The real state of endodontic instrumentation

Author _Barry Lee Musikant, DMD

While the quality of endodontic instrumentation and obturation are generally based on our final mesio-distal X-rays, we must not believe for a moment that such an X-ray is necessarily a predictable or even accurate reflection of a job well done even when the results look excellent. I say this today because research over the past several years has clearly established that canals are often quite oval, deviating significantly from the conical shapes we most often associate with thorough instrumentation and obturation (Figs. 1, 2).

In this regard, the inadequacy of rotary NiTi in shaping such canal configurations is established by a plethora of research articles. The use of rotary NiTi aggravates incomplete shaping by its need to stay centered at all times within the canal. It takes little imagination to realize that an instrumentation system that requires constant centering lest it be more prone to separation, is not going to cleanse what are often the buccal and lingual extensions of highly oval canals. To further compound inadequate debridement, single instrument NiTi instrumentation systems have been introduced that have also been clearly shown via micro CT scans to miss removing more than 50 percent of the tissue in the canals (Fig. 3).

Knowing that NiTi instruments of greater tip size and taper are more prone to separation, rotary NiTi

Figs. 1, 2. CT scan of a mandibular central incisor. Note the irregular canal shape. (Images/Provided by www.rootcanalanatomy.blogspot.com)

Fig. 3. The green areas of this CT photograph show areas missed during the root canal procedure.
Unlike rotary users, Endo-Express reciprocating users don’t fear instrument separation or dentin micro-fractures!

SafeSiders are the only instruments designed specifically to work in reciprocation. The flat along the entire length:
- Creates more efficient cutting
- Reduces engagement for faster advancement
- Reduces instrument stress improving durability
- Increases instrument flexibility without sacrificing strength

Increase your quality while reducing your costs!
Schedule a FREE In-Office Demo.

FREE In-Office Demo, Visit: www.edsdental.com/demo
Visit www.edsdental.com for promotional offers!

Learn More - Visit the EDS booth during the upcoming dental meeting!

*Research available upon request.
and to a lesser extent asymmetric NiTi reciprocation creates an incentive in the dentist to prepare canals conservatively with an increased incidence of debris left behind. Recent research has now demonstrated an increased occurrence of dentinal micro-fractures when the canal walls are exposed to NiTi instruments generating full arcs of motion. It should also be noted at this time that both hand instrumentation and engine-generated movement not resulting in full arcs of motion are not associated with the development of micro-fractures.

In short, 20 plus years after the introduction of rotary NiTi and its close cousin asymmetric reciprocation, we are becoming more aware of the limitations imposed by these systems including modification of technique to prevent separation, non-deviation from centered canal preparations leaving debris in the wider extensions of oval canals to again prevent separation, the understanding that NiTi instruments of increasing tip size and taper are not only more prone to breakage, but are more likely to create dentinal micro-fractures.

Given the aggressive marketing of these instruments and their universal adoption by our dental educational institutes, it is imperative that we understand what these instruments cannot predictably and safely do and what alternatives exist that can produce a safer and more thorough result. The research has clearly established that apical canal preparations must be to at least a 30 and preferably a 35 to provide sufficient space for effective irrigation. Given the insecurities of the present NiTi systems such apical preparations will be a rarity particularly in curved canals of molars.

The first improvement in instrumentation must be the elimination of instrument breakage as a source of concern. If breakage can be eliminated, the challenges to the dentist doing endodontics is now limited to negotiating and widening the canal without distortion, a far easier task when separation is no longer a worry.

It’s one thing to talk about the benefits of non-separation, but exactly how is this accomplished when it is common wisdom that breakage is something that anyone doing endodontics must contend with? The fact is that if the movement of the instruments are limited to a tight arc of motion manually and do not exceed a 30-degree arc of motion when engine-generated, the elastic limit of the instruments will not be exceeded and the instruments will remain intact. The twin factors that lead to the separation of NiTi instruments are torsional stress and cyclic fatigue, both generated by high degrees of rotation. Substitute 30-degree reciprocation for full arcs of rotation and the instruments will remain intact even when used at 3,000–4,000 cycles per minute.

The consequences of no longer needing to be concerned about instrument separation are several:

1) The earliest instruments can be used aggressively against all the walls of the canals including the thin isthmuses that may be present either between canals or the extensions of oval canals.
2) The instruments can be used several times until they become dulled. They need not be replaced after one use because the downside to over usage is dullness not breakage, a fact that relieves a good deal of gastric distress while dramatically reducing the cost.
3) The canals are widened to a minimum of 35 in accordance with the research that shows how such preparations correlate to superior irrigation.

What we have not mentioned up to now is just what design is optimal. Here we deviate from the traditional use of K-files, substituting K-reamers through a 10 and then relieved K-reamers (Fig. 4) starting with the 15 and continuing on with instruments of this design for the complete shaping proce-
Clinical Masters Program in Aesthetic and Restorative Dentistry

10-14 January 2013 and 24-27 April 2013 in Dubai, for a total 9 days

Session I: 10 - 14 January 2013 (5 days)
- Direct/Indirect composite Artistry in the Anterior Segment
- Direct/Indirect composite Artistry in the Posterior Segment
- Photography and shade analysis

Clinical Masters:
Didier Dietschi, Francesco Mangani, Panos Bazos

Session II: 24 - 27 April 2013 (4 days)
- Full coverage Anterior/Posterior Restoration
- Partial coverage Anterior/Posterior Restoration, Ceramic Restoration

Clinical Masters:
Mauro Fradeani, Ura Brodbeck

Full access to our online learning platform: hours of premium video training and live webinars collaborate with peers and faculty on your cases

Registration info
Course fee: € 8,900
Register by the end of October and you will receive a complimentary iPad preloaded with premium dental courses

Discover the Master's secrets and Dubai's superlatives

100 C.E. CREDITS

ADA CERP® Continuing Education Recognition Program
Tribe Tim CME
www.TribuneCME.com
The advantages of reamers both unrelieved and relieved are superior to K-files and eliminate the need for either rotary or asymmetric reciprocating NiTi’s subsequent use for the following reasons:

1) K-reamers have half the number of flutes with a flute orientation that is twice as vertical producing less engagement along length.

2) Used with the same watch-winding motion as K-files, the reamers will immediately shave dentin away from the canal walls because the more vertical orientation of the flutes puts them more or less at right angles to the plane of motion, similar to what occurs when shaving with a safety razor that is on a T. The same way a blade at right angles to the plane of motion produces smooth skin, it will effectively shave dentin away from the canal walls. The traditional use of K-files results in the engagement, not the removal of dentin, until the pull stroke is employed. Yet these same horizontally oriented flutes on a K-file have a high potential to impact dentinal debris when being introduced into the canal.

3) Having half the number of flutes compared to a K-file, the reamer is less work hardened making it more flexible. The incorporation of a flat along its entire working length makes it still more flexible. That along with its reduced engagement along length allows it to negotiate curved and tortuous canals with far less resistance than a K-file will encounter, allowing the canal to be shaped to the proper dimensions in significantly less time. It should also be noted that the creation of the glide path is where blockages, ledges and loss of length most frequently occur, a direct result of the poor K-file design. This is far less likely to happen when using the reamers both unrelieved and relieved either manually or in the 30-degree reciprocating handpiece.

4) A system based on the design of a relieved reamer and utilized in a way that minimizes the amplitude of motion is best made of stainless steel. NiTi requires only a small extension of distortion beyond the elastic limit to produce a breakage. Stainless steel will work under far more distortion before it separates, making it a more practical metal than NiTi.

5) Stainless steel can be pre-bent to adapt to any canal configuration. NiTi, in most preparations snaps back to the straight position with a tendency to shape curved canals to the outer wall. Those preparations of NiTi that can record a bend are so flexible that they can easily lock apically while rotating or reciprocating coronally. There is a downside to being too flexible.

6) The greater stiffness of stainless steel means it must not be used in rotation, but has no limitations when used with a short arc of motion either generated manually or in the reciprocating handpiece. The greater hardness of stainless steel means the instruments will retain their cutting edge far longer than NiTi. Considering the fact that these instruments should be used at least six times before replacement, the retention of a sharp blade is a decided advantage.

It is an easy task to enumerate the advantages of the reamers over that of K-files and the subsequent use of NiTi. The proof, however, is in the pudding and a recent example of the work that we produced in our office will illustrate the advantages gained from their usage.

Figures 5–7 show a maxillary molar that was prepared apically to a minimum of 35, 1 mm back to a 40 and the implementation of the single NiTi instrument we use in reciprocation, the 25/06 to blend in the middle and apical thirds. The dimensions of the preparation were in accordance with the research that recommended a 35 for effective irrigation.

From the outset, using the thinnest 06 reamers, all the walls of the canals were shaped by the reamers’ vertically oriented blades. If we are serious about removing the tissue in the thin isthmus extensions that often exist, we must address them at the very beginning of instrumentation when instruments are the thinnest.

The reamers far more easily negotiate curved canals than K-files and if increasing resistance is encountered are pre-bent and negotiated manually around any tortuous canal present. A combination of superior dentinal shaving, less initial engagement and increased flexibility give the reamers the ability to provide the dentist with excellent tactile perception, letting him know exactly when an instrument may require pre-bending.

With the ability to be pre-bent and limited to a short arc of motion, the stainless-steel reamers both unrelieved and relieved can adapt to any situation that may be encountered. The result is not only one that looks good in the mesio-distal plane, but is cleansed three dimensionally to a degree that assures cleaner canals and superior obturation while leaving the walls of the canal defect free.

Editorial note: A complete list of references is available from the publisher.