Minimally invasive and biomimetic endodontics: The final evolution?

By David J. Clark, DDS

Traditional endodontics has been based on feel, not sight. Tactile proprioception was the only guide as burs and files were blindly inserted into pulp chambers and root canal systems. Together with radiographs and electronic apex locators, this blind approach has produced surprising success, that, in the words of Dr. Eric Herbransen, “the endodontics succeeds often in spite of us.”

There is, however, a significant failure rate, especially long-term failure of the driving mainstream dentistry to aggressively extract natural teeth in favor of implants. The sting of clinical failure is a powerful motivator for change. In this article, I will describe the rationale and techniques involved in minimally traumatic endodontic access and shaping (Part I). In my upcoming Webinar I will discuss obturation techniques for smaller and non-round endodontic shapes, which will also appear as a follow up article in this publication (Part II).

Ribbons, sheets & banners

One of the most distressing “hangovers” of the era of blind endodontics and endo-restorative is the belief that canal systems are straight, exit at the radiographic apex and are round in cross section. In reality, most canal systems curve into a variety of unpredictable ovoid shapes, often round. As these canal systems mature, they narrow into a variety of unpredictable ovoid shapes, often with smaller anastamosing canal systems shown, only one is round. As these canal systems mature, they narrow into a variety of unpredictable ovoid shapes, often with smaller anastamosing canal systems (Figs. 4–6).

The evolution of endodontic shaping

The original endodontic shaping was established based on mostly hand filing and filling with either silver points or cold lateral condensation of gutta-percha. Sargenti later introduced a more rapid approach that involved machine-driven instruments (rotary files) creating larger shapes with significantly more dentin removal. As of late, a crown-down approach is now popular. The roots are rapidly and blindly machined. This can result in better obturation of the apical half because of improved penetration of irrigation during instrumentation and improved hydraulics during obturation. But at what cost (Fig. 2)?

Is crown-down endo actually better than lateral condensation?

The outcome studies are inconclusive, but what we do know is that the success rate today is no better than it was 40 years ago (Fig. 5). The advantages of crown down are often offset by the weakening caused by Gates-Glidden burs and orifice shapers. The short-term thrill of the radiographic “puff of sealer” at the apex is lost when the tooth imploodes a few years down the line. Residual dentin is directly related to long-term strength and has indisputably been shown as the key to long-term tooth retention.

In contrast, the supposed strengthening of the root from a “monolock” of bonded resin obturation, bonded core and fiber post is proving to be inconsistent. Another startling revelation is that the dentin in an endodontically treated tooth is not more brittle than in a vital tooth. In short, preservation of peri-cervical dentin and ferrule girth trump all other factors.

Ovoid canal systems & roots are non-round for a reason

Rotary instruments and obturating points of gutta-percha are round because of the limitations of their mechanical nature. They create anatomically appropriate shapes in round roots, but fail in ovoid roots. Over the ages, the dynamics of occlusion and arch form have guided the development of human tooth roots such that at least half have ovoid roots.

Smaller and/or ovoid shaping: Why and how?

Why? Biomimetics is a treatment approach that has, as its ultimate goal, to retain as much of the natural tissue as practical, and to mimic the physics and structures of the human body. There is nothing biomimetic about a stiff, round rod (prefabricated post) running through the center of an ovoid root. The natural ovoid root is essentially a semi-rigid pipe deriving its strength from without, not within. The endodontic and endo-restorative goal should be to mimic the pulp space that was present when the tooth was young. From that point, it can be argued that any secondary dentin that is deposited adds little additional strength because of the amorphous and irregular deposition pattern. This point is supported by the robust strength of young teeth with large pulp chambers and large radicular pulp spaces.

If a small round access that does not disturb primary dentin can allow instruments to engage potentially significant complex anatomy (e.g. a second or third major system and corresponding portals of exit), then the round access is acceptable. The See ENDONTOICS, Page 8

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Figure 3: This radiograph demonstrates a 31-year success with delicate shaping and crude obturation with silver points (#14), and a four-year failure with a large crown-down shape and heated gutta-percha (note the lesion on #13).
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The three components of ovoid systems branch into five systems in the coronal third. (Image courtesy Dr. John Khademi)

Creating a large round access that results in removal of primary dentin of the delicate, narrow portion of the root is the common approach today. While this can allow access to complex branching of systems that occurs further apically, it does not satisfy the more appropriate goals of anatomic, biomimetic dentistry.

Additionally, the single large round endodontic shaping pattern often encroaches upon a fluting in the endodontic shaping pattern often encroaches upon a fluting in the endodontic shaping pattern often encroaches upon a fluting in the endodontic shaping pattern.

Fig. 6: Another variation of ovoid roots, non-round systems branch into five systems in the coronal third.

Fig. 7, 8a, 8b: Several renderings contrast current endodontic shapes versus new biomimetic microscope enhanced shapes. Figure 7 shows the preservative pulpal space of the root, sectioned at the orifice, then shows lateral condensation shape that does not weaken the root but also does not address the potential complex anatomy. The third image shows the new aggressive crown-down shape that weakens non-round roots. Figure 8a shows two potential shapes that are anatomic and address the complex anatomy, yet do not weaken the tooth. Figure 8b shows the obliterated anatomic shapes in the second axis.

Fig. 9: A new model for lower incisor access is depicted, along with the new CK endodontic access bur. Note that the access has been moved away from the cingulum and toward the incisal edge. The delicate tip size of the bur and its conical shape are helpful for both visual (dentists using microscopes) and tactile (file or no magnification) endodontics.

Although no two roots are the same, general anatomic patterns allow the microscope-equipped clinician to search for major pulpal regions that will yield a high probability of cleaning and shaping the clinically available pulpal zones.

Anatomic, biomimetic shaping cannot occur safely “by feel” (Figs. 7, 8a, 8b).

Summary
Although no two roots are the same, general anatomic patterns allow the microscope-equipped clinician to search for major pulpal regions that will yield a high probability of cleaning and shaping the clinically available pulpal zones.

Can endodontics be minimally invasive? Biomimetic? Last as long as implants?

The implant era has raised the bar for endodontics serendipitously as new tools and techniques allow for the next level of endodontic excellence. Instead of “blindly poking around” the pulp chamber and “machining” the delicate root with Gates-Glidden and large rotary files, there are other options! Once we have created the new shapes, then how can we perform ideal obturation? Join us to find out!

This is one Webinar in a five part Webinar series that will be running over the course of the entire day to launch the brand new Dental Tribune Study Club. Participants will receive C.E. credits and attendance is free for the first 100 registrants. After the first 100 spaces are filled, the cost of attendance is only $49. Live attendees have 30-day access to the recorded Webinars to review at their convenience. Attendees require an online computer with audio capabilities. Please register at wire.DTStudyClub.com. After registration, you will be provided with a pass code. However, if you cannot attend the live Webinar, you may access the archived version for $49 by signing up on the site.

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Table 1: New microscope-enhanced protocol

1. Initial access with round-ended carbide or diamond burs. For incisors and canines, the new Cx endo access burs provide optimum safety and dentin preservation (Fig. 9).
2. Gross de-roofing with tapered diamond burs, retaining a small “soft fill.”
3. Provide straight-line access sweeping away from high-risk anatomy with the CPR-2D.
4. For ovoid systems...
5. Sweep the coronal ½ of the ovoid system with the CPR-2.
6. Sweep the next ½ or with the CPR-2D (Fig. 10b).
7. Irrigate, dry with the Stropko syringe and then evaluate at 16–24x for multiple systems that branch in the apical half.


Clinical


About the author

Dr. David Clark founded the Academy of Microscope Enhanced Dentistry and is a course director at the Newport Coast Oral Facial Institute. He lectured for Clinical Research Associates in the “Update Series.” In addition, Clark authored the first comprehensive guide to enamel and dentinal cracks based on 16 power magnification, and numerous articles relating to minimally invasive dentistry, biomimetic endodontic shaping, diastema closure and advanced magnification. Clark helped pioneer the concept of “biomimetic micro-endodontics.” He serves as an opinion leader for restorative dentistry and endodontics, introduced the “Clark Class II” for posterior composites and developed the Biolear Matrix System.

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Patient scheduling

Of all the duties and responsibilities of your staff, we hear more complaints about needing to fill the schedule than any other. The truth is that using the phone and paper-based systems is time-consuming, expensive and doesn’t allow for much interaction from our patients. Wouldn’t it be nice if there were some newer systems that could handle these chores with minimal input and time from us and, at the same time, involve the patient in the process? (You already know the answer to this!)

There are two basic types of systems out there: electronic and phone based. The electronic systems all work in the same manner: once a patient is entered into the practice management software’s scheduler, it automatically generates an e-mail to the patient (you are selecting e-mail addresses... aren’t you?) that he or she can click to confirm the appointment. Reminders can then be sent at intervals you designate, such as two weeks and four days before the appointment.

The companies that use these systems include DemandForce, Lappinetti and Smile Reminder. Smile Reminder also has a feature where you can send text message reminders to patients on their cell phones, such as reminding them to premedicate before appointments.

The other option is to use a phone-based system like the one used by Elexity. If you’ve used phone systems in the past, these are nowhere near as advanced as Elexity, which uses central software to track the calls and uses the hygienist’s or doctor’s voice. All of these systems run a couple of hundred dollars per month, but when you think about how much time and money is typically spent on phone calls, postcards and postage, etc., they are a real bargain.

Patient activation

In the same vein, don’t you find it annoying when a patient shows up for the first appointment and has not filled out the forms that the