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 failures. In 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 round. As these canal systems mature, they narrow into a variety of unpredictable ovoid shapes, often with smaller anastomosing canal systems (Figs. 4-6).

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 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. The dynamics of occlusion and arch form have guided the development of human tooth roots such that at least half have ovoid roots.

Small 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 ENDODONTICS, Page 8

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 (see the lesion on #13).
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 center of the root.

How? Visually shaping ovoid systems. The three components of ovoid shaping are:
1) the operating microscope with powerful coaxial shadowless lighting,
2) ultrasonic instruments, and
3) an understanding of the anatomy of ovoid roots.

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. 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!

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

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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 this archived version for $49 by signing up on the site. Upon registration, you will be provided with a pass to view the recorded Webinars to review at their convenience. Attendees require the full-day symposium is only $49. Live attendees have 30-day access to the online audience.
While these systems go by many different names, the best way to describe the system is that it's a cross between a digital pan/ceph and a CAT scan machine. The most popular model right now in the United States is the i-Cat by Imaging Sciences. While I could describe the system in detail, this excerpt from an i-Cat user does a much better job of explaining why they are becoming so popular:

"Compared to medical scanners, cone beam scanning is 10 times more accurate while reducing a patient's exposure to radiation by more than 97 percent. Pre-surgical implant treatment requires removing impacted third molars, determining how sinus grafts and ridge augmentation heal, determining the ideal position for a single-tooth replacement are just some of the benefits of cone beam scanning technology. Because cone beam scanning permits multiple slices through the axial, sagittal and coronal views, the guesswork is removed when it is critical to determine the width of edentulous ridges, whether or not cancellous bone exists between cortical plates, the position of supernumerary and developing tooth buds, if sockets have filled with bone, if irregularities exist to the condyles, where the mandibular nerve is relative to an impacted tooth and implant sites, or to visualize the borders of a cyst or tumor. Cone beam scanning has an added benefit in that it can take the maxilla and mandible in a single scan.

Probably the biggest drawback to these systems is the initial cost: they average around $170,000 to $200,000 each, although new units from Kodak and Gendex are now below $100,000. I'm seeing many dentists group together to create imaging centers to share the costs of the machines, and these centers are sprouting up all over the country. While the cone beam may someday be the standard of care for many procedures, it will be quite some time before that happens.

Table 1: New microscope-enhanced protocol

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<td>1.</td>
<td>Initial access with round-ended carbide or diamond burs. For incisors and canines, the new CR endo access burs provide optimum safety and dentin preservation (Fig. 5).</td>
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<td>2.</td>
<td>Gross de-roofing with tapered diamond burs, retaining a small &quot;soft fit.&quot;</td>
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<td>3.</td>
<td>Provide straight-line access sweeping away from high-risk anatomy with the CPR.2D.</td>
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<td>4.</td>
<td>Sweep the coronal 5% of the ovoid system with the CPR.2.</td>
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<td>5.</td>
<td>Sweep the next 20% with the CPR.2D (Fig. 10b).</td>
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<td>6.</td>
<td>Irrigate, dry with the Stropko syringe and then evaluate at 16–24x for multiple systems that branch in the apical half.</td>
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