You're never done learning; especially when you're a dentist! You have to keep learning otherwise you might as well be extracting teeth with a pair of pliers on the sidewalk outside of Wal-Mart. From techniques to technology, everything changes in this profession – and sometimes it's hard to keep up – but if you want to provide the best care for your patients and stay engaged with this amazing profession, you need to keep up with the cutting edge. There are things I learned in dental school that I haven't done in more than a decade because something new overtook it. Sure, learning new things is required to maintain your license, but learning something new can save your patients money, time and pain and make your practice more profitable. Learning something new and then implementing it in your practice is what makes dentistry exciting!

Chances are you've already attended some dental seminars, maybe at the American Dental Association Annual Session, or from the Academy of General Dentistry or your local state association. It takes a lot of time and resources to travel to those shows and seminars, and you're entering the profession during a time of economic uncertainty. It pays to work as many days during the week as you can, especially when you're trying to pay off your overwhelming student loans, mortgages, car payments, etc.

In 2005, Dentaltown began its Continuing Education department with the goal of providing outstanding online educational content at an affordable price. On Dentaltown.com, you can take top-notch courses on topics ranging from oral surgery, to practice management to endodontics while sitting on your couch in your underwear, and then earn credit when you're finished!

In this special edition of Dentaltown Magazine, we're providing you with a sample of one of our most popular continuing education courses from Drs. Kenneth Koch and Dennis Brave titled “Locating the Elusive Root Canal.” I invite you to come check out our library of courses and make Dentaltown your hub for self-study CE!

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Educational objectives

Upon completion of this course, participants should be able to achieve the following:

- Understand that straight-line access is critical for clinical success.
- Recognize that access shape should mimic the outline of the tooth.
- Realize that spending an additional five minutes on access preparation will result in a great overall savings of time (20-25 minutes) for the case.
- Appreciate the symmetry of canal orifices that exists in mandibular molars.
- Fully understand the application of ultrasonic use in endodontics.
- Recognize the benefits associated with a fiberoptic in ultrasonic use.
- Appreciate the difference between water-cooled and non-cooled ultrasonic tips.

Abstract

In this first part of a three-part series, we want to discuss the “basics” of doing root canal therapy – finding the canal and creating proper access. The concepts to be addressed in this initial segment are principally straight line access and the use of piezo electric ultrasonics. Our goal is to give Dentaltown readers as much information as possible over the next three installments. To begin, let’s review the principles of endodontics from a real world perspective.

The principles of endodontics, as we all know, are to clean, shape and obturate the root canal system. It doesn’t matter what school you attended, we all learned these same concepts. However, we have a second principle at Real World Endo. This is the principle that we need to do a root canal in such a fashion, that we can go back, restore the tooth, and reestablish the occlusion. It is not enough to meet the objectives but destroy the tooth in the process.

If these are the principles of endodontics, what are the clinical keys? The four keys to endodontics are: diagnosis, access, instrumentation and obturation. While diagnosis is certainly the most difficult aspect of endodontics, access is the first key to successful clinical endodontics.1 When proper access is created, NiTi rotary instrumentation can predictably result in properly shaped canals. Subsequently, when you have proper cleaning and shaping, as with a continuously tapered preparation, whatever obturation method you choose to use will work well. But the initial key remains straight-line access.

Before we discuss specific teeth, a few ground rules are in order. We’d like to offer the following suggestions. The first is to create an outline form that mimics the shape of
the tooth. This shape will help you locate all the canals in the tooth. You will find that with such a shape you will minimize “missed canals.” Our second suggestion is a method employed to confirm straight-line access. For confirmation of straight line access, close one eye and look into the chamber of the tooth. You should be able to visualize all the orifices. If you cannot see all the canals, you don’t have straight-line access. Let’s look at some other suggestions.

When accessing anterior teeth, we can make initial access with a #2 round bur and then flare the walls of the access preparation in such a manner to result in a straight-line entry into the canal. The preparation should mimic the shape of the lingual surface, just be smaller. Too often we see access on anterior teeth that, if continued, would perforate through the buccal CEJ area. While we try to be as conservative as possible on anterior teeth, we still need to have sufficient access to successfully complete the root canal. When accessing premolars with two roots, we must make the access in such a way as to incorporate both canals into the access preparation. The walls of the access need to be directed in such a fashion that access is a straight line into the canal. If you have a case where you think you might have a second canal but cannot find it, it is often a result of improper access. Sometimes by extending the access, either buccally or lingually, you will be able to incorporate the missing orifice into the access preparation. We recommend a slightly oval access on all premolars. If the tooth has two canals, two canals that merge into one or one canal that bifurcates, they all require an oval access preparation. Therefore, with premolars, get into the habit of always creating an oval shape preparation.

One point we always stress at our seminars is that the key to instrumenting molars is the access. Unfortunately, too many practitioners are too conservative when preparing molar access. Consequently, they must try and curve a K-file to get into the orifices and the canals. This does not work very well. Generally, what will happen as a result of this improper access, will be that at approximately the 18mm mark, or prior to the curvature, the instrument will not follow the curve. Rather it will deflect to the side and ledge the canal. Now, you have a problem. The absolute key to doing curved canals is to have proper straight-line access. Always remember this endodontic axiom: an instrument curves once with ease. If you need to curve the instrument to enter the orifice, when it goes down into the canal 18 or 19mm and needs to curve again, guess what? It will not curve! Rather, it will deflect to the side and you have now created a ledge. Never forget that an instrument only curves once with minimal stress. This is an adage that applies not only to stainless steel but to NiTi instruments as well.

**Anterior Teeth**

Access through the back of the crown should be extended (facially enough) to allow a rotary file to reach down the canal without being deflected by the canal walls. The access must be created to allow the file to enter the orifice in as straight-line a manner as possible. Concerning lower anterior teeth with two canals, the access needs to be extended in a lingual direction to incorporate the second canal. The second canal is almost always lingual to the primary one. A slightly oval shape is preferred for these teeth, not a concentric circle.

**Premolars**

The number of canals present dictates access on premolars. On maxillary bicuspsids we recommend an access that is oval in design. On single-canal lower-premolars, the access can be somewhat more circular in nature. If a second canal (or bifurcation) is suspected in a lower premolar, an oval access is best. All premolars that have two canals, two canals that join or one canal that bifurcates, require an oval access preparation.
Lower Molars

Approach all lower molars as if they have four canals, as many of them will. This requires that your preparation be rectangular in shape, not triangular. Subsequently, this allows the practitioner to see all the orifices and treat them accordingly. When clinicians get in the habit of taking a second angled X-ray, they will discover many four canal mandibular molars.

Also, there is great symmetry in lower molars. We want you to visually connect a line between the two mesial canals. Following this, we want you to drop a perpendicular line (mentally) that bisects this line, extending distally. Now, look for orifices. If there is only one orifice and it is right on the perpendicular line, you most likely have only one distal canal. But if the orifice is off the perpendicular, chances are excellent that there is an additional canal off the perpendicular (same distance) to the opposite side.

Upper Molars

Access preparation for upper molars is somewhat Y-shaped, which mimics the shape of the tooth. The addition of a fourth canal in the mesial buccal root will demand that the access preparation be extended mesially. Too often, secondary dentin that slopes off the mesial wall occludes the MB-2. A key part of accessing maxillary molars is to extend the preparation far enough under the mesial buccal cusp to gain access to the main mesial buccal canal. Once located, follow the dentinal map from the main MB orifice and this will lead you to the MB-2. A piezo electric ultrasonic will greatly aid in “troughing” this area to locate the second mesial buccal canal. This leads us to another discussion point.

The use of piezo electric ultrasonics still remains the most under-utilized technology in modern endodontics. However, with continued improvement in these units, we expect greater utilization of this technology in the future by general practitioners.

We prefer piezo electric ultrasonics, to the earlier magnetostrictive units, for two reasons. Piezo electric technology offers more “cycles” per second (40,000 CPS versus 24,000 CPS) and secondly, the tips of these units work in a linear, back and forth “piston like” movement. This motion is ideal for endodontics. This is particularly evident when “troughing” or searching for hidden canals. A magnetostrictive unit, on the other hand, creates more of a figure eight (elliptical) motion. This is not as ideal for either surgical or non-surgical endodontic use.

Many dentists are under the impression that ultrasonic use in endodontics only has a surgical application. This most definitely is not true. Probably 90 percent of all ultrasonic use is in non-surgical endodontics. In fact, a piezo electric unit should not be considered an accessory item, but a necessity. In our opinion, if you are serious about doing quality endodontics, you need to have a piezo electric ultrasonic.

Real World Endo in conjunction with Brasseler USA has developed a full line of endodontic products and techniques. A significant component of this line is a series of piezo electric ultrasonics developed in conjunction with NSK. A notable feature of this line of ultrasonics is their fiber optic capability. These units are the only ultrasonics in North America with such capability. The unit that we are most excited about is the Varios 350 Lux. Let’s take a closer look at this unit and some of its features.

The Varios 350 Lux, a piezo electric ultrasonic, is small enough to fit in the palm of your hand and on any bracket table. While the size alone distinguishes this unit as a compact portable system, the Varios 350 Lux also comes with a fiberoptic light source, built into the handpiece. The fiber optic is protected and it’s light is directed to the field of treatment. But why is this so important? Let’s consider for a moment the benefits of fiber optics.

The primary benefit of having a fiber optic built into an ultrasonic is enhanced vision. Not only will all clinicians be able to see better, but the fiber optic helps significantly in terms of diagnosis. This is true for both the hygienist and the dentist. By employing trans illumination (shine the light through the tooth at the CEJ), we can...
now readily diagnose cracks, fractures and even calcified canals. Additionally, think how great a fiber optic based ultrasonic is to see subgingival calculus.

The handpiece itself is small and light, and when combined with a fiber optic capability, allows the practitioner more visual access to the procedure. In endodontics, we have access into the tooth and straight line access to the canals, but we also need visual access to the procedure.

While the selection of the proper ultrasonic for your practice is important, choosing the correct tips is also vital if you wish to get the most from your unit. Any discussion of tips must begin with the comparison of water-cooled versus non-water-cooled tips. Historically, most ultrasonic tips have been water-cooled but some designs do not include this feature. We are strong proponents of water-cooled tips for a number of reasons. The first reason is that if you are using an ultrasonic tip on dry mode for any period of time, the tooth starts to heat up and an unpleasant smell develops. Eventually the patient (even with high speed evacuation) connects the dots and realizes that it is their tooth that is “burning.” The patient’s reaction is usually not good.

Additionally, when removing a post with a non-water-cooled tip, there is a very significant amount of heat that is generated and this can be transmitted to the periodontal ligament. This might be deleterious to the long-term health of the tooth and must be avoided.

The third reason why we do not favor non-water-cooled tips is that metal fatigue does develop as a result of over heating. The result of this increase in metal fatigue can be catastrophic to the tip. It will break. In our experience, the chance of breaking a water-cooled tip is significantly less than with a non-water-cooled tip. The tips that we recommend with the Varios 350 Lux are the following: E4, E14D, E9, E9D.

Having discussed some features of ultrasonic units and tips, let’s review some of the applications of this technology.

Finding Hidden Canals – Troughing

The biggest challenge facing most practitioners is finding the canals. Endodontic cases are becoming increasingly difficult. Particularly difficult are those cases where the orifice has become occluded (or hidden) by secondary dentin. You cannot perform root canal therapy unless you find the canal. Piezo electric ultrasonics are excellent for removing the secondary dentin that slopes off the mesial wall of molars and blocks the canal. It is in these cases (especially maxillary molars) where the Varios 350 Lux is exceptional.

The technique used to locate (or find hidden canals) with a piezo electric ultrasonic, as compared to a round bur in a handpiece, is dramatically different. When using a round bur to find a canal, we are often “working blind” because the contra angle obstructs our view. Furthermore, when searching with a round bur, we are using this in a vertical component, hoping that we somehow do not perforate the tooth. Unfortunately, perforations often happen.

The difference in techniques, when troughing with a fiber optic ultrasonic, is startling. First of all, we can actually see what we are doing! This enhanced visual access is a result of two things. The first is using an ultrasonic tip instead of a bur and handpiece and the second is taking advantage of the fiber optic lightsource which illuminates the entire chamber.

The other very notable difference is that an ultrasonic tip gives us the ability to brush stroke the tip in a back and forth linear motion. We do not have to resort to plunging the tip up and down in a vertical motion. Consequently, the ultrasonic method is a far safer way to locate canals. You and your patients will appreciate the difference in technique.

Real World Endo Tip

When searching for hidden canals, secondary dentin is generally whitish or opaque, while the floor of the chamber is darker and more gray-like in composition. The fiber optic is very helpful in these cases by making this an obvious distinction.
Piezoelectric ultrasonics also perform particularly well when breaking through the calcification that covers the canal orifice. A troughing tip is a good choice for this task. As a result of geriatric dentistry becoming a larger portion of our practices, we are seeing more coronal calcification. Simply put, this is a technology that should be part of your armamentarium. You need to have a good visual access to the procedure. Take advantage of enhanced illumination.

**Increased Efficacy of the Irrigation Agent**

It has been said that “Endodontics is about what you take out and what you don’t push out of the canal.” Real World Endo firmly supports this statement. Additionally, we are strong advocates of the Schilder concept that “instruments shape, irrigants clean.” But, how can we make our irrigation more effective? Simple. By placing an ultrasonic tip into our irrigation agent, which is in the chamber, we can enhance the cleaning efficacy of our irrigation agent. This is because an ultrasonic tip creates both cavitation and acoustic streaming.

The cavitation, which is like the action created with a boat propeller, is minimally effective and is restricted to the tip. However, the acoustic streaming effect is significant. The only way that you can effectively clean webs and fins is through movement of your irrigation agent. One can not mechanically clean these areas. Ultrasonics are a tremendous help in cleaning these difficult anatomical areas.

Multiple research, in the early 80s, showed that the cleanest canals are those that follow instrumentation with a brief period of ultrasonic cleaning. Further endodontic research has confirmed the earlier studies. For example, in the October 2003, *Journal of Endodontics*, R. Sabins et al. concluded that, “Ultrasonic passive irrigation produced significantly cleaner canals than passive sonic irrigation.” The topic still remains one of interest as evidenced by an article in the *Journal of Endodontics* (March 2005 Volume 31, Number 3).

The technique itself is quite simple. Choose a basic spreader or troughing tip, turn off the water and place the tip into the irrigation agent. We recommend taking the tip just above the floor of the pulp chamber and moving it around. However, do not take the ultrasonic tip deep into the canals. The first thing you will notice is lots of effervescence (bubbles). After about 30 seconds, you might have evaporated the solution. If this happens, replenish the solution and repeat for another 30 seconds. What is happening is that we are generating extensive streaming of the irrigation agent. The net result is a cleaner root canal system. This is particularly beneficial in cleaning large fins (such as C shape canals) that hold excessive amounts of tissue. Our recommended total time for acoustic streaming is one minute. Research has demonstrated no further advantage with three or five minutes.

**Removing Posts and Cores**

As previously mentioned, endodontic cases are becoming increasingly difficult. Many of these cases will involve removal of a post. We prefer to remove posts with a piezo electric ultrasonic. Here are some tips to follow.

When removing a post, it is critical to break the seal between the post and the tooth structure. This can be accomplished initially by using a spreader tip in a counterclockwise motion around the post. Another technique is the use of a high-speed surgical length 1/4 round bur to prepare a space around the post. This is technique sensitive so be careful that you are going parallel to the long axis of the root. Once you have trephinated around the post, you can place an ultrasonic spreader tip into the trough. This will further break the cement or resin and you will soon notice motion in the post. Sometimes you can place a spreader tip against the post itself. This works well if the seal has been broken. Don’t rush when removing posts. Take your time, don’t panic. The post will come out.
Fiber optic equipped ultrasonics will greatly enhance the ability of a clinician to remove a post. Enhanced visual access will, as well, ensure a more conservative removal of the post. If too much tooth structure is destroyed during removal of a post, it will complicate the restoration of the tooth and will most likely decrease the overall prognosis.

Removing Separated Instruments

Sadly, it is a fact of life that endodontic instruments might break. Any endodontic file can break if used improperly. Fortunately, piezo electric ultrasonics are excellent for removing separated instruments. However, you must be aware of the importance of the location of the separated file. If a rotary file is separated past the canal curvature, this will be extremely difficult to remove. Don't fall prey to those who cavalierly say, “I just pull over my microscope and remove it.” These are difficult cases. On the other hand, broken instruments in the coronal half of the canal often can be removed in a relatively straightforward manner. However, be honest with yourself. If you do not have the experience or necessary magnification, you should refer this case.

When removing a broken instrument in the coronal third, a thin spreader tip will work nicely. Take the tip into the canal and work it in a counterclockwise motion around the broken fragment. This will generally dislodge the broken instrument. However, please note that instruments separated in the middle or apical third of a canal are best removed by an experienced clinician with the use of a microscope.

Piezo electric ultrasonics have a host of other indications. For example, some metal crowns might be loosened by placing a vibratory tip against their buccal surface. Another use of ultrasonics is the burning off of gutta percha at the orifice following obturation.

Conclusion

We have attempted in this initial article to cover some of the topics that we discuss in our part I, continuing education course. Part II will concentrate on rotary instrumentation, which remains one of our passions. We look forward to further interaction with the Dentaltown readers.
## Post-test

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1. Which of the following is not a key to endodontics  
   a. Access  
   b. Instrumentation  
   c. Pharmacology  
   d. Diagnosis

2. Complete the axiom, “An instrument curves…”  
   a. Once  
   b. Multiple times  
   c. Until it breaks

3. On maxillary premolars, the access should be:  
   a. Made with a fissure bur  
   b. Circular  
   c. Oval  
   d. As wide as possible

4. The key to doing curved canals:  
   a. Lies in the apical 3-5mm  
   b. Is related to access in the chamber  
   c. Is related to access in the coronal part of the canal  
   d. b & c  
   e. None of the above

5. A premolar with one canal that bifurcates deep in the root requires what type of access preparation?  
   a. Oval  
   b. Round  
   c. Wider mesio-distally

6. A magnetostrictive ultrasonic unit creates what type of tip movement?  
   a. Linear  
   b. Elliptical  
   c. Circular  
   d. None of the above

7. A piezo electric unit creates what type of movement?  
   a. Elliptical  
   b. Circular  
   c. None of the above

8. Cavitation created by a piezo electric ultrasonic is  
   a. Minimally effective  
   b. Restricted to the ultrasonic tip  
   c. a & b  
   d. None of the above

9. The recommended time for acoustic streaming is  
   a. One minute  
   b. Three minutes  
   c. Five minutes  
   d. Length of time does not matter

10. Multiple research has shown that the cleanest canals are those that follow instrumentation with a brief period of ultrasonic irrigation. This statement is  
   a. True  
   b. False

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Locating the Elusive Root Canal
by Drs. Dennis Brave and Kenneth Koch

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