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The annual AAE meeting is our time to shine

It’s likely that you picked up this copy of roots at AAE17, the annual session of the American Association of Endodontists, held this year in New Orleans, and you are reading this on your flight home. That’s good, because this issue includes many helpful articles, including information on some of the latest topics — from cleaning and shaping to new technology used for disinfection.

If you are like me, you look forward to the AAE meeting each year, not only for the camaraderie but also because of the knowledge that is shared among compatriots. How many of the lectures and hands-on workshops did you attend at this year’s meeting? Which was your favorite? No matter what course or speaker inspired you, it's all part of the greater knowledge about our specialty.

A small part of that knowledge base is contained on the pages that follow. Chief among them is an article by Dr. L. Stephen Buchanan, titled “Recent advances in 3D-printed dental replicas for procedural training and board exams,” and an article by Dr. Khang T. Le, “18-month case study of a C-shaped mandibular molar: Preserving dentin and deep cleaning utilizing an innovative procedure.” There’s also a report on the newly opened Dentsply Sirona Endodontic Suite at NYU College of Dentistry.

The centerpiece of this publication is an article by Dr. Ove A. Peters. “Canal preparation and obturation: An updated view of the two pillars of nonsurgical endodontics,” which originally appeared in AAE’s ENDODONTICS: Colleagues for Excellence newsletter, is being made available in this issue of roots with the permission of the AAE. By reading this article, and then taking a short online quiz at www.DTStudyClub.com, you will gain one ADA CERP-certified C.E. credit. Remember that with roots, you can always earn C.E. credit without lost revenue and time away from your practice.

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As always, I welcome your comments and feedback.

Fred Weinstein, DMD, MRCD(C), FICD, FACD
Editor in Chief
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Canal preparation and obturation: An updated view of the two pillars of nonsurgical endodontics

Author Ove A. Peters, DMD, MS, PHD

The ultimate goal of endodontic treatment is the long-term retention in function of teeth with pulpal or periapical pathosis. Depending on the diagnosis, this therapy typically involves the preparation and obturation of all root canals. Both steps are critical to an optimal long-term outcome. This article is intended to update clinicians on the current understanding of best practices in the two pillars of nonsurgical endodontics, canal preparation and obturation, and to highlight strategies for decision making in both uncomplicated and more difficult endodontic cases.

Prior to initiating therapy, a clinician must establish a diagnosis, take a thorough patient history and conduct clinical tests. Recently, judicious use of cone-beam computed tomography (CBCT) has augmented the clinically available imaging modalities. Verifying the mental image of canal anatomy goes a long way to promote success in canal preparation. For example, a missed canal frequently is associated with endodontic failures.1

As most maxillary molars have two canals in the mesiobuccal root, case referral to an endodontist for microscope-supported treatment should be considered. Endodontists are increasingly using CBCT and the operating microscope to diagnose and treat anatomically challenging teeth, such as those with unusual root anatomies, congenital variants or iatrogenic alteration. The endodontic specialist, using appropriate strategies, can achieve good outcomes even in cases with significant challenges (Fig. 1).

Preparation of the endodontic space

The goal of canal preparation is to provide adequate access for disinfecting solutions without making major preparation errors such as perforations, canal transportations, instrument fractures or unnecessary removal of tooth structure. The introduction of nickel–titanium (NiTi) instruments to endodontics almost two decades ago2 has resulted in dramatic improvements for successful canal preparation for generalists and specialists. Today there are more than 50 canal preparation systems; however, not every instrument system is suitable for every clinician and not all cases lend themselves to rotary preparation.

Several key factors have added versatility in this regard, for example, the emergence of special designs such as orifice shapers and mechanized glide path files. Another recent development is the application of heat treatment to NiTi alloy, both before and after the file is manufactured. Deeper knowledge of metallurgical properties is desirable for clinicians who want to capitalize on these new alloys. Finally, more recent strategies such as minimally invasive endodontics have emerged.3

Basic nickel titanium metallurgy

What makes NiTi so special? It is highly resistant to corrosion and, more importantly, it is highly elastic and fracture-resistant. NiTi exists reversibly in two conformations, martensite and austenite, depending on external tension and ambient temperature. While steel allows 3 percent elastic deformation, NiTi in the...
austenitic form can withstand deformations of up to 7 percent without permanent damage or plastic deformation. Knowing this is critical for rotary endodontic instruments for two reasons. First, during preparation of curved canals, forces between the canal wall and abrading instruments are smaller with more elastic instruments, hence less preparation errors are likely to occur.

Second, rotation in curved canals will bend instruments once per rotation, which ultimately will lead to work hardening and brittle fracture, also known as cyclic fatigue. Steel can withstand up to 20 complete bending cycles, while NiTi can endure up to 1,000 cycles.

Recently manufacturers have learned to produce NiTi instruments that are in the martensitic state and even more flexible than previous files. Figure 2 shows how instrument conditions (austenite vs. martensite) are determined in the testing laboratory, using prescribed heating and cooling cycles. Heat-treated files with high martensite content typically do not have a silver metallic shade but are colored due to an oxide layer, such as gold or blue.

It is important to note that CM files frequently deform; however, with a delicate touch, cutting is adequate and often even superior to conventional NiTi instruments. It is imperative for clinicians to retrain themselves prior to using these new instruments to avoid excessive deformation and subsequent instrument fracture.

**Preparation strategies**

Experimental and clinical evidence suggests that the use of NiTi instruments combined with rotary movement results in improved preparation quality. Specifically, the incidence of gross prepa-ration errors is greatly reduced. Canals with wide oval or ribbon-shaped cross-sections present difficulties for rotary instruments and strategies such as circumferential filing and ultrasonics should be used in those canals.

Studies found that oscillating instruments re-commended for these canal types did not perform as well, particularly in curved canals. Specific instruments developed to address these challenges include the Self-Adjusting File (SAF) System (ReDentNOVA, Raana, Israel), TRUShape® (Dentsply Sirona, Tulsa, Okla.) and XP Endo® (Brasseler, Savannah, Ga.). However, there is no direct clinical evidence that these instruments lead to better outcomes.

Canal transportation with contemporary NiTi rotaries, measured as undesirable changes of the canal center seen in cross-sections of natural teeth, is usually very small. This indicates that canal walls are not excessively thinned and apical canal paths are only minimally straightened (Fig. 1), even when preparing curved root canals. While preparation usually removes dentin somewhat preferentially toward the outside of the curvature, current NiTi instruments, including reciprocating files, can enlarge the canal path safely while minimizing procedural errors.

Almost all current rotaries are non-landed, meaning they have sharp cutting edges, and they can be used in lateral action toward a specific point on the perimeter. This “brushing” action allows the clinician to actively change canal paths away from the furcation in the coronal and middle thirds of the root canal but may create apical canal straightening when taken beyond the apical constriction. Circumferential engagement of canal walls by active instruments may lead to a threading-in effect, but contemporary rotaries are designed with variable pitch and helical angle to counteract this tendency.

An important design element for all contempo-rary rotaries is a passive, non-cutting tip that guides the cutting planes to allow for more evenly distributed dentin removal. Rotaries with cutting, active tips such as dedicated retreatment files should be used with caution to avoid preparation errors.

**NiTi instrument usage**

As a general rule, flexible instruments are not very resistant to torsional load but are resistant to cyclic fatigue. Conversely, more rigid files can withstand more torque but are susceptible to fatigue. The greater the amount and the more peripheral the distribution of metal in the cross section, the stiffer the file. Therefore, a file with greater taper and larger diameter is more susceptible to fatigue failure;
There are several concerns about reusing NiTi instruments. The effectiveness of disinfection procedures is not clear. It has been shown that protein particles cannot be completely removed from machined nickel-titanium surfaces. Moreover, it is clear that with additional usage, the chance for instrument fracture increases. Current recommendations advise that clinicians are judicious when reusing rotary instruments as there is no conclusive evidence of disease transmission occurring.  

Recently, the term minimally invasive endodontics has been used to describe smaller-than-usual apical sizes and, perhaps more importantly, an understanding that the long-term success of root canal-treated teeth will improve by retaining as much dentin structure as feasible. The thought process for this was the finding that most root-canal treated teeth survive 10 years and longer. In studies, the reasons cited for the extraction vary but in many cases teeth are either fractured or non-restorable for other reasons.

In consequence, a smaller coronal dimension of rotaries is considered while maintaining apical sizes to support antimicrobial efficacy. There currently is no direct clinical evidence to support this strategy but it is clear that root fractures pose problems in the long-term outcomes of our patients. Another recent development is the emergence of certain specialized rotaries, such as dedicated orifice shapers and so-called glide path files. The orifice shapers have larger tapers, such as .08, which means that they are not flexible and can overprepare at the canal orifice level. Glide path files, for example PathFiles® and ProGlider® (Dentsply Sirona), are delicate instruments and may fracture when used incorrectly. It is recommended to use a small K-file (size #10) before any rotary instrumentation and to use a delicate touch.

**Clinical results**

While results from in vitro studies on rotary systems are abundant, clinical studies on these instruments are sparse. Comparing NiTi and stainless steel K-files, Pettiette et al found less canal transportation and fewer gross preparation errors such as strip perforations. Subsequently, using radiographic evaluation of the same patient group, they demonstrated better healing in the NiTi group. An earlier outcome study with three rotary preparation paradigms did not show any difference between the three systems with an overall favorable outcome rate of about 87 percent.

The most consistent clinical results are obtained when the manufacturer’s directions are followed. While these vary by instrument, a set of common rules applies to root canal preparation. Root
canal systems are best prepared in the following sequence:
- Analysis of the specific anatomy of the case.
- Canal scouting.
- Coronal modifications.
- Negotiation to patency.
- Determination of working length.
- Glide path preparation.
- Root canal shaping to desired size.
- Gauging the foramen, apical adjustment.

Obturation of the endodontic space

A well-shaped and cleaned canal system should create the conditions for intact periapical tissues. On the other hand, this root canal system is inaccessible to the body’s immune system and therefore it cannot combat coronal leakage. Accordingly, best practices dictate that root canals should be filled as completely as possible to prevent ingress of nutrients or oral microorganism. None of the established techniques for root canal filling provides a definitive coronal, lateral and apical seal.24

Basic strategies in root canal obturation

Ideally, root canal fillings should seal all foramina leading to the periodontium, be without voids, adapt to the instrumented canal walls and end at working length. There are various acceptable materials and techniques to obturate root canal systems, including:
- Sealer (cement/paste/resin) only.
- Sealer and a single cone of a stiff or flexible core material.
- Sealer coating combined with cold compaction of core materials.
- Sealer coating combined with warm compaction of core materials.
- Sealer coating combined with carrier-based core materials.

Several of these techniques have shown comparable success rates regarding apical bone fill or healing of periradicular lesions, so a clinician may choose from a variety of techniques and approaches that works best for him or her. Existing research directs clinicians toward preparation and disinfection of the root canal as the single most important factor in the treatment of endodontic pathosis, and no particular sealing technique can claim superior healing success.25

Current developments in root canal obturation materials

After the introduction of MTA (mineral trioxide aggregate) as a material for perforation repair and apical surgery more than two decades ago, materials with similar bioactive properties now are available as root canal sealers. Bioceramic root canal cement (BC Sealer™, Brasseler) has clinically acceptable radiopacity and flow.26 Moreover, it is well-tolerated in cell culture experiments.27 However, there is no clinical evidence that using this cement leads to better outcomes. In fact, most research has indicated the type of cement used has comparatively little impact.28

In contemporary practice, heat generators are used to plasticize gutta-percha. Additionally, cordless heating devices are available. Another recent addition is a carrier-based material, Guttacore® (Dentsply Sirona), which uses modified gutta-percha materials instead of plastic as its base. Early data indicate that obturation with this new material is similar to warm vertical compaction or lateral compaction.29

Practical aspects of obturation

The main steps in the sequence of root canal obturation are:
- Choosing a technique and timing the obturation.
- Selecting master cones.
- Canal drying, sealer application.
Filling the apical portion (lateral and vertical compaction).
• Completing the fill.
• Assessing the quality of the fill.

The root canal system should be assessed before choosing an obturation technique. In the presence of open apices or procedural errors such as apical zipper and also for teeth with apices in close proximity to the mandibular canal, there is significant potential for overfills. In order to avoid such mishaps, these cases may be better obturated with cold lateral condensation to avoid overfilling, or in some cases, MTA may be placed as a barrier.

In general, canals should be filled only when there are no symptoms of acute apical periodontitis or an apical abscess, such as significant pain on percussion or not dryable due to secretion into the canal. Gutta-percha cones first should be disinfected by submerging them in an NaOCl solution for about 60 seconds.

In addition to a solid filler such as gutta-percha, a sealer or cement should be used. Most sealers are toxic in the freshly mixed state, but this toxicity is reduced after setting. When in contact with tissues and tissue fluids, zinc oxide eugenol-based sealers are absorbable while resin-based materials typically are not absorbed. Some by-products of sealers may adversely affect and delay healing. Therefore, sealers should not be routinely extruded into the periradicular tissues.

The appropriate amount of sealer is then deposited into the canal system. This may be done using a lentulo spiral, a K-file or the master cones themselves; each method is acceptable, provided that an appropriate amount of sealer is deposited. If the master cones are the carrier for the sealer, they should be removed and inspected for a complete coating with sealer and then replaced in the canal.

The master cones are placed close to working length using a slight pumping motion to allow trapped air and the excess sealer to flow in a coronal direction. The marking on the cone should be close to the coronal reference point for working length determination. For lateral compaction, a preselected finger spreader is then slowly inserted alongside the master cone to the marked length and held with measured apical pressure for about 10 seconds. During this procedure, the master cone is pushed laterally and vertically as the clinician feels the compression of the gutta-percha. Rotation of the spreader around its axis will disengage it from the gutta-percha mass and facilitate removal from the canal.

The space created by the spreader is filled by inserting a small, lightly sealer-coated accessory gutta-percha cone. Using auxiliary cones larger than the taper of the spreader will produce voids or sealer pools in the filling and should be avoided. The procedure is repeated by inserting several gutta-percha cones until the entire canal is filled.

For vertical compaction, electrically heated pluggers are used to melt a master cone fitted to length. Tapered gutta-percha cones optimize the hydraulic forces that arise during compaction of softened gutta-percha with pluggers of a similar taper. After fitting the master cone as before, different hand pluggers and heated pluggers are placed into the root canal to verify a fit to within 5 to 7 mm of the apical constriction.

For both lateral and vertical compaction the gutta-percha mass in each canal should end about 1 mm below the pulpal floor, leaving a small dimple. In cases where placement of a post is planned, gutta-percha is confined to the apical 5 mm. All root canals that do not receive a post may be protected with an orifice barrier (Fig. 3) to protect from leakage prior to placement of a definitive restoration. This has been shown to promote healing of apical periodontitis. Materials that are suitable for such a barrier include light-curing glass ionomers, flowable composites or fissure sealants. In order to facilitate retreatment if necessary, such a barrier should be thin so that the gutta-percha fill is just visible.

Radiographic appearance of filled root canal systems

Prepared and filled canals should demonstrate a homogenous radiopaque appearance, free of voids and filled to working length. The fill should approximate canal walls and extend as much as possible into canal irregularities such as an isthmus or a c-shaped...
canal system. This is difficult to achieve clinically and frequently requires the clinician to use a thermoplastic obturation technique. This complicated procedure may benefit from the use of the dental operating microscope.

Other anatomical spaces that may be filled include accessory canals that are most common in the apical root third (Fig. 3, mesial and distal root) but may be found in other locations such as the furcation. It has been well established that accessory anatomy may contribute to periapical periodontitis but clinical experience suggests the role of accessory anatomy in causing bone resorption is comparatively small. Indeed, it appears that filling accessory canals is not predictable and not a prerequisite for success.

In order to avoid overextension of root filling material into the periapical tissue, specifically in the mandibular canal, it is recommended to accurately determine working length to prevent destruction of the apical constriction. For infected root canal systems, it seems that the best healing results are achieved when the working length is slightly short of the tip of the root, as visible on a radiograph.

Determination of apical canal anatomy is often difficult. It may be appropriate for second mandibular molars that are in close proximity to the mandibular canal to be referred to a specialist. Overfills are not only an impediment to healing but in the worst case can be associated with permanent nerve damage. In general, undesirable and uncorrectable outcomes of root canal treatment, identifiable on the final radiograph, include:

- Excessive dentin removal during access and instrumentation.
- Preparation errors such as perforation, ledge formation and apical zipping.
- Presence of an instrument fragment in not fully disinfected canals.
- Obturation material overfill and overextension.

Each of these outcomes must be documented and the patient notified as they may reduce the likelihood of a successful outcome. In cases such as par- or dysesthesia after an overfill, immediate referral to a surgeon is indicated.

**Summary and conclusions**

Root canal preparation with contemporary instruments is a predictable procedure in most cases for a well-trained clinician following established guidelines. Cases with a recognized high degree of difficulty are best referred to an endodontist. While many cases can be treated successfully in routine practice, the additional training, expertise and technology of endodontists is necessary in cases that are beyond the typical spectrum. The best long-term outcomes are obtained when a correctly planned final restoration is placed as soon as possible after root canal treatment is completed (Fig. 4).

Root canals may be filled through various methods, typically using a combination of a cement and a solid filling material such as gutta-percha. The specific obturation material used appears to have a smaller role on outcomes. Overfills, particularly into the area of the inferior alveolar nerve, have the potential to permanently harm a patient. The absence of gross errors that are associated with persistent presence of bacterial infection and excessive dentin removal during access and canal preparation have the greatest impact on outcomes.

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A complete list of references is available from the publisher and also at www.aae.org/colleagues.

**_about the author_**

Dr. Ove A. Peters was awarded a degree in dentistry (Dr. med dent) from the University of Kiel, Germany, in 1990. After two years in the Department of Neurophysiology at the University of Kiel, he served as an assistant professor of prosthodontics at the University of Heidelberg, Germany, from 1993 to 1996. Peters received post-graduate endodontic training at Zurich University Dental School (1997-2001) and at the University of California, San Francisco (2004-2006). He was an assistant professor and head of the faculty practice in restorative dentistry at the University of Zurich from 1996 to 2001. Peters also earned a certificate in endodontics and MS certificate in oral biology from UCSF and was board certified in endodontics in 2010. He received the Louis I. Grossman Award in 2012. Peters is currently a tenured professor and co-chair of the Department of Endodontics at the Arthur A. Dugoni School of Dentistry at the University of the Pacific, San Francisco, and the director of the Advanced Education Program in Endodontology. His main scientific interests are the performance of root canal instruments assessed by mechanical testing methods, three-dimensional imaging and the efficacy of antimicrobial regimes in root canal treatment. More recently, he became involved in endodontic biology and now runs a dental stem cell biology laboratory. Peters has published more than 100 papers in peer-reviewed journals and has lectured extensively both nationally and internationally. He has written multiple chapters in leading textbooks and serves on the review panels and editorial boards of high-impact endodontic journals. He may be contacted at opeters@pacific.edu.
Medical and dental procedural training has always had the severe limitation of being done on living patients in a one-on-one preceptorship basis unless cadavers are used. But cadavers are severely regulated and short in supply, thus quite expensive, as well as being biohazardous and creepy. A common alternative, of training dentists to do implant surgery in pig jaws, allows only the most fundamental procedures to be practiced — none of which present doctors with the case-by-case, on-the-fly treatment planning decisions that must be honed to empower predictable success when tissues have been incised and soft-tissue flaps have been reflected.

In this light, 3D-printed dental replicas offer an amazing paradigm shift in dental procedural training. Impossible otherwise, 3D printing authentically reproduces human anatomy in much the same way body parts are created — through additive means — rather than by reductive CAD/CAM milling of material blocks or by injecting material into the limited geometry of molds. Stereo-lithography offers the ability to re-create internal morphology just as human bodies do, layer by layer. Multi-ink printers even allow both hard and soft tissues to be replicated in a single training jaw.

It has been truly fortunate that we can train dentists to do endodontic procedures in human extracted teeth that are no longer attached to their original owners; however we are still faced with the random endodontic anatomy that presents as collected in extracted tooth jars. With extracted teeth, educators cannot choose the exact anatomic challenge presented to their students to satisfy a given training objective, nor do they typically know what is inside all of the student’s practice teeth during a hands-on course. When we control the anatomy that is practiced in, educators can better control the students’ experience and further shorten their learning curve.1,2

Beyond that, when students fail to achieve their procedural objective in an extracted tooth, there are no do-overs, thus it is a truism that it typically takes hundreds of endodontic procedural experiences in extracted teeth and patients’ root canal systems before predictable competence can be achieved. Airline pilots, astronauts, musicians, police and soldiers are all taught with simulation exercises that allow iterative improvements in skill sets, something that has previously been impossible in dental and medical procedural training.

When we consider traditional methods of training health care professionals to do dangerous procedures safely in human beings, it becomes obvious that medical and dental education is different than almost every other endeavor to create human competence in complex processes. Thus 3D-printed replication has and will continue to change everything about conventional and surgical training. This article describes recent advances beyond the printing of individual teeth for endo-
odontic training, both in educational as well as board exam arenas.

About two years ago, the president of a prominent board of dental examiners asked if we could model and print replicas that would authentically replace extracted teeth in their exams. Because 3D-printing allows fabrication of literally any organic or inorganic form that can be modeled on a graphics computer, it was obviously possible although many’s the slip between cup and lip. In these cases I follow the advice of Richard Diebenkorn1 for any creative project. I begin by doing research to understand the context, the art, that has preceded my efforts. What I found was that existing endodontic models were not anatomically authentic — their canals were like soda straws in their oversimplified form, they were much softer than tooth structure when cut with high-speed handpiece burs, and, despite claims to the contrary, they did not work with apex locators. Over a period of two years our design and development process resulted in board exam testing replicas (Figs. 1-3) that had:

1. Coronal hardness very similar to natural teeth when cut by high-speed handpieces.
2. The exact anatomy found in human teeth.
3. Apex locator function that was as accurate as natural teeth.
4. Embedment in a rubber sleeve (with serial numbers) that fit readily available typodonts.
5. Authentic radiopacity.

That development process also inspired an inexpensive version of these exam replicas that allowed our TrueTooth training replicas to be used in a better simulation than with individual replicas. While the exam replicas are expensive with milled composite/ceramic crowns, non-reusable sleeves and unique identification, the TrueTooth practice replicas now have reusable split sleeves that hold them in a typodont and perform perfectly with apex locators, allowing dental students to practice on replicas that cost less than $15 each (Figs. 4a,b).

The other recent advance was what I call TrueJaw 2.0 — full-jaw replicas designed to train endodontic residents to do periradicular surgery, including incision, ostectomy, apicoectomy, retrograde preparations and fills, bone grafting and suturing. Each upper and lower jaw has five teeth with various periapical lesions, some perforating the cortical plate and some with root ends that need to be located through intact boney structures (Figs. 5a-12).

Procedural dental education and testing will never be the same._

_References_


_L. Stephen Buchanan, DDS, FACC, FICO, is a diplomate of the American Board of Endodontics, a fellow of the American and International Colleges of Dentists and serves as part-time faculty to the UCLA and USC graduate endodontic programs. He holds patents on the Endo-Bender Plier (SybronEndo), System-B and Continuous Wave obturation tools and methods (SybronEndo), GT and GTX file systems (DENTSPLY Tulsa Dental Specialties), LA Axess Burs (SybronEndo) and Buc ultrasonic tips (Spartan/Oblura). Buchanan lives in Santa Barbara, Calif., where he enjoys a practice limited to conventional and microsurgical endodontics and dental implant surgery. He is the founder of Dental Education Laboratories, a hands-on training facility in Santa Barbara that he has directed for 28 years._

_about the author_

Fig. 5a, CAD model of endodontic surgical training replica showing PA lesions associated with tooth #9 and tooth #12.

Fig. 5b, 3D-printed maxillary endodontic surgical training TrueJaw. Each jaw has five different tooth replicas with periapical lesions, some perforating the cortical plate and others hidden behind intact bone surfaces.

Fig. 6a, Buccal view CT image of TrueJaw replica tooth #9 with PA lesion. Note the authentic appearance of tooth, PDL, medullary and cortical bone.

Fig. 6b, Sagittal view CT image of TJ replica #9.

Fig. 7, Incision of rubber-like soft-tissue replication in preparation for endo surgical flap.

Fig. 8, Flap replica reflected, revealing PA lesion perforating the cortical plate.

Fig. 9, Osseous crypt developed, showing root end with canal.

Fig. 10, Retrograde canal preparation with ultrasonic tip.

Fig. 11, Retrograde filling in place.

Fig. 12, Flap sutured.
18-month case study of a C-shaped mandibular molar: Preserving dentin and deep cleaning utilizing an innovative procedure

Author: Khang T. Le, DDS, SC Endodontics, Santa Ana, Calif.

Introduction

Complexities within the root canal system provide intricate regions for tissue, debris and bacteria-rich environments that remain untouched after standard root canal treatment. When the complicated anatomies of a C-shaped canal are introduced, occurring in about 8 percent of mandibular second molars, the endodontic challenges for debridement and disinfection are increased. An innovative technology, the GentleWave® Procedure (Sonendo®, Laguna Hills, Calif.) has been shown to enhance root canal cleaning and disinfection through advanced fluid dynamics, acoustics and tissue dissolution chemistry (Fig. 1). Studies have shown the GentleWave Procedure to have seven times faster tissue dissolution than standard root canal systems and demonstrated success rates of 97 percent at 12 months.

Background

A 47-year-old female presented with a chief complaint of spontaneous pain and sensitivity to cold and chewing. The patient reported a history of hypothyroidism, but all other medical history was unremarkable. Upon clinical examination, the mandibular second molar (#31) showed moderate sensitivity to percussion and palpation. Vitality testing elicited a lingering response (Fig. 2a). A diagnosis of symptomatic irreversible pulpitis and symptomatic apical periodontitis was made.

Methods

Following conservative endodontic access, examination of the pulp chamber floor revealed a C-shaped canal. To preserve tooth structure, orifice openers were not utilized. Two file paths were created to an apical diameter of #20 merely to facilitate a fluid and obturation path. This preservation of dentin is crucial, as clinical success in endodontics has been correlated to the maintenance of original canal shape. While excessive apical enlargement may lead to complications like apical transportation, ledges and instrument separation, it also has the potential to weaken the tooth, thereby increasing the likelihood of root fractures.

The GentleWave System was utilized to remove pulp tissue remnants, debris, smear layer and bacteria from the entire root canal system. The GentleWave Procedure was the endodontic treatment modality of choice for this case, due to its ability to thoroughly...
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case study  GentleWave Procedure

Figs. 2a-d, Radiographs:  
a) Pre-GentleWave Procedure;  
b) Post-GentleWave Procedure;  
c) 12-month recall; and  
d) 18-month recall. (Images/  
Provided by Dr. Khang Le)

Figs. 3a-d, CBCT:  
a-b) Post-GentleWave  
Procedure; and  
c-d) 12-month recall.

Clean and disinfect the entire root canal system  
without removing excessive dentin. The canals  
were subsequently dried with paper points and  
obturated using a warm vertical compaction  
technique with gutta-percha and a resin-based  
sealer. A coronal seal was immediately  
achieved by restoring the access cavity with  
composite build-up.

Post-operative radiographic analysis revealed  
the C-shaped anatomy (Fig. 2b). It should be  
noted that a major cause for endodontic  
failure is the inability to locate and treat all  
root canal anatomy.14-15 Without adequate  
debridement, successful obturation would  
not be possible. As obturation of the entire  
root canal system is an indication of success  
for the endodontic cleaning and debridement  
process, the ability to clean and then  
obturate all of the root canal system,  
as in this case report, is crucial to a  
successful endodontic procedure.16

Results

While post-procedure radiographs show the  
C-shaped anatomy, the cone-beam computed  
tomography (CBCT) images highlight the complex  
anatomy of the C-shaped canal, the uninstrumented  
webbing and a periapical lesion that are not  
visualized upon radiography (Figs. 2b, 3a and 3b).  
Studies report CBCT imaging is more sensitive in  
detection of periapical lesions than radiography,  
even in cases diagnosed with irreversible pulpitis.17-19  
Clinical, radiographic and CBCT analysis was  
completed at the 12-month recall. The tooth  
was asymptomatic, and the periapical lesion,  
previously visible on CBCT, had healed (Figs. 2c, 3c  
and 3d). A final recall was completed  
18 months post-procedure. The patient  
continued to be asymptomatic, and radiographic  
assessment revealed normal periradicular  
tissue (Fig 2d).

Discussion

The challenge of C-shaped canals is the  
webbing and ribbon-like structures throughout  
the root system, creating small areas and recesses  
tissue, debris and bacteria to remain.120  
This case report portrays the  
complex anatomy associated within the C-shaped  
canal, yet the standard root canal therapy protocol  
that is associated with a high rate of procedural errors  
was bypassed in favor of the innovative GentleWave  
Procedure.21-24 The case revealed normal  
periradicular tissue and no clinical signs or  
symptoms at both the 12- and  
18-month recalls. This case report  
demonstrates the ability of the GentleWave  
Procedure to clean and disinfect C-shaped mandibular  
molars in a single visit while  
conserving natural tooth structure and decreasing  
the chance of intra-procedure complications as seen  
in standard endodontic treatment._

Disclosure: None. A list of references is available  
from the publisher.

Dr. Khang Le earned his doctor of dental surgery  
degree from the University of Colorado School of  
Dentistry in 1991. He was commissioned as a dental  
officer in the United States  
Navy in 1994 and proudly  
served for 11 years. In 2002,  
he received a certificate of  
advanced clinical programs  
in general dentistry from the  
Naval Dental Center Southwest, San Diego. He went on to  
receive his endodontic certification from the Herman  
Ostrow School of Dentistry at the University of Southern  
California in 2008. He serves as part-time faculty for the Advanced Endo-  
dontics Program at the Herman Ostrow School of Dentistry,  
University of Southern California. He is an active member  
of the American Association of Endodontists, the American  
Dental Association, the California Dental Association and  
the Orange County Dental Society. He may be contacted at  
Khangle.3588@yahoo.com.

about the author
Dentsply Sirona Endodontic Suite opens at NYU College of Dentistry

Author_Dentsply Sirona staff

On Thursday, Nov. 17, 2016, NYU College of Dentistry (NYU Dentistry) celebrated the culmination of a goal set years earlier with a ribbon-cutting ceremony for the opening of the Dentsply Sirona Endodontic Suite. The new clinical suite, which employs the most advanced educational and patient care technologies available, was made possible by a partnership between NYU Dentistry and Dentsply Sirona, a manufacturer of professional dental products and technologies.

"Today," said Dr. Charles N. Bertolami, Herman Robert Fox Dean of NYU Dentistry, "NYU has the most sophisticated endodontic suite in the nation, ensuring our ability to provide the finest endodontic education in an environment that reflects truly patient-centered care. And it could never, ever have happened without Dentsply Sirona."

Dr. Asgeir Sigurdsson, associate professor and chair of NYU’s Dr. Ignatius N. and Sally Quartararo Department of Endodontics, expressed his appreciation to both Dentsply Sirona and the college’s leadership team for "making possible this outstanding facility."

“For an endodontics department chair," Sigurdsson said, "it is a dream come true."

Speaking on behalf of New York University, NYU President Andrew Hamilton said: "Thanks to Dentsply Sirona and its partnership with the College of Dentistry, we have been able to create this beautiful and most advanced facility of its kind. Just one of the new treatment centers would be impressive, that there are 37 of them is remarkable, and that they are all in the same location and interconnected is even more so. NYU thanks Dentsply Sirona from the bottom of our hearts for the remarkable contribution that this new facility makes to the College of Dentistry and to our students’ education. It is wonderful to know that the future endodontists we are training will have a positive impact on the lives of our patients and on our community because of the splendid environment they now have in which to learn."

NYU Executive Vice President for Health Robert Berne said: "At NYU, the scarcest commodity is space. The Dentsply Sirona Endodontic Suite is a magnificent example of a brilliant use of space. It is the lodestar for future renovation projects at NYU, the one that people will look to again and again, and it is a major contribution to the education of our students."

Dean Bertolami expressed both the college’s and his personal appreciation to Bret W. Wise, executive chairman of the board of Dentsply Sirona, noting that when the college approached what was then Dentsply International last spring to propose a partnership on behalf of the renovation, the company was in the midst of a complex, international merger with Sirona Dental Systems. Nevertheless, Bertolami said, Wise immediately indicated his support and as soon as the merger was completed, renovation of the existing clinic began.

Wise said: "This was the first project undertaken by the newly merged Dentsply Sirona and represents our commitment to research, product development and clinical education. Now, one of the best departments of endodontics has the most modern clinical suite. With this new facility, the standard has been set, and together we’ve created an unparalleled environment for research and clinical education. Dentsply Sirona is grateful for this opportunity to collaborate with NYU to advance dentistry and improve oral health."

Dr. Mark Wolff, the college’s associate dean for development, noted that the effort to renovate the endodontic facility had been years in the making, but once the partnership with Dentsply Sirona was underway, the entire renovation was completed in just three months, making it a “fitting testimony to the powerful synergy that can occur when academia and industry partner on behalf of a shared goal.”

A video of the ribbon-cutting ceremony is available online, at https://youtu.be/NhT5UIEJZ6O_
You know how those days go — all morning long, it felt like you were struggling to keep on track with the schedule. Your team is frustrated because they haven’t had their full hour lunch more than one day a week in as long as they can remember. You walked by the sterilization room 15 minutes ago, and it sure sounded like they were complaining to each other because you said to work in that emergency, and they were struggling to figure out how to pick up their kid from daycare on time. Again.

You want them to enjoy working here, but you have to be able to pay the bills. And your best assistant asked you again if she can have that raise you have been promising her. Don’t they understand?

Today will be another day of three chairs and patient after patient asking you questions about treatment, all eager to get started with getting their mouth fixed, but yet you still won’t see any of them show up on the schedule. They said they wanted to do the work, but for some reason, they never seem to come back and do it.

They say insurance doesn’t cover it, or they ask for a pre-determination. Too bad they don’t know the pre-determination doesn’t mean much.

Today, you have 27 patients on your schedule and will work your butt off and still not have a chance to pee. It looks like you should be able to be done by 5, but today will finish worse than yesterday.

It feels like half of your patients are crankier than you are, and your team isn’t really talking to you today, and you know when you get home, all you will want to do is go to sleep and wake up on Saturday — except it’s still Tuesday!

It doesn’t make sense — you have taken C.E. courses every time they come to town. The new insurance plan was supposed to make things easier. You bought a bunch of new equipment to save money on taxes — of course now you have to pay for it every month — but why does it seem like the harder you work, the further behind you get? There has to be a simple reason.

Well, it turns out there actually is — and it’s something that you learned when you were about 5! Do unto others. More specifically, build systems in your office so that you can treat your patients the way you would want to be treated — comprehensively and with exceptional information to make good decisions — and produce a consistent experience time after time.

While doing that, add exceptional care — esthetic adhesive excellence like you see in the journals. But how? Well, the answer happens to be the foundation that LVI was built upon — building the excellence in a patient-centered practice. And the programs at LVI have been teaching clinical excellence and communication and business systems for almost 20 years to help doctors do a better job of not only seeing the patient but, more importantly, connecting with them. Two decades of not only communication but comprehensive diagnosis and clinical excellence. As a result, the doctors at LVI have a statistically higher professional satisfaction and income.

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Safe and effective irrigation with Directa’s double-side-vented Calasept Irrigation Needle

Author: Directa staff

Dual-side Calasept Irrigation Needles are vented for irrigation during root canal therapy. These high-quality, double-side-vented, luer-lock irrigation needles will provide for safe and efficient irrigation when performing endodontic treatments, according to Directa, the company behind the product.

Calasept Irrigation Needles optimize the cleaning of canals, creating a “swirl-effect.” This will give an effective and safe irrigation when performing an endo treatment. Calasept irrigation needles are available in a container packed box of 40 needles; choose 27g or 31g. Both sizes are bendable and have a luer-lock hub.

Directa’s dedicated goal with the development and production of Calasept products has made the Calasept brand a reliable line with the prime focus to facilitate and simplify the root canal treatment with innovative solutions for the dental practitioner, according to the company.

In 2015, Directa incorporated all Nordiska Dental’s non-amalgam products in its growing product line, including the well-known Calasept Endoline. Calasept is a well-known brand of products from calcium hydroxide paste for temporary root fillings to a complete assortment of liquids for effective irrigation of root canals. It is a range of products for the proper treatment of root canals by any clinic, general practitioners and endodontic specialists.

Contact your local dealer for more information and to order the Calasept Endoline. More product information is available online, at http://directadental.se/products/calasept.
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