The rationale and use of electronic apex locators

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_Electronic apex locators (EALs) are my best friend when performing a root canal. Of all the devices I use in practice, my RootZX-mini (Fig. 1) is the most indispensable. This is borne out by the fact that most endodontists use an EAL to determine length in every root canal they treat.

The rationale for using an EAL in every single canal you treat? A short review of the anatomy literature reveals conventional radiography to be no greater than 80 per cent accurate for length determination, vs. 97 per cent accuracy with EALs. One of the worst endo concepts—ever—has been the procedural recommendation that we treat root canals a certain distance from the root apex—a strategy based on the average position of root canal foramina.

Unfortunately, none of our patients is average. Every single root canal you enter for the next 35 years of practice will be different than the one before. So how is it going to work when we arbitrarily assign apical preparation sizes based on averages? Not so good, actually. When we decide all small canals should be enlarged to a #35 file size at the end of the prep, we will often have one of two untoward outcomes: apical damage or incomplete preparation.

Fig. 1_The RootZX-mini.

Fig. 1

So it is with length determination.

With an EAL, you will know immediately when you reach the end of root canals with the smallest, first negotiating files – data that is so critical to controlling our use of these instruments and preventing apical damage. Without an apex locator, you will never know where you are in a root canal until you have horsed a #15 KF to estimated length and have taken an X-ray; in small curved molar canals, this can be disastrous. Working initial negotiating files short in error invites apical blockage and ledging, while working them erroneously long invites ripping apically curved canals straight, outcomes that happen more often than most of us realize.

Yet the majority of general dentists do not use EALs. Why? Many have been unsuccessful in first use—no surprise; EALs are technique-sensitive to use.

Here are the technique touch points I consider when using an EAL:

Condition of the EAL

Confirm a good condition of the EAL, its batteries, its cords and its file probes (Fig. 2). These are sensitive electronic devices with boards inside that can break when drop-kicked in an operatory. Be gentle with them. When their signal shows halfway, replace the batteries with fresh ones. When EAL cords have been autoclaved repeatedly, they may develop tarnish that inhibits conduction at the cord connections and at the end of the file probe where it touches the shank of the file being used. Using a bur brush here will take care of the tarnish.

Ideally, use a straight file probe that has been gold plated (this prevents oxidation) at its business end. These work the best of all EAL probe designs I have used (Fig. 3).

My least favorite is the spring-loaded test file leads that most dentists attach to their files. They are too

Fig. 2

Fig. 2_Make sure your EAL is in good working condition by checking its batteries, cords and file probes.

wide to fit them between the rubber stop and handle in canals longer than 22 mm. Test leads attached to files during negotiation dampen tactile feedback, increasing the risk of damaging tortuous apical anatomy.

The straight probe can be temporarily set on an alcohol gauze, located on the patient's bib, as the assistant places the lip clip under the rubber dam—on the opposite side of the tooth being treated, with the EAL display nearby. When estimated length is approached, it is then very convenient to simply retrieve the file probe from under the patient's chin, touch its thin, V-cut end to the file shank, between the rubber stop and the handle (Fig. 4).

The file in hand is then advanced into the canal until the display meter pegs to the farthest red "Apex" indication, and the instrument is turned slowly in a counter-clockwise direction until the meter is only lit up to the simulated "0.5 mm" mark and the green bar opposite that mark stops blinking and holds steady for a couple of seconds.

Lead sets typically need replacing in my office every six to 12 months. Not autoclaving EAL cords and probes is not good, and the temperature and steam fatigues the insulation, so accept this and pop for a new cord set every now and then.

Access cavity

Cut a nice access cavity. I am often asked how I use EALs when working next to metallic restorations, as it can be difficult to avoid shorting the signal. My first consideration is to make sure the line-angles of the access cavity have been cut so that files may drop smoothly, without hitch, into each canal without significant flexure of their shank ends.

A well-cut access cavity will allow files to be easily held away from an adjacent metal crown or alloy restoration. To do so, get a finger rest, look carefully as you center the file in the access prep, then direct your attention to the EAL display as you turn the file back and forth until the meter arrives at a reproducible length measurement.

If you still have trouble keeping files from shorting, cut heat-shrink tubing (RadioShack) into 9 mm lengths and place them on your initial negotiating files and the procedure can go on. A little practice and this will no longer be necessary. Not to brag, but I don't have any greater difficulty using EALs through metallic restorations or crowns and would rather do that than work on teeth devastated by caries.

Fig. 3

Fig. 3_This straight file probe has been gold plated at its business end to prevent oxidation.

Use of lubricant

Use a lubricant such as RC Prep or ProLube instead of NaOCl during electronic length determination. This is the second requirement for working successfully through access cavities with adjacent metal. In fact, doing all initial negotiation procedures through an access cavity filled with lubricant will smooth out all EAL use as it helps eliminate the apical blockage so common in vital cases. Not only has there been no evidence-based research proving NaOCl is helpful for negotiation procedures, all of our clinical experience shows lubricants to be the ideal solution to have in the pulp chamber as initial negotiating files are taken into small curved canals. When sufficiently small first files are used in a bath of lubricating solution, apical soft tissue blockage can be totally avoided.

Plus, all EAL readings are more stable with lubes, and most erratic with bleach. Lose the bleach, until later in the procedure.

File size

Increase file size when EAL readings are erratic. Simply using one or two larger sizes of negotiating file

Fig. 4_When estimated length is approached, it is then convenient to simply retrieve the file probe.

works virtually every time when first or second files taken to length return an erratic, jumpy signal. Going to a larger size file with a lubricant during EAL use will solve erratic signals for most brands of apex locators.

Of all the unnecessary obstacles to success with EALs, this one was my bêté noir for years until Johan Masrelleiz twigged me to the use of lubricants during EAL use.

Use an EAL often

Use an EAL in every canal you treat, and you will become proficient. Pulling the office EAL from the back of a dusty closet once every two months—when radiographic length determination isn't working—and expecting immediate success requires a rich fantasy life. Conversely, when I have an apex locator, I can be on a dental mission in an underserved region and do a pretty nice RCT with no X-ray machine. Get one, if you don't already have one, and use that sucker every time, and you will have way more fun doing RCT.

Length determination radiographs

Stop taking length determination radiographs—take this recommendation to heart, and soon you will be ready for the EAL homerun. If you are able to accept gifts from heaven and are looking for a way to be more efficient when delivering RCT, eschew length determination radiographs. Remember 80 per cent vs. 97 per cent? So what do we accomplish when we stop everything to capture a length determination X-ray? To see files as they exit molar root structure, multiple X-rays are usually required, so why are we doing this?

Furthermore, curved canals change length as they are worked. When you use an EAL for each negotiating file, it is common to observe the loss of 1/4 to 1/2 mm of canal length just going from the 08 KF to the 10 KF, as the original irregular canal path is smoothed. So do we capture a second length determination X-ray, after negotiation, and a third after shaping?

Rather than spend the time to capture a radiographic record of a length that will change almost immediately after, consider using today's rotary instrumentation. I can literally cut an initial shape, a final shape, gauge the terminus and fit a gutta-percha cone in less time than it usually takes to capture a well-angulated X-ray image of a #15 KF at length. Then, when I take an X-ray image with the cones in place and be certain that the length represented will be stable to the completion of the case. If you want to eliminate working films altogether, use a lubricant and an EAL during apical gauging procedures and you will know exactly where to fit the cone.

I know this works; I practiced for three years (including live demonstrations) without taking a working film after canal location—and my apical accuracy improved._

_about the author

roots

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