Title: Usage parameters of nickel-titanium rotary instruments: a survey of endodontists in the United States

Author: Bird D


Reviewer: Michael Sha, DMD

Purpose: To retrieve data from a representative sample of endodontists regarding contemporary usage of rotary instruments.

Materials and Methods: An online questionnaire composed of 14 questions was sent to 945 active members of the AAE. The questions address NiTi rotary root canal instruments, equipment, systems, configuration, techniques, usage, storage, issues, and developmental expectation. The data collected were statistically analyzed.

Results:

- 38% response rate.
- Those who graduated between 2000 to 2007 were more likely to: use NiTi rotary instrument at every root canal treatment, use multiple NiTi systems, use torque control motors, use Gates Glidden instruments
- More than 50% of respondents use NiTi rotary instruments in several patients before discarding (avg. 2-4 pt).
- 57% of respondents clean NiTi rotary instruments with ultrasonics and sterilization.
- 79% use crown-down technique.
- More than 70% of respondents expected similar but improved files in the next 10 years.

Discussion: More than 55% of respondents use NiTi rotary file on 2-4 patients before discarding. Only 22% reported single use of NiTi rotary. Single use of NiTi rotary reduce the risk of fracture, however it also increase the practitioners’ operating cost. Some studies have shown the inability to remove all organic debris (ex. prion proteins) from the surface of NiTi instruments.

Conclusion: More in vitro and clinical research is needed to determine best clinical practice for NiTi rotary instruments.

LOE: 5
Title: pH changes in external root surface cavities after calcium hydroxide is placed at 1, 3 and 5 mm short of the radiographic apex

Author: Chamberlain TM et al


Reviewer: Avedis Encioiu, DDS

Purpose: To test the null hypothesis that there is no difference in the pH on the external apical dentin surface when the canal is completely filled with calcium hydroxide or when it is placed 3 or 5 mm short of the apical foramen in extracted human teeth.

Materials and Methods:

• *in vitro*, using 40 permanent Max and Mand anterior single-rooted teeth.
• Teeth decoronated 10mm from the apex to create equal length roots and instrumented using crown down technique to size 50, 0.04 taper.
• Canals were irrigated with 3mL 6% NaOCl between each file, followed by 3mL 17% EDTA for smear layer removal and a final rinse of 3mL 6% NaOCl, followed by paper point drying.
• Cavities 1.0 mm in diameter and 0.5 mm deep were made on the external surface at 1, 3 and 5 mm coronal to the apical foramen using a round bur
• Using 35% Ca(OH)$_2$ (UltraCal® XS), teeth were then divided into 4 groups and filled 1mm (Group A), 3mm (Group B), 5mm (Group C) short of the apical foramen; controls (Group D) were left empty.
• Teeth were sealed at the apical foreman and canal orifice using sticky wax, then placed in a scintillation vial and stored in unbuffered isotonic saline at 37°C.
• pH was measured in the cavities located at 1, 3 and 5mm from the apical foreman using a calibrated microelectrode at 0 (immediate), 1,3,5,7,14,21 and 28 days.

Results:

• Group A (filled 1 mm from radiographic apex) had significantly higher pH levels at 1mm, 3mm and 5mm from the apex over time compared to Groups B, C and D.
• At day 28 however, the average pH in Group A dropped to the level of control Group D.
• Group B (filled 3 mm from radiographic apex) had significantly higher pH levels at 3mm from the apex over time compared to Groups C and D
• There was no difference between Group C and D at any level and time.

Conclusion: The results demonstrate that the pH change on the external root surface near the apex in greater when the canal is packed with Ca(OH)$_2$ closer to the apical foramen. The results also show a gradual drop in average pH level at 21 and 28 days, indicating that it could be beneficial to replace Ca(OH)$_2$ at least every 4 weeks.

LOE: 5
Title: Proportion of healed teeth with apical periodontitis medicated with 2 % chlorhexidine gluconate liquid: a case series study

Author: Tervit C et al.


Reviewer: S. Purtuc, DMD

Purpose: This is a second stage of a study designed to compare long-term healing of 2% chlorhexidine gluconate (Chx.) liquid medicated teeth with the results of another study by the same group of researchers that used Ca (OH)₂ as a medicament.

Materials and Methods: Twenty-two subjects with 22 single-rooted teeth with radiographic evidence of apical periodontitis. Aseptic techniques were used. Canals were measured for WL with apex locator. Canals were enlarged with ProFile® 0.4 and 0.6 and Ni-Ti k-files to size 35-60 at WL, using NaOCl 2.5% for irrigation. Canals were then medicated with Chx. 2% for 7-15 days. The teeth were temporized with a temp. filling. In the second session, teeth were irrigated with NaOCl 2.5% again. Teeth were then filled with Pulp Canal Sealer and vertical condensation (one tooth was filled with AH Plus and lateral condensation). The access cavity and crown were restored with composite filling. Bacterial samples were taken before and after canal enlargement, and after canal medication. In 11 teeth an additional sample was taken before the permanent filling was placed.

Results: Of the 22 teeth, 17 teeth were examined after a follow-up of 26 to 53 months. 5 teeth were not examined because: one subject was deceased, one tooth had crown fracture at 13mo. post-Tx, and was extracted, one tooth was extracted because of extensive caries 24 mo. post-Tx, and 2 subjects did not respond to follow-up calls. The recall rate was 17/22 = 81%. Ninety-four percent (16/17) teeth had healed, only one tooth had persistent disease. All teeth with positive samples at the second appointment had healed. The tooth with persistent disease did not have a positive sample at the second appointment. There was no association between outcome and whether the teeth were treated with Chx. or Ca (OH)₂.

Discussion: Authors mention that because of study limitations, the results of this study should not be generalized (small sample size, referral pattern to a dental school, outcome classification based primarily on radiographic appearance). The control group was the Toronto study which has a similar design and tested healing in apical periodontitis teeth treated with Ca (OH)₂ medicament.

Conclusion: Overall the results (94% of 17 single-rooted teeth with PA lesion treated with Chx. were assessed as healed after 2-4 years) compare well with the results of a historical control that used Ca(OH)₂ (98% of 78 single-rooted teeth healed after follow up of 4-6 years).

LOE: 4 (low cohort)
Title: Effect of radiopaque Portland cement on mineralization in human dental pulp cells.

Author: Kyung-San Min et al.


Reviewed by: Aneel Belani, DDS

Purpose: To investigate whether radiopaque Portland cement (RPC) facilitates mineralization and odontoblastic differentiation in human dental pulp cells (HDPC’s) compared with Portland cement (PC).

Materials and Methods: Human dental pulp cells were cultured. In part 1, RPC and PC were mixed with saline, ZOE was mixed according to manufacturer’s instructions (positive control), and glass cover slips alone were used as a negative control. After 24 hour setting time, the materials were placed in culture. After 48 hour incubation, dishes were fixed and then examined under SEM. In part 2 of the study RPC and PC were again mixed and then placed in culture with HDPCs and alakaline phosphatase activity was measured at 1, 3, 7, and 14 days. In part 3 of the study, RPC and PC were cultured with HDPCs for 1, 2, and 3 weeks and then stained with Alizarin Red. In part three, cells were lysed and put through PCR to measure mRNA levels of dentin sialophosphoprotein and osteonectin. Statistical analysis was preformed.

Results: PART 1: Both the RPC and PC groups had abundant flattened cells when viewed on SEM, the cells were in close contact with both materials. This was very similar to the cellular distribution in the glass cover slip group. PART 2: Results (as shown in figure 2 show no significant difference in ALP activity between RPC and PC. PART 3: Alzarin red staining showed increase deposition of mineralized nodules in both RPC and PC groups at 14 and 21 days. PART 4: Both groups showed increased levels of ON and DSPP at 14 days.

Conclusion: This study showed that RPC allows normal cellular morphology of HDPCs. RPC and PC both increase the amount ALP at one day significantly and thus increase the amount of matrix deposition. The presence of increased amounts of DSPS in both groups suggests that each of these materials can induce odontoblast differentiation. Alzarin red staining showed the presence of mineralization nodules in both groups. Due to these results we can conclude that RPC has the potential to be an effective pulp capping material.

LOE: 5

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Title: Presence of arsenic in different types of MTA and white and gray portland cement

Author: Bramante et al.


Reviewer: Jay Gupana DMD

Purpose: A reply to the editor of OOOOE regarding the presence of arsenic in MTA

Conclusions:

- Arsenic compounds combine with sulfhydryl radicals and may widely distributed in the liver, heart, CNS, and kidneys, or may accumulate in the erythrocytes, leading to leukopenia.
- Portland cement is obtained from a mixture of clay and calcium oxide.
- Since clay comes from soil, Portland cement may present arsenic contaminant.
- Portland cement is the main component of MTA, which may mean that it harbors arsenic.
- Quantification of arsenic compounds was done with the photometric method (spectrophotometry).
- The maximum amount of arsenic they found in MTA mixed with HCl (used for homogenization) was 2 grams in an 8 ml solution.
- The amount of arsenic ingested that is lethal is 2-3 mg arsenic / kg body route.
- MTA was found to have an amount of arsenic well below toxic levels (2mg arsenic/kg of material).
Title: Efficacy of the NaviTip FX irrigation needle in removing post instrumentation canal smear layer and debris in curved root canals

Author: Zmener O et al


Reviewer: Andrew Cho, DMD

Purpose: To evaluate the efficacy of the NaviTip FX in removing the smear layer and root canal debris during root canal instrumentation and irrigation in extracted human molars with curved root canals and to evaluate the cleanliness of the curved canals after the additional use of the NaviTip FX together with FileEze (Ultradent Products Inc)

Materials and Methods:

- 40 curved (20º-30º) mesiobuccal root canals from maxillary and mandibular 1st molars were used in the study
- All teeth were decoronated to obtain standard root length of 16mm and canals were prepared in a crown-down method to a ProTaper F3 instrument (corresponds to ISO #30 instrument at tip with 9% taper in apical portion)
- During instrumentation, canals were irrigated with 5.25% NaOCl and 17% EDTA using #30 gauge NaviTip FX or standard NaviTip irrigation needles with following conditions:
  - NaED - NaOCl/EDTA/nonbrushing (10 samples)
  - EDBr - NaOCL/nonbrushing + EDTA/brushing (10 samples)
  - EDFEBr - NaOCL/nonbrushing + EDTA/brushing + FileEze/brushing (10 samples)
  - CG - Control (NaviTip needle without brush) (10 samples)
- Accesses were sealed and superficial longitudinal groove were made on the teeth and circumference of the canal walls at levels 1, 5, 10 mm from WL were examined with SEM.
- A 300µm square grid was examined for debris remnants and smear layer and a three step scale was used to assess

Results: At all levels the canals from EDBR and EDFEBr groups did not differ significantly and both had less surface debris and smear layer than NaED and control group. For all groups, significantly better cleanliness at 5 and 10mm from WL than at 1 mm.

Conclusion: Results show that at all evaluation levels, the cleanliness of the root canal walls was significantly improved when the NaviTip Fx was used in a brushing motion to within 1 to 2 mm from the WL with best results at 5 and 10 mm from the WL. Furthermore, the cleanliness of the canals may be improved by the additional use of the NaviTip with a 19%EDTA water soluble viscous chelating gel complementary to the irrigation protocol.

LOE: 5
Title: Rapid chairside sterilization of endodontic files using 6% sodium hypochlorite.

Author: Gnau, HI, et al.


Reviewer: Christian Lehr, DMD

Purpose: To assess the percentage of new endodontic files, taken directly from the manufacturers’ packages, that were contaminated with viable microorganisms and to determine the amount of time new files needed to be immersed in 6% sodium hypochlorite to achieve sterility.

Materials and Methods:

- 25 each SureFlex® size 30, FlexoFile® size 30, K3™ 0.04 taper size 30, and ProFile® 0.04 taper size 30 files were taken directly from their packages and individually immersed in sterile tubes containing 10 mL of sterilized thioglycate broth using a sterile technique. The broth was incubated for 72 hours and each tube was examined for turbidity compared to sterile tubes of thioglycate broth included in the same incubation.
- 75 each SureFlex® size 30, FlexoFile® size 30, K3™ 0.04 taper size 30, and ProFile® 0.04 taper size 30 files were taken directly from their packages using a sterile technique and immersed in 6% sodium hypochlorite for either 1, 2, or 5 minutes (25 files from each file type, for each immersion period). The files were then placed in a tube containing 10 mL of sterilized thioglycate broth. The broth was incubated for 72 hours and each tube was examined for turbidity compared to sterile tubes of thioglycate broth included in the same incubation.
- 12 files that were purposely contaminated with *S. epidermis* served as positive controls and 12 files that had been sterilized in an autoclave served as negative controls. These files were incubated in the same manner as the experimental groups.

Results:

- New files showed a 6% contamination rate.
- New files first immersed in 6% sodium hypochlorite for 1, 2, or 5 minutes showed contamination rates of 2%, 1%, and 2%, respectively.
- Positive controls and negative controls behaved as expected with all positive control files showing contamination and no negative control files showing contamination.

Conclusions: The results of this study confirm the presence of viable microorganisms on new endodontic files at a 6% contamination rate. Also, in this study, it was not possible to achieve sterility of new endodontic files using 6% sodium hypochlorite. A possible explanation for the continued contamination is that bacteria may be located in microfractures on the file making them inaccessible to the sodium hypochlorite. Another explanation is that air bubbles in the sodium hypochlorite may prevent direct contact of disinfectant with bacteria.

Limitations of this study include the facts that it is not known if the bacteria are cultivatable and that only aerobic bacteria were investigated. Finally, this study did not attempt to identify which bacteria were present.

LOE: 5
Title: A practitioner survey of opinions toward regenerative endodontics

Author: Ingrid E et al.

Journal: JOE, vol 35(9): 1204, Sept 2009

Reviewer: Michael Sha, DMD

Purpose: To collect the opinions of attendee’s of the 2008 Endodontic Board of Diplomates 2008 Summer Conference on the issue of regenerative endodontic procedures (REPs).

Materials and Methods: A questionnaire composed of 40 questions was circulated among the attendees. Questionnaire:

- Part A - dentist’s professional status
- Part B - dentist’s opinions, beliefs, and judgments regarding REPs.
- Part C - dentist’s current clinical practice

Results: (56% response rate)

- Part A:
  - Mostly male, older than 56 y.o., had at least 21 years of experience, read scientific dental journals every week, and attend CE courses on REPs.
- Part B:
  - 96.4% thought regenerative therapy should be incorporated into dentistry.
  - 63.6% stem cell banking would be useful to regenerate dental tissue.
  - 84.5% agree to save teeth and dental tissue for future REPs use.
  - 87.9% thought REPs should be tested on animal before human use.
- Part C:
  - 49.1% already using some type of regenerative therapy in practice.
  - 63.4% thought REPs could be used for root development, pulp revitalization, replanting avulsed teeth, and to heal periradicular bone.
  - 47.7% consider Ca(OH)₂ and MTA to be the optimal tx for necrotic immature teeth.
  - 50% willing to deliver REPs for a fee.

Discussion/Conclusion:

- Many endodontic regenerative procedures are already in common use.
- More complicated REPs such as the use of embryonic stem cells could be controversial. The use of patient’s own stem cells or body tissue would appear to be a more ethical option.
- Endodontists were generally enthusiastic about REPs, but it is not clear if the same enthusiasm exists among general dentist, physicians, and other health care workers.
- There need to be more official ethical and clinical guidelines regarding the use of REPs.

LOE: 5
Title: *In vitro* tomographic image of human pulp-dentin complex: optical coherence tomography and histology


Author: Bratz A et al.

Reviewer: Felicitas Wibowo, DMD

**Background:** Optical Coherence Tomography (OTC) is a noninvasive imaging method with high spatial resolution (<10 µm) images of biological microstructure. An OCT setup includes a broadband light source and an interferometer containing the sample in one arm and a delay line and an optical detector in the other arm. Signal output from interferometer is electronically treated and fed to a computer for the image generation. (Fig 1)

**Purpose:** To show OCT images of human pulp-dentin complex and compare them with histologic sections

**Materials and Methods:**
- Five extracted intact human maxillary premolars were used.
- The occlusal surface was polished with wet aluminum oxide abrasive paper perpendicular to the long axis of teeth, creating a plane on that surface.
- The wear stopped until the occurrence of minimal pulp exposure.
- A home built OCT system with 6 µm spatial resolution at 800nm was used in this study.
- The images were taken by scanning the occlusal surface in mesiodistal direction.
- The laser penetrated into the tooth structure and a tomographic image of pulp-dentin complex, parallel to the long axis of the tooth, was obtained.
- After image construction by OCT, the teeth were serially sectioned for histological studies. The histologic and OCT images were analyzed and compared.

**Results/Discussions:** OCT, in this study, could provide images into dentinal substrate up to 700 µm in depth at 800 nm wavelength. Author mentioned that increasing the wavelength will increase penetration into dentin. OCT technique was able to identify the boundaries of pulp and its relation to dentin. Structures of dentin and pulp were clearly delineated because hard and soft tissues backscatters light in very different ways. Histologic and OCT images were comparable (see Fig 1-3).

**Conclusions:** Uses of OCT include understanding the interactions between remaining dentin thickness and dental pulp and monitoring dentin bridge formation in pulp capping. OCT allows for a more predictive prognosis of treatment.

*Figure 1.* Diagram of home-bulk spectral OCT.
Figure 2. (A), histologic image; (B), OCT counterpart. P, pulp; D, dentin.

Figure 3. Site of pulpal exposure. (A), histologic cross-section; (B), OCT image. P, pulp; D, dentin.

LOE: 5
Title: Influence of *Streptococcus mutans* on *Enterococcus faecalis* biofilm formation

Authors: Dong M et al.


Reviewed by: Chinchai Hsiao, DMD

Purpose: To investigate the effect of *S. mutans* biofilm on hydroxyapatite (HA) on biofilm formation of 8 *E. Faecalis* clinical isolates.

Materials and Methods:

- The *E. faecalis* and *S. mutans* clinical strains were routinely grown anaerobically on brain-heart-infusion agar at 37°C.
- Bio films were grown in a biofilm medium (BM) that contained amino acids, vitamins and sucrose.
- A new biofilm model was designed in which substrata was positioned vertically.
- *E. faecalis* biofilm were grown anaerobically on HA disks in the absences or presence of a preformed 24-hr *S. mutans* biofilm.
- Two to 3 experiments were carried out for each *E. faecalis* strain, with triplicate samples in each experiment.
- CFU’s were used to evaluate the bacterial compositions of biofilms where each of the HA disks with biofilms were dispersed by sonication on ice for 30secs at 40W and then they were incubated and the bacterial colonies were counted and expressed as CFU’s.

Results: Five strains displayed significantly higher *E. faecalis* CFU counts on the HA disks covered with *S. mutans* biofilms than on the clean HA disks. Three strains showed no significant difference in biofilm with/without *S. mutans*. Without *E. faecalis* the total CFU’s of *S. mutans* increased.

Discussion: The data presented demonstrated that the presence of an *S. mutans* biofilm on HA significantly increased the biofilm formation of 5 *E. faecalis* strains while 3 strains exhibited different dual species biofilm characteristics. Hence there should be emphasis on the need to study the virulence factor in a multispecies setting.

LOE: 5