the patients. Lower non-narcotic use was found in liposomal bupivacaine group; no significant difference in narcotic use

Discussion: Similar incidence of postoperative pain when comparing administration of a formulation of bupivacaine versus patients managed by ibuprofen/acetaminophen postoperatively. Pain levels decreased from day 1 to 5 for both groups, but less non-narcotic medication was consumed in patients who had received infiltration with liposomal bupivacaine. Success of the use of either formulation of bupivacaine ranged from 22-29%, which does not support routine use of the drug

LOE: 3
Title: Comparison of the anesthetic efficacy of mepivacaine and lidocaine in patients with irreversible pulpitis: A double-blind randomized clinical trial

Author: Visconti R et al.

Journal: JOE, Vol. 42(9): 1314-1318

Reviewer: Reza Akhavan DMD

Purpose: This study compared the anesthetic efficacy of 2% mepivacaine with that of 2% lidocaine, both administered in conjunction with 1:100,000 epinephrine in IAN blocks in patients with irreversible pulpitis of mandibular posterior teeth.

Materials and Methods: The patients included 42 adult patients 8 to 50 years old, currently feeling pain, in good health, and not taking any medication that would alter perception of pain. Patients were asked to rate their current pain on a 4-point scale: 0 - no pain; 1 - mild pain (pain recognizable did not cause discomfort); 2 - moderate pain (pain causing discomfort but bearable); and 3 - severe pain (pain caused considerable discomfort and difficult to bear). Only patients with moderate to severe pain were included. IAN block injections were given of 2% mepivacaine or 2% lidocaine, both with 1:100,000 epinephrine by the same person. Electric pulp stimulation was used to assess pulpal anesthesia. If no profound lip numbness appeared within 10 minutes and EPT did not reach maximum output without patient reporting pain, the block was considered unsuccessful. Second cartridge (1.8 mL) of the same anesthetic solution was reapplied. Immediately before the pulpectomy, EPT was repeated and patients were asked to report any painful discomfort during pulpectomy. Intensity of any pain felt was recorded (0-4).

Results: After injection of the first cartridge (1.8 mL), 11 patients in the mepivacaine group (52%) and 7 patients in the lidocaine group (33%) exhibited pulpal anesthesia (negative response to EPT).

Conclusions: For both solutions, increasing the volume of anesthetic increased the rate of pulpal anesthesia, but without statistical difference between the 2 volumes. This result could be due to small sample size. The authors claim that mepivacaine to have a better performance; however, the presented data does not support this claim. The addition of the second carpule is warranted for irreversible pulpitis as long as there is evidence that pulpal anesthesia has not been achieved.

LOE: 5
Title: Survival rate of teeth with a c-shaped canal after intentional replantation: A study of 41 cases for up to 11 Years

Author: Jang Y et al

Journal: J Endod. 42 (9):1320-1325

Reviewer: Laura Hayoung Kim DDS

Purpose: This study assesses the outcome of intentionally replanted teeth with C shaped canal though a retrospective study.

Materials and Methods: Thirty five mandibular second molars, 4 maxillary second molars, 1 maxillary lateral incisor, and 1 mandibular first molar that were intentionally replanted with C shaped canal were reviewed. The preoperative preparation included: periodontal probing, mobility, percussion, bite test, and PA and CT radiographs. Indications for intentional replantation were teeth treated with nonsurgical RCT with symptoms of non-healing (pain or sinus tract) and teeth that could not be treated with apicoectomy due to anatomic limitations. The surgical procedure involved: prescription of oral amoxicillin 500mg and ibuprofen 400mg 1 hour preoperatively, inserting a #15 blade into PDL space and knocking with a mallet, then luxating buccolingually the tooth with forceps. No elevator was used. The apical root was resected 2-3mm, inspected with the microscope, and a retrocavity preparation was done to 3mm depth. The cavity was filled with: ProRoot MTA, Endocem, or Super EBA. Then the tooth was replanted into the socket using finger pressure. The patient was put on soft food diet with 0.1% chlorhexidine gluconate mouth rinse for 2 weeks. The assessment included: a follow up done at 1, 3, 6, 12 months post operatively and periodontal probing, mobility, percussion, bite tests, and PA were examined. The treatment outcome classification were: “Tooth survival”: Normal masticatory function, decreasing or same periapical lesion, <2mm tooth mobility or “Treatment failure”: Increase in periapical lesion, hindered masticatory function, >2mm tooth mobility due to alveolar bone loss or inflammatory root resorption.

Results: Survival rate of intentional replantation of teeth with C shaped canal was 83.4% at 4 years and 73% at 11 years. Extraoral time over 15 minutes and use of ProRoot MTA as retrofilling material were associated with lower survival rate. Longer extraoral time may reduce PDL cell viability. ProRoot MTA has >4 hour setting time, whereas Super EBA and Endocem require <15 minutes to set. This puts teeth retrofilled with ProRoot MTA at more risk for early blood contamination and washout in intentional replantation.

LOE: 4
Title: Complement c3a mobilizes dental pulp stem cells and specifically guides fibroblast recruitment

Author: Rufus P, et al.

Journal: Journal of Endodontics, Volume 42(9): 1377-1384

Reviewer: Salome Masrani DDS

Purpose: This study investigated the possible role of Complement component, C3a, in dentin-pulp regeneration. In response to destruction of odontoblasts and injury to fibroblasts after a trauma or carious lesion, Dental Pulp Stem Cells (DPSCs) must proliferate and migrate to the site of injury to lead to the production of reparative dentin, or dentin-pulp regeneration. In innate immunity pathways, Complement is a key system. A component, C5a, has been shown to induce migration of DPSCs. C3a is a factor produced earlier in the cascade, and is a chemo-attractant.

Materials & Methods:

- Immunohistochemistry: Pulps were extracted from human third molars and fixed. Sections were incubated with primary antibodies to Fibroblast Surface Protein (FSP) and the receptor for C3a (C3aR). These sections were incubated with a fluorescently labeled secondary antibody
- Cell Culture: Pulp cells were cultured in minimal essential medium (MEM) and Identified DPSCs through expression of STRO-1 with magnetic cell sorting
- Immunofluorescence Double Staining: Cells incubated with primary antibodies to STRO-1, FSP, C3aR, followed by fluorescently labeled secondary antibody, before being counterstained with DAPI
- Microfluidic Chemotaxis Assays: Migration of the pulp fibroblasts and DPSCs were studied in response to a gradient of C3a
- Proliferation Tests: DPSCs in culture and fibroblasts were incubated with concentrations of C3a in medium for 3 days and Proliferation measured with MTT assay
- Reverse Transcriptase PCR: RNAs were isolated from DPSCs and pulp fibroblasts

Statistical Analysis performed with significance at P<0.05

Results: FSP expressed on pulp fibroblasts, STRO-1 expressed in perivascular areas of pulp tissue, and C3aR was found widely expressed in dental pulp cells. STRO-1 sorted cells (DPSCs) expressed KLF4, NANOG, OCT3/4, and SOX2; whereas STRO-1 negative cells were fibroblast like and expressed FSP. Both DPSCs and fibroblasts expressed C3a receptors. C3a induced proliferation of fibroblasts, and DPSCs at higher concentrations. C3a affected migration of fibroblasts and in the presence of an antagonist to the C3aR, migration was inhibited. Presence of C3a mobilized DPSCs, but did lead to migration.

Discussion: This study demonstrates the role of C3a in proliferation of DPSCs and fibroblasts, and in recruitment of fibroblasts. C3a can be a possible factor associated with pulp-dentin regeneration.

LOE: 5
Title: Residual microstrain in root dentin after canal instrumentation measured with digital moiré interferometry

Author: Lim H et al.

Journal: JOE, Vol. 42(9)1397-1402

Reviewer: Reza Akhavan DMD

Purpose: This study determined the residual in-plane microstrain distribution in root dentin subsequent to NiTi instrumentation of canals using digital moiré interferometry (DMI) and to explore its correlation with the formation of dentinal microdefects in teeth maintained in hydrated and nonhydrated environments.

Materials and Methods: The canals of 18 extracted premolars (single-root) canals were instrumented with ProTaper Universal (S1, S2, F1, and F2), WaveOne, control group (hand files). Half of the specimens (3/group) were maintained in deionized water (hydrated) and half were in ambient relative humidity conditions (22°C, 55% RH) for 72 hours (non-hydrated). Digital moiré interferometry was used to qualitatively evaluate pre- and post-instrumentation dentinal microstrain. Specimens were examined for dentinal microdefects with micro–computed tomographic imaging and polarized light microscopy.

Results: Digital moiré interferometry showed only minor changes in post-instrumentation microstrain in hydrated dentin in all groups, suggestive of a stress relaxation behavior. Non-hydrated dentin in all groups showed localized concentration of post-instrumentation microstrain, which appeared higher in the WaveOne group than in the other groups. No dentinal microdefects were detected by micro–computed tomographic imaging and polarized light microscopy in hydrated and non-hydrated specimens in all groups.

Conclusions: This study suggested that the biomechanical response of root dentin to instrumentation was influenced by hydration. Reciprocating, rotary, and hand instrumentation of well-hydrated roots did not cause an increase in residual microstrain or the formation of microdefects in root dentin.

LOE: 5
Title: Calcium hydroxide–induced proliferation, migration, osteogenic differentiation, and mineralization via the mitogen-activated protein kinase pathway in human dental pulp stem cells

Authors: Chen L et al.


Reviewer: Xiomara Rivera, DMD

Purpose: The mitogen-activated protein (MAP) kinase pathway controls a broad array of physiological processes, such as proliferation, migration, gene expression, mitosis, and apoptosis. It is composed of 4 signaling families: extracellular signal-regulated kinase (ERK), c-Jun N-terminal kinase (JNK), and p38. This study investigated the role of MAP kinases in calcium hydroxide–induced proliferation, migration, osteogenic differentiation, and mineralization in Dental Pulp Stem Cells (DPSCs).

Materials and Methods:

- Cell Isolation and Culture: Human dental pulps were obtained from third molars from patients 14–22 years old, pulp tissue was digested and cell suspensions were seeded, cells between passages 3 and 5 were used in the following experiments
- Western Blot Analysis: DPSCs cells were treated with Ca(OH)2, harvest, and lysed by radioimmunoprecipitation assay (RIPA), 40 to 60 mg proteins were separated by electrophoresis gel (SDS-PAGE), primary antibodies to phosphorylated JNK, phosphorylated p38, phosphorylated ERK, were used, horseradish peroxidase (HRP)-conjugated secondary antibodies were used to detect the bands of target proteins.
- Methylthiazol Tetrazolium Assay: Cell viability was analyzed via the methylthiazol tetrazolium (MTT) assay, DPSCs were pretreated with Ca(OH)2 and JNK, ERK, or p38 inhibitors
- Wound Healing Assay: DPSCs were cultured into a monolayer and a cross area was scratched with a pipette tip, DPSCs were pretreated with an MAP kinase inhibitor and changed to culture medium with or without calcium hydroxide, Migration of DPSCs was then calculated
- Alizarin Red Staining Assay: DPSCs were pretreated with an MAP kinase inhibitor and changed mineralization induction medium with Ca(OH)2. Alizarin red–stain was then added to the samples

Results: The Ca(OH)2 induced MAP kinases phosphorylation within 5 to 10 mins. The numbers of DPSCs decreased significantly by inhibitors of JNK and p38. The inhibition of p38 and ERK, not JNK, suppressed calcium hydroxide–induced migrations. JNK and p38 inhibitors decreased calcium hydroxide–induced ALP expression significantly (osteogenic differentiation). JNK, p38, and ERK inhibitors, inhibited the formation of mineral nodes remarkably.

Discussion: MAP kinases exposed to Ca(OH)2, induced proliferation, migration, osteogenic differentiation, and mineralization in human DPSCs.

LOE: 4
Title: Regenerative endodontic therapy in a single visit using platelet-rich plasma and biodentine in necrotic and asymptomatic immature molar teeth: A report of 3 cases

Author: Topcuoglu G et al

Journal: Journal of endodontics Vol. 42(9) 1344-1346

Reviewer: Michelle Jordán DMD

Purpose: Biodentine (Septodont) is a calcium silicate-based material with various clinical applications such as root perforation, apexification, resorptions, root-end filling, pulp capping procedures. The setting period is as short as 9 to 12 minutes. This shorter setting time is an improvement over other calcium silicate materials including MTA. This study described three successful single visit regenerative endodontic therapy cases using Biodentine and PRP as a scaffold material in 3 mandibular permanent molar teeth, all asymptomatic with necrotic pulp

Materials and Methods:

- 3 patients (2 girls 8 y/o and 1 boy aged 9 y/o) were referred for endodontic treatment in a immature permanent mandibular first molar. The teeth were not sensitive to percussion or palpation and did not response to cold test
- teeth were isolated with rubber dam, access was done and working length determined
- none of the canals were instrumented, they were irrigated with 2.5% NaOCl, saline, and 17% EDTA and dried with paper points
- followed by the apical tissue was irritated using a #20 K file, in all cases inadequate bleeding was observed. Hence it was determined that regenerative endodontic therapy should be performed using PRP as scaffold
- 10ml of blood was drawn of patient's right arm, blood samples were centrifuged
- PRP was then injected into the canal up to the CEJ. Followed by 3mm of Biodentine was placed over PRP clot and teeth were restored with composite

Follow up examination: Patients were examined every 3 months during an 18-month period. The teeth were not sensitive to percussion or palpation and didn't respond to cold test. Probing and mobility was normal and no PA lesion were observed. Thickening of canal walls and apical closure of all teeth was seen.

Conclusion: A single visit regenerative endodontic procedure may be a positive treatment option for an asymptomatic immature tooth with a necrotic pulp and no PA lesion. Further clinical studies are needed.

LOE: 5
Title: Antibacterial nanoparticles in endodontics: A review

Author: Shrestha A et al.

Journal: JOE Volume 42(10) 1417

Reviewer: Adnan Kazim DMD

Purpose: This article presents a comprehensive review on the scientific knowledge that is available on the application of antibacterial nanoparticles in endodontics

Methods: Nanoparticles with their enhanced and unique physicochemical properties, such as ultra-small sizes, large surface area/mass ratio, and increased chemical reactivity, have led research toward new prospects of treating and preventing dental infections.

Results: The current level of evidence showed that despite the advancements in treatment strategies the rate of treatment failure has not decreased below 18%-26% for the past 4 to 5 decades.

• Chitosan Nanoparticles: has a structure similar to extracellular matrix components and is therefore used to reinforce the collagen constructs; the minimum inhibitory concentrations ranged from 18-5000ppm depending on the organism, pH, degree of deacetylation, molecular weight, chemical modifications, and presence of lipids and proteins; proposed mechanism of action: contact-mediated killing that involves the electrostatic attraction of positively charged chitosan with negatively charged bacterial cell membranes

• Bioactive Glass (BAG): osteoinductive and antibacterial properties; mechanism of action 1) high pH 2) osmotic effects 3) Ca^{++}/P^{++} precipitation; in vitro root canal disinfection studies showed significantly less antibacterial effect compared with Ca(OH)_{2} in preventing residual bacterial growth

• Silver Nanoparticles: silver nanoparticles have been widely used in biomedicine, mainly because of their antibacterial property; mechanism of action: known to produce an antibacterial effect by acting on multiple targets starting from interaction with the sulfhydryl groups of proteins and DNA, alter the hydrogen bonding/respiratory chain, unwind DNA, and interfere with the cell-wall synthesis/cell division; silver nanoparticle when combined with Ca(OH)_{2} significantly reduced E. Faecalis from root canal dentin; clinical use is best suited as a medicament.

• Nanoparticles Incorporated Sealers and Restorative Materials: commonly used sealers are known to possess antibacterial activity for a maximum period of week, with most of them showing a significant decrease in antibacterial properties immediately after its setting; adding CS-NP incorporation significantly increased the antibacterial efficacy of these different root sealers even after a 4-week aging time with lesser biofilm formation at the sealer-dentin interface; quaternary ammonium polyethyleneimine nanoparticles (QPEI-NPs) incorporated into root canal sealers may improve sealer’s wettability

• Functionalized Antimicrobial Nanoparticles: functionalized nanoparticles containing various reactive molecule and decorated with peptides or other ligands have led to new possibilities of combating antimicrobial resistance

Conclusion: Nanoparticle-based treatment strategies have the potential to improve antibacterial/antibiofilm efficacy in endodontics.

LOE: 3-4
**Title:** Cost-effectiveness of single- versus multistep root canal treatment

**Author:** Schwendicke F et al

**Journal:** Journal of Endodontics Vol. 42(10): 1446-1452

**Reviewer:** Michelle Jordán DMD

**Purpose:** This study evaluated the long-term cost effectiveness of single versus multiple visit RCT using a model based approach.

**Materials and Methods:** A mixed, public private-payer perspective in German health care was adopted. Forty-year-old male individuals with one permanent molar with a nonvital asymptomatic pulp and without PA lesion were selected.

- Single visit involved access, instrumentation and obturation
- Multiple visit was assumed to perform access and large parts of the instrumentation in the first visit and finalization of root canal treatment in a second visit
- Simulations were performed in 6 month cycles using the model based approach
- Monte Carlo microsimulations were performed for analysis and incremental cost-effectiveness ratios (ICERs) were used to express cost differences per gained or lost effectiveness when comparing treatments

**Results:** Study parameters: relative to multiple visit treatment, single visit treatment was minimally more effective for non-vital and vital molars with or without PA lesions. Base case scenario: the best case was a nonvital molar without a PA lesion. A single visit treatment was minimally less costly (1703 vs 1729 Euro) and more effective (19.9 vs 19.8 years) than multiple visit treatment and regardless of a payer’s willingness to pay threshold, single visit treatment had a high chance of being the most cost effective treatment.

**Conclusion:** Single visit treatment is very likely to generate reduced initial treatment costs compared with multiple visit treatment. Doubts still remains as to the different effectiveness of both treatments. Within the limitations of the study, the overall cost and effectiveness is likely to differ between subgroups of teeth. Practical aspects in scheduling treatments as well as patients and dentists’ preferences should be considered for decision making.

**LOE:** 5
Title: Factors associated with apical periodontitis: A multi-level analysis

Authors: Hussein F et al

Journal: J Endod 42(10): 1441-1445

Reviewer: Rachel Mitrani DDS

Purpose: Apical periodontitis (AP) is an inflammatory disease of endodontic origin that often develops and persists without clinical symptoms. Risk factors of AP can be divided into tooth and patient level variables. Tooth-level variables include presence of PARL, root-filled teeth, inadequate or overfilled canals, presence of a post, or defective coronal restoration. Patient-level variables include age and gender. Application of multivariate modeling to endodontics can account for simultaneous presence of both tooth and patient-level variables, and clarify the epidemiology of AP. This study explored the use of multilevel modeling in investigating the effect of tooth-level and patient-level factors on apical periodontitis.

Materials & Methods: The panoramic radiographs of 233 patients (147 women and 86 men) were assessed. The age range was 16-70 years. A total of 6409 teeth were assessed, and 43 of these teeth were root-treated. Radiographic Evaluation: the radiographic periapical health status and technical quality of root fillings were assessed using the PAI.

Data Analysis: Multi-level modeling was carried out to investigate the association between AP and risk indicators at both the tooth and patient levels.

\[
\log \left( \frac{p_y}{1 - p_y} \right) = \gamma_0 + \gamma_{01}W_{ij} + \gamma_{02}W_{ij} + \gamma_{10}X_{ij} + \gamma_{20}X_{ij} + \gamma_{30}X_{ij} + \gamma_{31}X_{ij} + \gamma_{32}X_{ij} + \mu_{ij}
\]

Results: Apical periodontitis was found in 1.5% of teeth without root filling, and 37.2% of root-filled teeth. The predicted probability of a tooth having AP was 0.42%. 53.16% of the variability was accounted for by the patients, and 46.84% of the variability was attributed to the teeth or other factors. Regarding tooth-level variables, posterior tooth location and inadequacy of canal fill increased the odds of AP. There was an association between age and AP, but not gender and AP.

Discussion and Conclusions: It can be concluded that the predicted probability of having AP was shown to be due to greater variability between individuals than between teeth. Multi-level statistical modeling is an effective method of assessing etiology of AP by accounting for the simultaneous presence of several risk factors. Due to the cross-sectional study design, association between the variables of interest and resulting AP does not imply causality.

LOE: 4
Title: How effective is supplemental intraseptal anesthesia in patients with symptomatic irreversible pulpitis?

Author: Webster S et al.

Journal: Journal of Endodontics, Volume 42(10)1453- 1457

Reviewer: Xiomara Rivera DMD

Purpose: Intraseptal anesthesia is the deposition of anesthetic solution directly into the interdental septum allowing solution to flow through the porous crestal alveolar bone and into the cancellous bone surrounding the tooth. This study determined the anesthetic efficacy of the supplemental intraseptal technique in mandibular posterior teeth diagnosed with symptomatic irreversible pulpitis when the conventional IAN block failed.

Materials and Methods:

- 100 mandibular posterior tooth (molar & premolar) with irreversible pulpitis and moderate to severe pain were included
- Patients were given topical anesthetic (20% benzocaine) and a conventional IAN block using 1 cartridge of 2% lidocaine with 1:100,000 epinephrine
- After lip numbness, buccal nerve was blocked with 0.9 mL 2% lidocaine with 1:100,000 epinephrine.
- All patients experiencing moderate to severe pain upon access or instrumentation received a intraseptal injection using 1.4 mL 4% articaine with 1:100,000 epinephrine.
- The anesthetic was delivered using a computer-controlled local anesthetic delivery (C-CLAD) system
- In patients who experienced pain after intraseptal injections, buccal infiltration of 1.8 mL 4% articaine with 1:100,000 epinephrine followed by an intraosseous injection using 1.8 mL 2% lidocaine with 1:100,000 epinephrine.
- The success of the supplemental intraseptal injection was defined as the ability to access and instrument the tooth with no or mild pain

Results: The IAN block was 25% successful, and the intraseptal technique was 29% successful. Failures occurred in dentin with the IAN block 65% of the time and 40% of the time with the intraseptal technique.

Conclusion: The supplemental intraseptal injection achieved profound pulpal anesthesia in 29% of patients when the IAN block failed. This low level of success would not provide predictable levels of anesthesia for patients requiring emergency endodontic treatment for symptomatic irreversible pulpitis in mandibular posterior teeth.

LOE: 4
Title: Association between systemic diseases and apical periodontitis

Author: Khalighinejad N et al

Journal: Journal of Endodontics, Volume 42(10): 1427-1434

Reviewer: Laura Hayoung Kim DDS

Purpose: This study evaluated the relationship between lesion of endodontic origin and systemic diseases

Materials and Methods:

- Review questions were asked using the patient population, intervention, comparison, and outcome (PICO) framework—“When compared with medically healthy individuals, can systemic diseases modify and/or influence apical pathosis?”
- Peer reviewed journals published in English from 1997-2016 reviewed.
- Search of MEDLINE, Embase, Cochrane, and PubMed were done
- Present review assessed 8 articles looking at association between endodontic pathology and cardiovascular disease, 5 articles looking at diabetes mellitus (DM), one study assessing liver disease, one study evaluating blood disorder, and one study looking at bone mineral density.
- Most studies looked at panoramic radiograph to determine apical periodontitis.

Results: Association between endodontic pathosis and:

- Cardiovascular Disease (CVD): Seven of 8 articles confirmed association between endodontic pathosis and CVD. However, these studies do not indicate a cause-and-effect relationship. One of 8 articles (Segura-Egea et al) rejected the association. This study displayed high level of bias, with a wide range of hypertensive states in the patient sample, and the smoking and Diabetes Mellitus status was not matched. The investigators were not blinded.
- Diabetes Mellitus (DM): There is inconclusive evidence of association between diabetes and higher prevalence of root canal treatment. There were no studies with low level of bias that looked at this association and the studies that confirmed or rejected their association had high levels of bias.
- Chronic Liver Disease: This association was inconclusive—Case and control groups were not matched for confounding variables of DM, CVD, alcohol consumption, and periodontal status.
- Hematology Disorder: Relationship with endodontic pathology is inconclusive. Castellanos-Cosano reported that hemophiliacs had higher chance of endodontic pathosis than the control group—However, there is a high level of bias.
- Bone Mineral Density: Association between endodontic pathology and low bone mineral density was reported. However, there was a high risk of bias—confounding factors were not matched and the authors were not blinded.

There needs to be more longitudinal cohort studies with low levels of bias to assess the association between endodontic pathosis and systemic diseases to determine correlation and causation. The use of periapical radiograph and CBCT are recommended. There might be an association between systemic diseases and endodontic pathosis based on this review.

LOE: 2
Title: Triple antibiotic polymer nanofibers for intracanal drug delivery: effects on dual species biofilm and cell function

Author: Pankajakshan D et al.

Journal: JOE Volume 42(10): 1490-1495

Reviewer: Adnan Kazim DMD

Purpose: This study was designed to investigate the antimicrobial efficacy of triple antibiotic-containing nanofibers against a dual species biofilm and evaluate the ability of dental pulp stem cells (DPSCs) to adhere to and proliferate on dentin upon nanofiber exposure.

Methods:

- Dual-species biofilm (7 day old) on dentin specimens was exposed for 3 days to the following: saline (control), antibiotic-free nanofibers (control), and triple antibiotic-containing nanofibers or a saturated triple antibiotic paste (TAP) solution (50 mg/mL in phosphate buffer solution).
- Experimental and control group were tested for bacterial viability by using the LIVE/DEAD assay (Molecular Probes, Inc, Eugene, OR) and confocal laser scanning microscopy.
- For cytocompatibility studies, dentin specimens after nanofiber or TAP (1 g/mL in phosphate buffer solution) exposure were evaluated for cell adhesion and spreading by actin-phalloidin staining.
- DPSC proliferation was assessed on days 1, 3, and 7.
- Statistical testing was performed at the P<.05 level.

Results:

<table>
<thead>
<tr>
<th>Group</th>
<th>Bacteria (%) ± Standard deviation (minimum–maximum)</th>
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<tbody>
<tr>
<td>Biofilm (no treatment, control)</td>
<td>94.76 ± 6.92 (73.92–99.92)</td>
</tr>
<tr>
<td>Antibiotic-free nanofibers</td>
<td>97.73 ± 2.94 (87.30–100.00)</td>
</tr>
<tr>
<td>Triple antibiotic-containing nanofibers</td>
<td>4.68 ± 8.38 (0.01–20.76)</td>
</tr>
<tr>
<td>TAP solution (50 mg/mL)</td>
<td>6.67 ± 7.93 (0.00–34.21)</td>
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Confocal laser scanning microscopy showed significant bacterial death upon antibiotic-containing nanofiber exposure, differing significantly (P < .05) from antibiotic-free fibers and the control (saline). DPSCs showed enhanced adhesion/spreading on dentin specimens treated with antibiotic-containing nanofibers when compared with its TAP counterparts. The DPSC proliferation rate was similar on days 1 and 3 in antibiotic-free nanofibers, triple antibiotic–containing nanofibers, and TAP-treated dentin. Proliferation was higher (9-fold) on dentin treated with antibiotic-containing nanofibers on day 7 compared with TAP.

Conclusion: Triple antibiotic–containing polymer nanofibers led to significant bacterial death, whereas they did not affect DPSC attachment and proliferation on dentin.

LOE: 3
Title: Effect of sodium bicarbonate buccal infiltration on the success of inferior alveolar nerve block in mandibular first molars with symptomatic irreversible pulpitis: A prospective, randomized double-blind study

Authors: Saatchi M et al.


Reviewer: Salome Masrani DDS

Purpose: In cases of symptomatic irreversible pulpitis, the inflammation within the pulp results in reduced efficacy of local anesthetics due to the activation of nociceptors. Hydrogen ions are released by damaged cells, which lowers pH. Acid-sensing ion channels along with other channels including, tetrodotoxin-resistant sodium channels, are activated by the reduced pH. This study investigated the effect of raising pH of local anesthetic solution through the addition of sodium bicarbonate as a buccal infiltration when anesthetizing mandibular first molars with Symptomatic Irreversible Pulpitis.

Materials and Methods:

- Randomized, double-blind study including 100 healthy adult patients (27 men and 73 women), 18-53 years of age. Inclusion criteria: Vital mandibular first molar with clinical diagnosis of Symptomatic Irreversible Pulpitis.
- Patients scored pain according to Heft-Parker visual analog scale (HP-VAS) as no pain, mild pain, moderate pain, and severe pain.
- Solutions were created: Sodium Bicarbonate solution (0.7ml 8.4% sodium bicarbonate + 0.3ml 2% Lidocaine 1:80,000 epi) and Non-Sodium Bicarbonate solution (0.7ml distilled water + 0.3ml 2% Lidocaine 1:80,000 epi).
- Topical gel of benzocaine applied prior to buccal infiltrations for 60 secs, and solutions deposited over one minute.
- After 15 minutes, 2 carpules of 2% Lidocaine 1:80,000 epi were administered for IAN block, which was considered successful upon lip numbness.
- After 15 minutes, rubber dam placed and access initiated.
- Patient instructed to rate pain during access preparation and initial file placement according to HP-VAS.
- Statistical analysis performed.

Results: No significance of age, sex, or initial pain between groups. Success of IAN block with Sodium Bicarbonate was 78%, while non-Sodium Bicarbonate group was 44% (p<.001).

Discussion: Sodium bicarbonate buccal infiltration improves the efficacy of the IAN block when administered 15 minutes prior to treatment. This suggests that the major cause for decreased effectiveness of local anesthetic, in patients with Symptomatic Irreversible Pulpitis, is the activation of channels expressed by nociceptors through decreased pH of the tissue.

LOE: 3
Title: Properties of tricalcium silicate sealers

Author: Khalil I et al


Reviewer: Michelle Jordán DMD

Purpose: Materials based on tricalcium silicate used in combination with a radiopacifying material are used as sealers. These sealers were developed because they induce bioactivity on the material surface when in contact with tissue fluids as a result of the interaction of calcium hydroxide produced as a reaction product of tricalcium silicate hydration with phosphates present in tissues fluids. This study characterized and investigated the properties of a new tricalcium silicate-based sealer and verify its compliance to ISO 6876(2012)

Materials and Methods: Three sealers were investigated: BioRoot RCS (Septodont, St Maure de Fosses, France) is based on tricalcium silicate-based sealer that does not contain any additives to the powder except for the zirconium oxide radiopacifier, AH Plus (Dentsply, DeTrey, Konstanz, Germany) which is an epoxy- based sealer that has been considered the gold standard and has been used as a control material in most studies, and Bio MM (St Joseph University, Beirut, Lebanon) composed of tricalcium silicate but include calcium carbonate in the formulation. Addition of calcium carbonate is added as a filler and acts a nucleating agent to provide more reaction sites for cement hydration. The sealers were characterized by scanning electron microscopy, energy dispersive spectroscopy (EDS) and X-ray diffraction analysis (XRD). Assessment of setting time and assessment of sealer flow was done.

Results: The microstructure of Bio MM sealer at 1 and 28 days did not change. It was composed of a range of particles with different sizes. The particles rich in calcium and silicon were small. BioRoot RCS was composed of calcium and silicon together with white particles rich in zirconium. AH Plus was composed of white particles composed of tungsten and calcium, which varied in size and particles composed of zirconium. Both BioMM and BioRoot RCS contained a tricalcium silicate phase. Bio MM did not exhibit a presence of Ca(OH)2. Both BioRoot RCS and Bio MM exhibited the presence of a radiopacifier phase, namely, zirconium oxide and tantalum oxide respectively. Both had a comparable setting time that was much shorter than that of AH Plus. Bio MM had an additional phase, namely calcium carbonate. The crystalline phases in AH Plus were calcium tungstate and zirconium oxide. AH plus complied with the ISO norms for both flow and film thickness. Both BioRoot RCS and Bio MM exhibited a lower flow and a higher film thickness than that specified for sealer cements in ISO 6876(2012). All the sealers exhibited adequate radiopacity, with AH Plus being the most radiopaque and Bio MM was the least radiopaque

Conclusion: The new Bio MM interacted with physiologic solution, thus showing a potential for bioactivity. The sealer properties were acceptable, and this sealer could be developed further for prospective clinical use

LOE: 5
Title: Biocompatibility evaluation of EndoSequence root repair paste in the connective tissue of rats

Authors: Taha N et al

Journal: J Endod 42(10):1523-1528

Reviewer: Rachel Mitrani DDS

Purpose: Biocompatibility is an important factor for endodontic root repair materials and contributes to the long-term clinical performance. MTA has been the most commonly used material in apical surgery, perforation repair, and apexification. EndoSequence root repair paste (ERRM) has been shown to be a favorable material for these procedures. The purpose of this study was to evaluate the subcutaneous connective tissue response to EndoSequence root repair paste compared with MTA.

Materials & Methods: Thirty-six rats were used in this study. They were divided into 3 groups; each group was allocated for a post-operative interval of 1, 3, or 6 weeks. Sterile polyethylene tubes, which contained either ERRM paste, MTA, or nothing (control) were implanted subcutaneously. At the end of each experimental period, the rats (12 per group) were killed. The implant tubes and surrounding tissue were removed and processed for histologic analysis.

Results: Control: At 1 week, mild chronic inflammation was observed in the subcutaneous tissue. At 3 and 6 weeks, sparse chronic inflammation was observed. The highest concentration of inflammatory cells occurred next to the tissue-tube interface. At 3 and 6 weeks, sparse chronic inflammation was observed. Normal vasculature was seen in the 3 and 6 week specimens. EndoSequence RRM: High initial scores at 1 week dramatically declined at 3 and 6 weeks for intensity of inflammatory response, extension of the inflammatory reaction, foreign body reaction, vascular congestion and coagulative necrosis.

Conclusion: ERRM was significantly more irritating than MTA and control at 1 and 3 weeks, in terms of severity and extension of inflammation, foreign body giant cells presence and vascular congestion. After 6 weeks, there was improvement in the tissue response to ERRM, but it is important to mention that the extension of inflammation and vascular congestion was still significantly higher than MTA and control.

LOE: 2
Title: Uncontrolled removal of dentin during in vitro ultrasonic irrigant activation in curved root canals

Authors: Retsas A et al.

Journal: Journal of Endodontics, Volume 42(10)1145-1549

Reviewer: Xiomara Y. Rivera DMD

Purpose: This study examined the effect of file type and activation time on the uncontrolled removal of dentin during in vitro ultrasonic irrigant activation in prepared curved root canals.

Materials and Methods:

- 36 human mandibular molars with curved root canals were included
- Inclusion Criteria: presence of 2 mesial canals with separate apical foramina; no root caries, fractures, or cracks; no signs of resorption or calcification; and completely formed apices. The mesial root canal curvature was between 20 – 40.
- Specimen were hemisected and mounted in pairs on stage of the micro-CT scanner using self-curing acrylic resin. Scanning was done before any intervention.
- Working lengths were standardized to 21mm and specimen were instrumented using NiTi rotary files to apical size 35/.04 taper
- Irrigation was done with 2 mL of 2% NaOCl between rotary files. 2 mL of 2% NaOCl and 2 mL of 17% EDTA were used at the end of the instrumentation.
- Specimens were divided into 4 Groups:
  - Group A: 2mL of 2% NaOCl was delivered 3 times and ultrasonic activation was performed after each delivery for 10 seconds, using a size 15/.02 taper pre-bent ultrasonic K-file
  - Group B: activation was done using a size 20/.00 taper pre-bent Irrisafe file
  - Group C: activation was done using a size 15/.02 taper not pre-bent, NiTi wire
  - Group D: Control- same irrigation protocol was followed but no activation was done
- Specimens were examined in micro-CT
- All root canals were then refilled with 0.2 mL 2% NaOCl, and groups A through C received additional continuous activation for 30 seconds.
- Specimens were examined again in Micro-CT.

Results: The volume of dentine removed ranged from 0.00mm to 0.18mm. K-files removed more dentin than Irrisafe file and NiTi files in the coronal and middle thirds. All files removed comparable amounts in the apical third.

Conclusion: Both the type of file and activation time affected the uncontrolled removal of dentin during ultrasonic irrigant activation.

LOE: 4
Title: Association between odontogenic conditions and maxillary sinus disease: A study using cone-beam computed tomography

Author: Nasimento E et al

Journal: J Endod. 2016 Oct; 42(10) 1509-1515aA

Reviewer: Laura Hayoung Kim DDS

Purpose: This study assessed maxillary sinus alterations in association with odontogenic conditions using cone-beam computed tomographic images (CBCT).

Materials/Methods:

- 400 patients with sinus disease were evaluated with CBCT. Sinus alterations were categorized as: generalized or localized mucosal thickening (MT), Maxillary sinusitis (MS) and Retention cysts (RCs)
- Odontogenic conditions evaluated: Inadequate endodontic treatment—indicated by root filling shorter than 2mm from the apex or long fill or instrument fracture, deviations, nonhomogeneous filling. Periapical lesions – indicated by apical radiolucency or ligament space was 0.5mm or greater and Periodontal bone loss – P1 mild (bone loss <25%), P2 moderate (bone loss 25-50%), P3 severe (bone loss >50%).

Results:

- Maxillary sinuses had disease 85.9% of the time.
- Generalized mucosal thickening (MT) prevalence- 65.2%, occurring bilaterally and Generalized MT was more common in males and periodontal bone loss.
- Localized mucosal thickening prevalence- 24.8%, Localized MT was associated with periapical lesions and the chance of sinus disease when there is contact between the sinus and the tooth is 2.77 times greater.
- Maxillary sinusitis (MS) prevalence–6.4%
- Retention cysts (RCs) prevalence—3.6% and 3.47 times more likely to be seen in older patients (>57 years).
- Only generalized mucosal thickening and localized mucosal thickening showed correlation with odontogenic condition (periodontal bone loss and periapical lesions, respectively).

Conclusion: CBCT is an appropriate tool to determine sinus condition and odontogenic findings.

LOE: 3