Endodontic success: It’s all about the apical third

By E. Steve Senia, DDS, MS, BS

It goes without saying that as professionals we should strive for the highest success possible. Yet, defining and determining long-term success isn’t always black and white. For example, is a tooth that hurts while chewing really a success? Some say yes — it’s still in the mouth. I have a problem with that kind of thinking. Successful cases should be fully functional and pain free. Similarly, how much time should elapse until you can consider a root canal treatment successful? Three years is a common figure. Inadequate and even very poorly done root canal procedures often last at least that long — or even longer — thanks to an efficient immune system.

I believe that root-endodontic failures are caused by inadequate apical cleaning — period. In dental school we were taught that cleaning and sealing root canals, especially in the apical third, is the most critical part of the procedure. This basic concept has not changed, nor has that fact that instrumenting the apical third is usually the most difficult part of the procedure. In my many years of teaching and lecturing, I don’t recall any serious challenges to these widely accepted beliefs. Given that almost all dentists agree, why do so many still use instruments and techniques that do not address these vital issues? Why have we been slow in converting to better instruments and techniques? The answer is inertia. It is much easier to keep doing the same thing over and over than it is to change. But this is the way of a caring profession.

About 20 years ago, Bill Wilder and I questioned the antiquated design of K-type instruments. We learned that existing metal and machining technologies were the limiting factors. You can dream about an ideal instrument, but you can have only what can actually be made. Even today, machining technology and materials are still limiting factors, but they have advanced tremendously. While nickel-titanium is better than stainless steel in most respects, manufacturers simply changed the material but retained the basic tapered design. That’s only going halfway.

By cross-sectioning and microscopically examining a very large number of endodontically treated teeth, it became painfully obvious to Bill and me that many times root canal treatment did not adequately clean the apical third of canals. Better instruments and techniques were clearly needed. We made prototypes of our design by grinding K-files to form an instrument with a short blade on the end of a long, smooth flexible shaft. Why such a design?

We theorized that cleaning the very end of a long “pipe” (canal) required an instrument similar to a plumber’s Roto-Rooter (a short cutter at the end of a long flexible shaft) (Fig. 1). In 1992, we reported our thoughts and findings in an article titled “Another Look at Root Canal Instrumentation.”

Canal anatomy

Computer tomography has made visualizing canal systems a much simpler task. We’ve learned that nearly every canal is curved. What may appear as a straight canal in a two-dimensional X-ray almost always has some degree of curvature in an unseen plane. Furthermore, the cross-sectional shape of most canals is not round but oval (mimicking the oval shape of most roots). Lastly, canals have a constant taper; instead, they exhibit nearly parallel walls in multiple segments throughout the length of the canal.

Here are some generalizations about canal anatomy worth remembering:

- Most canals are curved in one or more directions. The more severe a curve, the more difficult the treatment.
- Most canals are oval in cross-section. Oval canals have two diameters, a minor (smaller) and a major (larger) diameter. The quality of cleaning is dependant on instrumenting the larger diameter; it’s Working Width (Fig. 2a). Working Width (WW) is best understood by studying cross-sections of apical canals. If the greater diameter of the original canal is measured, the correct WW is an instrument size slightly larger than that dimension.

Change begins by questioning current thinking and creating new paradigms

- Since canals are mostly curved, shouldn’t instruments be as flexible as possible? Shouldn’t they warn us when encountering a curve so severe that they are likely to break? Since instrument separation is of great concern, shouldn’t manufacturers make them safer? We didn’t stop driving cars; rather, we installed seat belts, anti-lock brakes and airbags for added safety. Addressing breakage by using instruments just once is an expensive solution and one that doesn’t always work, either.
Since canals are oval (Fig. 2a), shouldn’t an instrument tell us when it’s not cutting canal walls in the apical third, when it is doing some cutting at the minor diameter (Fig. 2b), and when it is cutting all canal walls because it has reached the size of the major diameter (Fig. 2c)? By experiencing these transitions, we would know when apical instrumentation is complete. Clearly, if we stopped instrumentation at the minor diameter we would have overinstrumented the extruded ends of the canal would remain uninstrumented and full of debris. Yet, why should we ever insist on preparing a tapered form. So, why should our instruments be tapered and why must we insist on preparing a tapered shape when we know this must stay within the limits of the canal? This shape doesn’t allow Flexibility allows instrumenting to naturally occurring large apical diameters. No longer must we compromise canal cleanliness by ending our preparations at small instrument sizes to avoid transportation and lodging. Instrumenting to the correct apical size (avoiding both under and over instrumentation) is just half the battle. The “right size” instrument must stay within the limits of the canal or the resulting transportation can do more harm than good.

Application of new paradigms

The new LightSpeed LSX™ instrument and EndoVac irrigation system are the cornerstones of the new paradigm we call Smart Endodontics™. We’ll discuss how EndoVac is creating new irrigation paradigms in a future article. For now, we’ll look at how LSX (Fig. 4) is shifting our thinking away from current instrumentation paradigms.

Flexibility

When compared to tapered instruments, the LSX is by far the most flexible. Given the same tip size, no other instrument design comes close. Flexibility allows instrumenting to naturally occurring large apical diameters. No longer must we compromise canal cleanliness by ending our preparations at small instrument sizes to avoid transportation and lodging. Instrumenting to the correct apical size (avoiding both under and over instrumentation) is just half the separation rates involving tapered instruments.12

Tactile feedback

The smallest LSX blade is an ISO #20, which is significantly larger than most canals. Being smaller, the blade just glides gently against the wall. If it’s touching the wall, it’s not cutting. The tip is rotating — leaving the other canal walls untouched. As we progress to larger diameters the blade is cutting only a small section of canal wall because it is rotating — leaving the other canal walls untouched. As we progress to larger diameters the blade is cutting only a small section of canal wall because it is rotating — leaving the other canal walls untouched.

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Conclusions

We’ve developed an obturation system called SimpliFill® (Fig. 5). Its design frees us from having to create an artificial tapered shape just to obturate with tapered cones or to use condensing devices deep in the canal. SimpliFill’s ability to seal the canal is as good, if not better, than other techniques. It requires much less time, skill, equipment and patience.

10 Instrumentation

Maxillary Apical Sizes (Working Widths)

Mandibular Apical Sizes (Working Widths)

Figs. 3a, 3b: Tables show canal preparation sizes in the apical third (trange of working widths). Notice the minimum size is 0.15mm (#11 instrument at the tip). However, most widths are much larger. The goal of instrumentation is to use the correct Final Apical Size appropriate for each canal and flexible enough to stay centered in the canal. As I said before, more rigid instruments cause more harm than good.
Instrumenting to the proper diameter

Working Width — if you are not familiar with this term, don’t be surprised. It’s relatively new. Working Width relates to canal diameter from the coronal to the apical constriction. It’s relatively new. Working Width relates to canal diameter from the coronal to the apical constriction. It was first used by Dr. Jou from the University of Pennsylvania. I like this term very much, because it is a valuable reminder that canals are three-dimensional. This means that all instrumentation techniques have to contend with both a working length and a working width. Incidentally, this area of the canal (coronal to the apical constriction) was called, and with good reason, the “Forgotten Dimension” by Carl Hawrish, an endodontist from Canada (deceased). Your goal should be to avoid both under and over preparing the canal. Achieving this doesn’t have to be a mystery anymore. Anatomical research tells us that canals come in many different diameters, from small to very large. Therefore, we make LSX in many sizes too, #20 to #160 — with the most common Apical Sizes ranging from 45 to 80.

The proof is in the cross-section

As part of our hands-on courses, participants instrument and obturate extracted teeth with LSX and SimpliFill and actually see the results. It’s one of the highlights of our course. Teeth are cross-sectioned, photographed under a microscope and projected onto a big screen for group discussion and evaluation. Don’t worry, we don’t give grades — it’s a learning experience. Participants are amazed at how well they do with the technique; more than 90% get the Final Apical Size correct the very first time. With practice it becomes second nature. View sample cross-sections at www.discusdental.com/endo. While you are on Web site, look for case reports, course schedules, technique guides and more than 100 references supporting what I’ve discussed above.

The LSX Technique

This short article doesn’t allow us to get into much detail, so here is an overview:

1. Make a straight-line access and flare the coronal third of the canal.
2. Establish a glide path to working length (WL) with #20 k-file.
3. Start NiTi rotary preparation with the LSX #20 to WL. Continue with increasing instrument sizes until tactile feedback indicates the final apical size (FAS) has been reached.
4. Subtract 4 mm from WL and instrument to this length with the next larger LSX size. This completes the preparation of the apical third (5 mm).
5. Prepare the middle third with the next 2 or 3 larger LSX sizes.
6. Irrigate with EndoVac using your irrigants of choice (Fig. 6).
7. Obtain the apical 5 mm with a 5 mm SimpliFill GP or Resilon Plug that is placed with a removable carrier. Complete the obturation of the middle and coronal thirds with the HotShot™ cordless backfill gun (Fig. 7), or technique of your choice.

Now - What to do with this information?

Try to overcome inertia knowing full well it may be somewhat difficult; most of us just don’t like change. It is our hope that the existing scientific evidence will convince you to overcome inertia, get rid of the old, bring in the new, and embrace the future — now, not later. Transition to this new technique slowly, start with easy cases and gradually work up to more difficult cases as your confidence and abilities increase. Remember you didn’t learn your current technique in a day either.

If you are ready for change, please call Discus Dental at (800) 817-5636. They will send you a free CD showing what Smart Endodontics is all about.

I wish to thank Steven S. Senia, BSIE, MBA, for his valuable contributions to this article.

References


Fig. 7: The cordless HotShot backfill gun makes for an easy and effective obturation behind the SimpliFill Plug.