Minimally invasive and biomimetic endodontics: The final evolution?

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Traditional endodontics has been based on feet, not sight. Tactile proprioreception 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, that is 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 and exit short of the radiographic terminus. A very large number, at least 50 percent, are ovoid or super-ovoid in cross section. Figure 1 demonstrates that of the three roots and 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 shape was established based on mostly hand filing and filled with either silver points or cold lateral condensation of gutta-percha. Sargentii 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 inclusive, but what we do know is that the success rate today is no better than it was 40 years ago (Fig. 3). 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 implodes 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 "monoblock" of bonded resin obturation, bonded core and fiber post is proving to be inconsistent.1 Another startling revelation is that the dentin in an endodontically treated tooth is not more brittle than in a vital tooth.2,3 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 reality of ovoid roots would seem to disagree with this approach.

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...
encroaches upon a fluting in the center of the root.

How: visually shaping ovoid systems

1) The operating microscope with powerful coaxial shadowless light, 2) ultrasonic instruments, and 3) an understanding of the anatomy of ovoid roots.

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

**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 shapes that were introduced during the Schilder era have served as a transitional technique to allow the real first three-dimensional compaction of gutta-percha. Endodontics is, in reality, a restoratively driven procedure; and minimally invasive and biomimetic principles will require different skills and materials to shape, pack and restore these non-round canal systems.

**Table 1: New Microscope-Enhanced Protocol**

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<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>1.</td>
<td>Initial access with round-ended or diamond burs. For incisors and canines, the new CK endo access burs provide optimum safety and dentin preservation (Fig. 9).</td>
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<td>2.</td>
<td>Gross de-roofing with tapered diamond burs, retaining a small “soft fit.”</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 ⅓ of the ovoid system with the CPR-2.</td>
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<td>5.</td>
<td>Sweep the next ⅓ or ⅔ with the CPR-4D or 5D (Fig. 10a).</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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**References**


**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 lectures at 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 Bioclear Matrix System.

**Attend Dr. David Clark’s Webinar!**

On March 14 at 1:45 p.m. E.S.T., Dr. Clark will present a one-hour Webinar, “World Class Obturation for General Dentists,” followed by a live question and answer session with the online audience.

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

The implant era has raised the bar for endodontics, serendipitously as the implant era has raised the bar for endodontic treatment on some restoratively driven procedures. Instead of “blindly poking around” the pulp chamber and “machining” the delicate root with Gates Gliddens 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 the full-day symposium 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 under www.DTStudyClub.com. Upon registration, you will be provided with a pass code. Hurry to be one of the first 100!