

# OAE

## 2019 ABSTRACTS

**The Ohio Association of Endodontists**  
Spring Scientific Meeting  
Columbus, Ohio  
May 22, 2019

## 2019 Graduate Research Presentations

- 9:00**    **Welcome & Introductions**
- 9:15**    The effects of hydroxyapatite in a DAP-loaded methylcellulose carrier on dental pulp stem cells    **Dr. A. Everhart**  
Indiana University
- 9:30**    Ibuprofen and Acetaminophen versus Intranasal Ketorolac (Sprix®) in an Untreated Endodontic Pain Model    **Dr. E. MacDonald**  
The Ohio State University
- 9:45**    Nano-computed Tomography Visual Analysis of Two Root Canal Obturation Methods in TrueTooth 3D Printed Tooth Replicas    **Dr. R. Gibson**  
University of Detroit Mercy
- 10:00**    Regenerative Endodontics: A Systematic Analysis of the Failed Cases    **Dr. G. Yassen**  
Case Western Reserve
- 10:15**    A Survey of Current Endodontic Irrigation Techniques and Iatrogenic Mishaps Using Irrigation Adjuncts    **Dr. S. Siddiqui**  
University of Louisville
- 10:30**    **Break**
- 11:00**    The antibacterial effects of radiopaque double antibiotic paste against both an established multispecies and a single species *E. faecalis* biofilm    **Dr. B. Haslam**  
Indiana University
- 11:15**    Anesthetic Efficacy of Intranasal 3% Tetracaine plus 0.05% Oxymetazoline (Kovanaze®) in Maxillary Teeth    **Dr. J. Capetillo**  
The Ohio State University  
NorthEastern Ohio  
Endodontics
- 11:30**    The combined relationship between torsional and cyclic fatigue of heat treated endodontic files: A new 3D printed testing model    **Dr. R. Wilson**  
University of Detroit Mercy
- 11:45**    Incidence of maxillary premolars with three canals treated in an endodontic graduate program: A retrospective chart review    **Dr. D. McHenry**  
University of Louisville

- 12:00** The Effects of Non-surgical Endodontic Therapy on HbA1c and Periapical Index in Patients with Type 2 Diabetes **Dr. Q. Wang**  
Case Western Reserve
- 12:15** Use of electromagnetic stimulation on an Enterococcus faecalis biofilm on root canal treated teeth in vitro **Dr. J. Kindler**  
Indiana University
- 12:30** Business Meeting (OAE Members only)
- 12:45** **Lunch/Adjourn**



## The effects of hydroxyapatite in a DAP-loaded methylcellulose carrier on dental pulp stem cells

*Everhart A, Ehrlich Y, Spolnik KJ, Bringas JS, Gregory RL, Bruzzaniti A*

**Introduction:** Regenerative endodontic procedures (REP) require disinfection techniques to eliminate bacteria from the infected immature root canal system and promote new growth of the pulp-dentin complex. Double antibiotic paste (DAP), a mixture of ciprofloxacin and metronidazole, has shown efficacy in doing so while minimizing cytotoxicity on dental pulp stem cells (DPSC). Scaffolding helps in the maturation and proliferation of DPSCs to the root canal system. Nano-hydroxyapatite has shown biocompatibility in multiple studies. In addition, hydroxyapatite scaffolds have been shown to promote the proliferation and differentiation of mesenchymal stem cells.

**Objective:** The aim of this in vitro study was to investigate the proliferation and mineralization of DPSC in the presence of 1% DAP and methylcellulose with varying concentrations of nano-hydroxyapatite.

**Materials and Methods:** DPSC were plated in 24-well plates containing culture media. The next day, semi-permeable 0.1  $\mu\text{m}$  Transwell chambers were inserted into the wells to separate the reservoirs for medicaments. Treatment paste composed of methylcellulose (MC) containing 1% DAP with either 0.25%, 0.50%, or 1.0% nano-hydroxyapatite was added along with culture media. Methylcellulose alone and calcium hydroxide (Ultracal) were used as control groups. After 3 days, cells were evaluated for cytotoxic effects using an MTS proliferation assay ( $n = 10$ , in triplicate). DPSCs were also cultured with these medicaments for 7 days in osteogenic media and evaluated for alkaline phosphatase (ALP) activity and mineralization activity ( $n = 13$ , in triplicate). Comparisons between groups for differences in mineralization, BSA, and ALP activity were performed using analysis of variance (ANOVA), with different variances allowed for each group and a random effect included in the model to account for correlation within each of the three trials. A simulation-based model was used to adjust for multiple comparisons.

**Results:** All treatment groups increased mineralization significantly greater than calcium hydroxide, with MC alone and MC+DAP+0.5% HA providing the greatest effect. Regarding ALP, all HA concentrations performed significantly greater than MC and DAP concentrations. Proliferation proved less conclusive with few comparisons significant.

**Conclusion:** The challenge in REPs is to maintain and preferably promote the proliferation and development of DPSCs into the pulp-dentin complex with a consistent treatment outcome. The combination of DAP with hydroxyapatite may allow for both disinfection and improved mineralization and cellular differentiation



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## **Ibuprofen and Acetaminophen versus Intranasal Ketorolac (Sprix®) in an Untreated Endodontic Pain Model**

*Kathryn Watts DMD, MS, Stephen Balzer DDS, MS, Melissa Drum DDS, MS, John Nusstein DDS, MS, Al Reader, DDS, MS, Sara Fowler DMD, MS, Mike Beck DDS, MA*

**Introduction:** Previously, ketorolac was available for primary use only via intravenous and intramuscular routes. Its availability in intranasal form offers an alternative route of administration that patients can self-administer. The purpose of this study was to compare the efficacy of intranasal ketorolac (Sprix®) to a combination of ibuprofen/acetaminophen in an acute pain model of untreated endodontic patients experiencing moderate to severe pain and symptomatic apical periodontitis.

**Methods and Materials:** Seventy patients experiencing moderate to severe pain, a pulpal diagnosis of symptomatic irreversible pulpitis or symptomatic necrosis, and a periapical diagnosis of symptomatic apical periodontitis participated. Patients were randomly divided into two groups and received either 31.5 mg intranasal ketorolac and placebo capsules or 1000 mg acetaminophen/600 mg ibuprofen capsules and a mock nasal spray. Patients recorded perceived pain scores on a VAS every 15 minutes for 240 minutes. Time to 50% pain relief, time to first sign of pain relief, and to meaningful pain relief were recorded and the data analyzed.

**Results:** A decline in reported pain was observed until 120 minutes post-dosing, after which reported pain remained relatively constant. Fifty percent pain relief was achieved at 70 minutes and 87 minutes for the acetaminophen/ibuprofen/mock nasal spray group and placebo/intranasal ketorolac group, respectively, with no significant difference between the groups.

**Conclusions:** The effectiveness of intranasal ketorolac was not significantly different from that of a 1000 mg acetaminophen/600 mg ibuprofen combination. Intranasal ketorolac provides a non-narcotic alternative and an additional route of medication administration to practicing clinicians.



## Nano-computed Tomography Visual Analysis of Two Root Canal Obturation Methods in TrueTooth 3D Printed Tooth Replicas

*Dr. Ryan Gibson*

**Introduction:** This study provides a volumetric comparative analysis of two different obturation methods using 3-dimensional (3D) nano-CT imaging in standardized 3D printed tooth replicas.

**Methods:** Twenty effectively identical TrueTooth 3D printed maxillary left central incisor tooth replicas were selected for use in the study. The selected TrueTooth consists of a single main canal with a mid-root lateral canal and an apical accessory. All teeth were prepared with an ESX 40.04 rotary instrument to 2.0mm short of the anatomical apex. The prepared replicas were randomly assigned and obturated by a single operator using one of the following obturation methods and materials (n=10): single-cone with EndoSequence Points with BC Sealer (SC) and GuttaCore Crosslinked Gutta Percha Core Obturator with ThermaSeal Plus RIBBON sealer (GC). The obturated specimens were scanned using a Nanotom S nano-CT. Materialise Mimics program, which is an image processing software, was utilized to calculate the volumetric value of obturation and voids for each tooth. T-test statistical analysis was performed ( $P < .05$ ).

**Results:** 3-dimensional volumetric analysis of the obturated TrueTooth replicas revealed that the mean obturation volume for the SC was  $0.0054 \text{ mm}^3$  with a standard deviation of 0.000025. The mean obturation volume for GC was  $0.0045 \text{ mm}^3$  with a standard deviation of 0.00074. SC obturation had significant higher volume of obturation fill ( $P = 0.0005$ ). The mean volume of voids for the GC was 0.0000 and SC was 0.0002. Qualitative differences in volume of voids were observed between GC and SC but there was no statistical difference ( $P = 0.051$ ).

**Conclusions:** TrueTooth replicas prepared with ESX 40.04 rotary files to 2.0mm short of the anatomical apex and obturated with the SCTS resulted in a statistically greater volumetric fill of the 3-D printed canal when compared with the GC obturation method.



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## Regenerative Endodontics: A Systematic Analysis of the Failed Cases

*Ghaeth H. Yassen, BDS, MSD, PhD, Anita Aminoshariae, DDS, MS,  
Kristin A. Williams, DDS, MPH, Andre Mickel, DDS, MSD*

**Introduction:** The aim of this systematic review was to analyze failed cases of regenerative endodontic treatment (RET) reported in the literature in term of etiology, diagnosis, treatment protocols, signs of failure and additional endodontic interventions.

**Methods:** Electronic searches were performed in PubMed, Web of Science and ProQuest Dissertations & Theses databases. All in vivo publications in humans that reported at least one failed case of RET were included in this systematic review. Failed RET cases were defined in the current study as any case that required an additional endodontic intervention or extraction after the completion of the initially RET.

**Results:** A total of 28 studies that reported 67 failed cases of RET were included in this review. A total of 37 failed RET cases reported the etiology which resulted in the initiation of RET, 59% of these cases were caused by dental trauma and 30% were caused by dens evaginatus. A total of 26 (39%) failed RET cases were detected at least 2 years after initiation of RET. A total of 53 (79%) failed RET cases were presented with signs and/or symptoms of persistent infection.

**Conclusions:** Persistent infection was the main presentation in 79% of failed RET cases. Furthermore, 39% of failed RET cases were identified after more than 2 years of follow up. Future studies should include detailed description of the etiology, preoperative variables, intraoperative protocols and postoperative follow up to provide a better understanding of failed cases after RET.

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## **A Survey of Current Endodontic Irrigation Techniques and Iatrogenic Mishaps Using Irrigation Adjuncts**

*Shoaib Siddiqui BDS, MDS and Stephen J. Clark DMD*

*Division of Endodontics, Department of Diagnosis and Oral Health, University of Louisville School of Dentistry*

### **Introduction/Background:**

Previous studies and case reports have reported irrigation mishaps using delivery of irrigant with a conventional syringe and needle technique. With current advancements in endodontics and irrigant delivery and activation techniques, use of different irrigants and techniques has greatly increased.

The purpose of this study was to survey members of the American Association of Endodontists regarding their preference in irrigants and irrigation techniques and their experience(s) with a sodium hypochlorite accident using current irrigation adjuncts.

### **Methods:**

Current members of the American Association of Endodontists were sent a fourteen question survey using SurveyMonkey.com. Respondents identified types of irrigants and delivery techniques that they currently use and reported their experience with a sodium hypochlorite accident and irrigation adjuncts used during those mishaps.

### **Results:**

662 responses of 3,789 surveys sent (17.4%) were collected. Sodium hypochlorite was the most frequently used irrigant in initial treatment (98.3%) and non-surgical retreatment (97%). 53.6% of respondents used NaOCl at a greater than 5.25% concentration while 40.1% used a concentration between 2.5% - 5.25%. The frequency of use of different irrigant delivery methods were syringe and needle (93.3%), ultrasonic activation (50.1%), sonic activation (46.6%), manual activation (28.8%), negative pressure (11.8%), and Sonendo Gentlewave® (11.3%).

30.7% (n = 196) reported experiencing one hypochlorite accident (HA), while 11.2% (n = 71) reported more than one HA. 58.1% reported never experiencing a HA. 89.5% reported that the HA occurred using a syringe and needle. Significantly more hypochlorite accidents occurred in the maxilla (75.6%, n = 198). Overinstrumentation, irrigant device too close to the apex, and excessive pressure during irrigation were the most common reasons given by respondents reporting a HA.

### **Conclusions:**

Occurrence of a sodium hypochlorite accident was reported by 41.9% of respondents. A syringe and needle was the most common irrigation adjunct reported with HA but this study highlights that other modern adjuncts can also lead to a HA. Continued investigation into a safe mode of delivery of irrigants into the canal is needed.

## The antibacterial effects of radiopaque double antibiotic paste against both an established multispecies and a single species *E. faecalis* biofilm

Haslam B, Ehrlich Y, Spolnik KJ, Bringas JS, Gregory RL

**Introduction:** For regenerative endodontic procedures (REP) to be successful an elimination of bacteria from the root canal system is needed. Double antibiotic paste (DAP) containing both ciprofloxacin and metronidazole has currently been shown to be a promising intracanal medicament. The addition of a radiopaque filler zirconium oxide to DAP may affect the antibacterial properties of DAP as well as allow precise placement and radiographic visualization.

**Objective:** The aim of the study was to test the direct antibacterial properties of radiopaque DAP (RoDAP) against a multispecies biofilm from a bacterial isolate from an immature tooth with a necrotic pulp and a known single species biofilm

**Materials and Methods:** 4x4 mm radicular dentin specimens obtained from human extracted teeth. A multispecies clinical bacterial isolate from an immature tooth with a necrotic pulp and a single species *E. faecalis* isolate were used. These bacterial isolates were used to inoculate dentin slabs and grown for 3 weeks. The dentin was treated for 1 week with 1 and 10 mg/mL radiopaque DAP, 1 mg/mL DAP, or 2 placebo pastes consisting of methyl cellulose (MC) and methyl cellulose combined with zirconium oxide (RoMC), respectively, as well as 2 no-treatment controls. The biofilm was detached and spiral plated then cultured for 24-48 hours and examined using a colony counter to determine bacterial numbers (CFUs/mL).

**Results:** 1 and 10 mg/mL RoDAP and 1 mg/mL DAP demonstrated significant antibacterial effects against the tested bacterial isolates. RoMC had significantly lower immature biofilm colony count than MC and no treatment, but RoMC did not have significantly different *E. faecalis* biofilm colony count than MC and no treatment. 10 mg/ml RoDAP, 1 mg/ml RoDAP, 1 mg/ml DAP, and Sterile Control were not significantly different from each other for either biofilm. The *E. faecalis* biofilm colony count was significantly higher than immature biofilm count for RoMC, with no significant differences between biofilms for any other group

**Conclusion:** The use of DAP with zirconium oxide had a direct antibacterial effect on radicular dentin biofilm obtained from both bacterial isolates. The radiopaque DAP with its effects on antibacterial properties can optimize the intracanal disinfection of the root canal in REP.



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## **Anesthetic Efficacy of Intranasal 3% Tetracaine plus 0.05% Oxymetazoline (Kovanaze®) in Maxillary Teeth**

*J. Capetillo, M. Drum, J. Nusstein, A. Reader, S. Fowler F.M. Beck*

**Introduction:** Needle-free anesthetic delivery is a promising alternative to traditional anesthetic routes of administration. The purpose of this study was to determine the patient preference for and pulpal anesthetic efficacy of a 3% tetracaine plus 0.05% oxymetazoline (Kovanaze®) nasal spray in maxillary lateral incisors and first premolars.

**Methods:** Fifty adult subjects randomly received a 3% tetracaine plus 0.05% oxymetazoline (Kovanaze®) nasal spray and mock infiltration or a mock nasal spray and 2% lidocaine with 1:100,000 epinephrine infiltration at the maxillary lateral incisor or first premolar in two appointments spaced at least 1 week apart in a single-blind cross-over design. Pulpal anesthesia was evaluated with an electric pulp tester. Side effects and subject preferences were also recorded.

**Results:** Anesthetic success was significantly lower for the Kovanaze® nasal spray and mock infiltration (22-37%) than for the mock nasal spray and lidocaine infiltration (89-91%). Subjects reported more unwanted effects (nasal drainage and congestion, burning, pressure, and sinus congestion) after the Kovanaze® nasal spray and mock infiltration than the mock spray and maxillary infiltration. Prior to participating in the study, more subjects (56%) preferred the nasal spray route versus a standard infiltration (44%). After experiencing both routes of administration, 100% of subjects preferred the standard infiltration.

**Conclusions:** The 3% tetracaine plus 0.05% oxymetazoline (Kovanaze®) nasal spray provided significantly less successful pulpal anesthesia than the lidocaine infiltration, was less preferable, and caused more unwanted effects.



## **The combined relationship between torsional and cyclic fatigue of heat treated endodontic files: A new 3D printed testing model**

*Dr. Ryan Wilson*

**Introduction:** The purpose of this study is to create a new 3D model to test for cyclic fatigue and torsional resistance of conservative rotary endodontic files.

**Methods:** A 3D printed resin model was used to test and compare the effects of cyclic fatigue and the torsional strain in martensitic files: Three different filing systems were tested; V-Taper 2H(VT#17/.04 25mm), Edge File X7(EF #17/.04 25mm), Brasseler Scout file (BS#17/.04 25mm). A total of 120 files were tested with 40 files of each type. The 40 files were then divided into 2 groups with group 1 being tested for cyclic fatigue and group 2 being tested for torsional fatigue.

### **Cyclic Fatigue Resistance Experiment:**

Twenty files from each group were used. Cyclic fatigue was tested by placing the file in the 3D printed resin model to be used for cyclic fatigue. The canal had a width of 1.0 mm with a curvature of 60 degrees with a 5 mm curvature radius. The V-Taper 2H files were tested at 400 rpm and 460g-cm, Edge X7 files at 400 rpm and 300g-cm, and Scout files at 400 rpm and 200g-cm. The 3D resin block had a consistent water source of 37 degree recycled from a water bath to mimic the natural body temperature. The handpiece was secured and rotary file was inserted to a depth of 25mm and ran until fracture occurred. The number of cycles to failure (NCF) was timed in minutes and video recorded. The length of each fractured instrument was also recorded. Results were statically analyzed using T-test to evaluate for any differences in the groups at a significance level of  $p=0.05$ .

### **Torsional Resistance Experiment:**

Twenty files from each group were used. The 3D printed insert was created to fit into the previous cyclic fatigue jig to test a combined torsional and cyclic fatigue from being rotated in the canal. The 3D printed insert had a 0.75mm artificial canal space with a 60 degree curvature. All inserts had a #15 k-file placed to length for patency. The V-Taper 2H files were tested at 400 rpm and 460g-cm, Edge X7 files at 400 rpm and 300g-cm, and Scout files at 400 rpm and 200g-cm. The 3D resin block and insert had a consistent water source of 37 degree recycled from a water bath to mimic the natural body temperature. NiTi files were slowly directed apically into the insert which continuous rotation until full depth of 25mm was achieved. Time and force were calculated and video recorded. The length of file fracture occurrence was recorded for each file. The results were statistically analyzed using T-test ( $p=0.05$ ) and overlaid with the cyclic fatigue test using bell curves to evaluate if there is any difference between the 3 groups of rotary files.

**Results:**

In the cyclic fatigue test, VT had the most cycles before fracture at 315.9 +/- 99.2(sd) and EF at 288.3 +/-69.6. BS file had significantly lower cyclic fatigue at 235.9 +/- 46.9

In the torsional resistance test, VT was 313.2 +/- 87.0, EF at 275.3 +/- 72.5, and BS at 280.2 +/- 63.4. In both cyclic and torsional, VT had superior resistance to both cyclic and torsional combined, but all were statistically similar in both cyclic and torsional resistance. The fracture lengths were comparable in EF, BS, and VT in cyclic groups with 4.58 +/- .76, 5.22 +/- .81, and 5.63 +/- 1.34 mm, respectively.

The fracture segment in the torsional group was greater than the cyclic group in BS, VT, EF with 6.26 +/- .73, 6.65 +/- 1.16, 6.98 +/- .58mm, respectively.

The results show that cyclic fatigue will result in fracture below the level of the curvature. As the effect of the torsional strain was added, the fracture occurred higher up on the length of the file at the level of the curvature. When the paired t-tests were combined, both cyclic and torsional stresses occurred together during the rotary process.

**Conclusion**

All file systems showed statically similar results when cyclic and torsional stresses were applied. V-Taper showed the best results with both cyclic and torsional stress resistance. Fractures of the instrument in cyclic fatigue testing tended to occur below that level of the curvature, whereas torsional fatigue occurred at or just below the level of the curvature.



## **Incidence of maxillary premolars with three canals treated in an endodontic graduate program: A retrospective chart review**

*Daniel McHenry DDS and Stephen Clark DMD*

*Division of Endodontics – Department of Diagnosis and Oral Health University of Louisville School of Dentistry*

**Background:** Knowledge of the relative incidence of the number of canals in maxillary premolars (MP) assists clinicians in locating the canals and successfully treating apical periodontitis with root canal therapy (RCT). Bellizzi and Hartwell (J Endod 1985) analyzed the incidence of three canals in maxillary premolars treated with RCT. The authors found the incidence of three canals in maxillary first premolars to be 3.3% and in maxillary second premolars to be 1.1%. The purpose of this study was to determine the incidence of three canals in maxillary premolars clinically treated in a graduate endodontic clinic using current endodontic technology.

**Methods:** All cases of MP treated with nonsurgical root canal therapy by residents at the University of Louisville Graduate Endodontic Clinic from years 2006 through 2018 were reviewed in this study. The total number of endodontically treated maxillary first and second premolars and the number with three canals were determined by reviewing clinical records from a database of completed cases. The incidence of maxillary first and second premolars with three canals was calculated as a percentage. Subset analysis was conducted on each of the premolars with three canals, including: type of restoration, age group, sex of patient, preoperative pulpal and periodontal diagnosis, presence of a separated instrument, and whether the third canal was recognized before completion of treatment.

**Results:** A total of 1719 MP were treated by endodontic residents from 2006-2018 (759 first premolars and 960 second premolars). The incidence of three canals was 4.6% (n = 35) and 3.2% (n = 31) for first and second MP respectively, with an overall incidence of 3.8%. The majority of the MP with three canals had caries with no restoration (52%). The most common age group with three identified canals was 26-49 years (48%). Irreversible pulpitis and symptomatic apical periodontitis were the most common pulpal and apical diagnoses (59% and 52%, respectively). 6.2% of the cases had separated instruments, while 15% had a third canal that was only recognized after completion of treatment. Gender of the patient was not significantly related to incidence of three canals (males = 54%, females = 46%).

**Conclusions and Practical Implications:** The results of this retrospective chart review suggest that the incidence of three clinically treatable canals in maxillary first and second premolars is higher than reported by multiple previous *in vitro* studies and a previous *in vivo* retrospective chart review.



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## **The Effects of Non-surgical Endodontic Therapy on HbA1c and Periapical Index in Patients with Type 2 Diabetes**

**Qian Wang, DMD, Ph. D, Andre Mickel, DDS, MSD, Anita Aminoshariae DDS, MS**

Several studies have shown the possibility that diabetes predisposes to oral infection and could act as a risk factor for apical periodontitis (AP), negatively impacting the outcome of non-surgical root canal treatment (NSRCT). The present study was designed as a cohort study, with the objective to investigate the effects of NSRCT and Root canal retreatment (Retx) on glycemic control (HbA1c level) in patients with Type 2 diabetes (T2DM).

We hypothesized that NSRCT and Retx would exert positive impact on mediating HbA1c in AP patient with T2DM. Twenty-four T2DM subjects were enrolled between Jun 2016 and Sep 2018 at the Graduate Endodontic Clinic. The study group (n= 12) was T2DM subjects who received NSRCT or Retx, and was compared to the control group (n=12) consisting of patients with T2DM without endodontic treatment. Both groups were matched for age and sex.

The primary study outcome was the change in HbA1c levels from baseline to 8 months. Secondary outcome included the change in apical bone density as determined by the periapical index (PAI). Data was analysed through SPSS 16. Changes in HbA1c in the study group were not significantly different with those in the control group at 3 and 6 months. The decrease in HbA1c levels in the study group ( $1.4\pm 1.2$ ) was greater than that in the control group ( $0.5\pm 0.7$ ) at 8 months. PAI decreased in patients with Type 2 diabetes after Non-surgical Endodontic Therapy in 8 months.

Nonsurgical endodontic therapy could improve glycemic control and periapical health in patients with T2DM. The findings would position non-surgical endodontic therapy as an important relevant T2DM management therapy in therapeutic protection against AP with T2DM.

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## Use of electromagnetic stimulation on an *Enterococcus faecalis* biofilm on root canal treated teeth *in vitro*

Kindler JK, Ehrlich Y, Spolnik KJ, Bringas JS, Gregory RL, Duarte S

**Introduction:** The most commonly used irrigant solution in endodontic therapy is sodium hypochlorite, often at concentrations toxic to human cells. Electromagnetic wave irradiation has been shown to kill planktonic bacteria *in vitro*; the process is thought to occur through a mechanism coined electromagnetic stimulation (EMS). If confirmed, lower concentrations of sodium hypochlorite may be used to irrigate infected root canals.

**Objective:** The purpose of this *in vitro* study was to evaluate the anti-biofilm effect of EMS against an established biofilm of *Enterococcus faecalis*.

**Materials and Methods:** Single rooted teeth were cut to a standardized length (12 mm) and instrumented with a 45.05 Wave One Gold reciprocating file. Specimens were sterilized and inoculated with *E. faecalis*, which grew for two weeks to form an established biofilm. There were five treatment groups: 1) 6% sodium hypochlorite; 2) 1.5% sodium hypochlorite; 3) 1.5% sodium hypochlorite with EMS; 4) 0.9% saline with EMS and 5) 0.9% saline. Samples were collected, spiral plated, and incubated for two days. The number of CFUs/mL were determined. Wilcoxon Rank Sum tests were used to analyze the data.

**Results:** 0.9% Saline and 0.9% Saline + EMS were significantly higher than 6% NaOCl, 1.5% NaOCl, and 1.5% NaOCl + EMS. 0.9% Saline was significantly higher than 0.9% Saline + EMS. The three groups that included treatment with NaOCl were not significantly different from each other. The power to detect the observed difference between 0.9% Saline and 0.9% Saline + EMS was greater than 99%

**Conclusion:** In all treatments with sodium hypochlorite, no colonies formed regardless of the concentration used. Treatment with 0.9% Saline and EMS showed approximately half the CFU/mL than did 0.9% Saline alone, indicating that EMS had some sort of anti-biofilm effect. Future studies should apply EMS with lower concentrations of sodium hypochlorite than 1.5% and with mixed biofilms to aid in determining whether this anti-biofilm effect will translate to clinical disinfection.

# Notes

**Ohio Association of Endodontists**

2019