Endodontically speaking, the proof is in the pudding

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_Having lived through the traditional (hand instrumentation) and rotary NiTi periods of endodontics, the main drawback of both periods, in my estimation, has been in not applying what our clinical experience and our wealth of research has told us. Today, we essentially use K-files as if they were reamers. By this, I mean that we use them predominantly in a watch-winding motion, a reaming action by another name.

Does it matter if a K-file is used in a reaming motion? What are the differences between a K-file and a K-reamer that call for differences in their usage? A K-file has twice as many flutes along the 16 mm working length that a K-file and K-reamer have in common. Twice as many flutes means twice as much engagement along length and at least twice the resistance encountered during apical negotiation. Increased resistance to gaining apical length does not sound like a desirable trait.

Are there any other differences? The flutes on a reamer are twice more vertically oriented than those on a file. Does this have implications for using the recommended watch-winding motion?

The more the cutting edges of the flutes approach a right angle to the plane of motion (which is mainly horizontal), the greater the cutting efficiency of the flutes. An easy way to visualise this concept is to consider the use of a file in carpentry. The carpenter is able to cut wood with a file because he/she is applying a vertical motion to an instrument that has horizontal flutes. If the flutes were vertical, in the same plane


Fig. 1

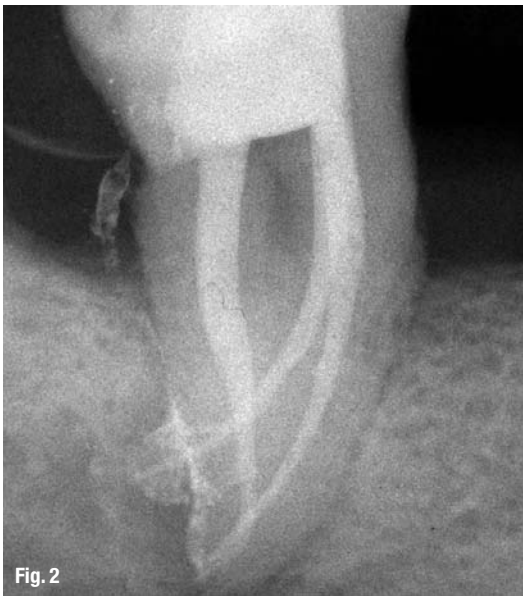
Fig. 2

as the plane of motion, then the carpenter would be scratching the wood, not cutting it. The same applies to planing an internal root surface.

In addition to engaging the walls of the canal less and cutting dentine more efficiently, the K-reamer is more flexible than the K-file because the fewer number of flutes produces a less work hardened instrument. Greater flexibility, less engagement and more efficient planing of the canal walls give the dentist an improved tactile perception, providing the ability to distinguish between a tight canal and the encountering of a solid wall.

1. even greater flexibility because of its thinner cross-sectional diameter;
2. less engagement along length;
3. the inclusion of two vertical columns of chisels that cut effectively in both clockwise and counterclockwise motion;
4. the inclusion of a cutting tip; and
5. a space for dentinal debris.


Fig. 3


Fig. 4


Fig. 5

This is all very well, but the problem is that the vast majority of dentists are still being taught to use K-files if not for the entire preparation of the canal at least for the glide path so that rotary NiTi can be used with greater safety. The K-file, an instrument not well designed for its function makes glide-path creation a challenge. It also motivates dentists to use these instruments for as short a period as possible so the more efficient rotary NiTi instruments can be used. There is a bit of a conundrum here. Inefficient K-files are being used so that the more efficient rotary NiTi can be safely employed. If instruments far more efficient than K-files could be employed, the need to switch to rotary NiTi would be reduced. Furthermore, rotary NiTi has its own problems, including unpredictable separation, the need for single usage and great expense.

The way to solve this conundrum is through relieved reamers used either with a tight watch-winding motion or in a 30° reciprocating handpiece. This brings a vast improvement and nullifies the need for rotary NiTi. While K-reamers are vastly superior to K-files in the shaping of canals, relieved K-reamers, otherwise known as SafeSiders, are measurably superior to non-relieved K-reamers. The reasons for this superiority include the following:

These factors produce an even better tactile perception, giving the dentists precise knowledge regarding not only when a solid wall is being encountered, but also whether the canal is round or oval.

Why is the dentist better off using an instrument that clearly tells him when he/she is encountering a wall? The more precisely the instrument tells the dentist what the tip of the instrument is encountering, the easier it is for the dentist to know when to bend the instrument at the tip to negotiate around any blockage that he/she comes upon. If a dentist doesn't know a wall has been encountered, he/she is more likely to keep applying increasing vertical force as the instrument is twisted. The result is often an artificially made canal with the original canal with tissue in it untouched or at best inadequately cleansed. Once the dentist has negotiated around the blockage manually, he/she may reattach the relieved K-reamer to the reciprocating handpiece for quick and effective apical negotiation. It usually takes no more than a few seconds to achieve apical length when the canal is patent.

The relieved reamers have two requirements to achieve rapid non-distorted shaping. First patency must be maintained. The way to do this is by extending the instrumentation 0.5 mm beyond the constriction through a #25. As long as this is done, patency will be maintained and distortion will not occur. The other requirement is either the use of a tight watch-winding motion or use in a 30° reciprocating handpiece. This particular

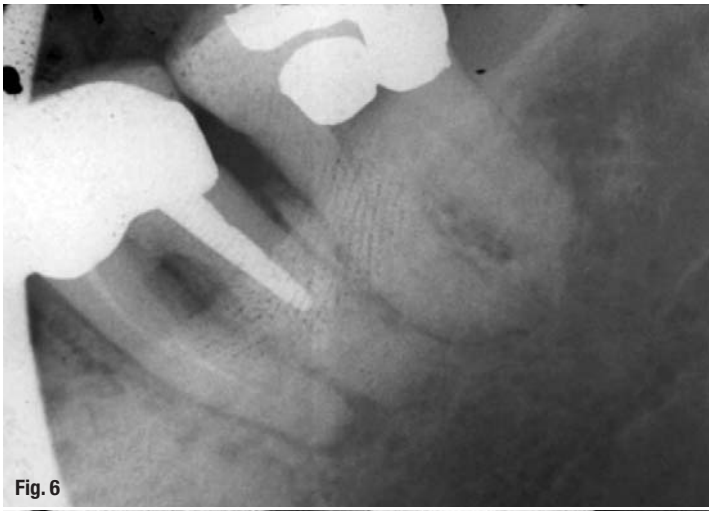

Fig. 6

Fig. 7

requirement becomes increasingly essential with increasing curvature of the canal. The short arc of motion keeps the K-reamers well centred within the confines of the canal. Distortion will only occur in curved canals if the arc of motion is significantly increased. This cannot happen when a reciprocating handpiece is used and is unlikely to happen with manual use simply because canals of increasing curvature produce dramatically more resistance to rotation, making the short arc of motion far more achievable. In fact, customising a short arc of motion, where the greatest resistance is encountered, is entirely compatible with distortion-free shaping.

These two insights eliminate the need for rotary NiTi entirely and in doing so, eliminate the concerns for separation either through torsional stress or cyclic fatigue. While this sounds good, are there drawbacks? Does this system require many more instruments and can they be used efficiently?

If one considers the reality that most glide paths are first created with difficulty using K-files through a #20 before rotary NiTi is used, we can dispense with instrumentation through a #20 for both approaches because the number of instruments is common to both. In reality, the glide path through a #20 with both non-relieved and relieved K-reamers will be dramatically easier and more rapid than K-files, but it is the use of the same relieved reamers in larger dimensions that negate the need for rotary NiTi. After the #20 relieved reamer is used, the coronal curve is straightened with a tapered peeso called a Pleezer. It is used only until resistance is met and never closer than 6 mm from the apex, even if possible. The use of a Pleezer would be similar to the use of a rotary NiTi instrument employed in a crown-down fashion, except the Pleezer is made of stainless steel with a far greater capacity to remove tooth structure from the outer wall of the canal, thus providing straight-line access for the subsequent instruments.

Once straight-line access has been attained with the Pleezer, the #25 relieved reamer is taken 0.5 mm beyond the constriction, followed by the #30 to the constriction. At this point, if the canal was tight to begin with and highly curved, the final instrument would be a 25/.06 reamer 0.5 mm beyond the constriction, followed by obturation of the canal. In order to gain a canal preparation of a #30 at the apex, the minimum preparation stated in the literature to ensure adequate irrigation and a 25/.06 overlayed taper requires four instruments beyond the #20. This preparation compares favourably with rotary NiTi that often will not shape a curved canal to more than a 20/.04 or at most a 25/.06 to the apex, dimensions that do not fulfil the minimum preparation for effective irrigation as suggested by research.

If the canals are larger, shaping may be continued with the #35 after the #30 to the apex with the #40 1 mm short and the 25/.06 used at this point. Even these larger preparations require no more than six instruments and are rarely ever needed in recapitulation, the way rotary NiTi instruments must be used.

The system sounds too good to be true. The claims are that the system is able to shape highly curved canals without distortion, that canals can be shaped to a minimum diameter of #35 in most cases and that the instruments will not break, that they can be used six to seven times and overhead will diminish by approximately 90 % when switching from a rotary NiTi system to one using relieved reamers both manually and in the reciprocating handpiece. Where is the proof for these claims?

Well, for one we have the presentation of cases. Secondly, we offer free two- to three-hour workshops for anyone interested in trying our system, so they can decide for themselves on the validity of these assertions.

Below are some examples of fairly challenging cases that were treated recently in our office using the SafeSiders. Please understand that the instruments are not simply placed into the reciprocating handpiece and then the canals are shaped. Rather, the reamers—both relieved and non-relieved—give excellent tactile feedback so we know when we are in the canal and when we are encountering a wall. With this knowledge, we know when to bend an instrument to negotiate manually around any blockage. Once patency has been achieved, the instruments used either manually or in the handpiece give us the ability to widen most often apically to a #35 without distortion and then obturate most often with a single medium point in a canal flooded with epoxy resin cement.

The case pictured in Figures 1 and 2, treated by Dr Young Bui, displays several important features of the system. Dr Bui was able to shape the canals to a #35 to the apex, ensuring enough irrigation to open up whatever lateral canals were present so they too could be obturated with the epoxy cement. While shaping to these dimensions, distortion is avoided because the instruments are fed apically using either a tight manual watch-winding motion or the reciprocating handpiece. If a wall had been encountered, the instruments would have been pre-bent, fed manually around the blockage and then reattached to the reciprocating handpiece. Please note the density of the fills. These radiographs were originally generated from film, not a digital source, which tends to exaggerate the density of gutta-percha and cement. The original negotiation of the canal was fairly straightforward because, despite the curves negotiated, the reamers (both relieved and non-relieved) produce far less resistance along length than K-files. After the #20, the coronal curves of the canals were straightened with a Pleezer, which has a tip size of 0.75 mm and a 0.03 mm taper.

Figures 3 to 5 demonstrate the maintenance of canal anatomy while shaping canals to a minimum of #35 and an overlayed taper of 25/.06, producing conditions that allow for adequate irrigation and the placement of a 3-D fill in a predictable manner. Again, the canals were initially negotiated with instruments that are inherently less engaging along the walls of the canal, providing for less resistance as they negotiate apically. All apical negotiation is achieved with the same manual watch-winding motion or the 30° arc produced by the reciprocating handpiece. Either way, maintaining patency assures a non-distorted canal preparation.


Fig. 8


Fig. 9


Fig. 10

Figures 6 and 7 present an extreme case of canal curvature, treated by my partner Dr Doug Kase. The curve on the distal root could not be

Fig. 11

Fig. 12

taken to a #30 to the apex. In this situation, Dr Kase shaped to the apex to a #20, 1 mm back to a #25, another 1 mm back to a #30 and then shaped as far as he could go with the 25/.06 without applying excessive apical pressure. Some of the lessons from this case include reading the original X-ray accurately to be aware that roots sometimes make strange bends. This is easy to say in hindsight. Just when you think you have a set of rules to follow, a condition comes up that doesn't allow for such consistency. In these cases, it is good to know that the shaping and obturation system you are using has the adaptability to handle whatever arises.

Figures 8 to 12 give two more cases that demonstrate the use of our system. The first case (Figs. 8–10) again shows the subtle curve that we successfully maintain, and the second case (Figs. 11 & 12) demonstrates the shaping of thicker canals because, as we know, not all canals are round. Some are thin and wide, particularly in the bucco-lingual dimension, and we must be prepared to shape these in such a way as to remove as much debris as possible.

Maintaining the curves is relatively indigenous to the instruments, as long as they are used with the two following criteria: maintaining patency and used within a short arc of motion—something that the system is designed to deliver.

As seen in Figure 12, canals call for wider preparations, be they in the mesio-distal or bucco-lingual plane. The relieved reamers in combination with the Pleezer are able to adapt to these situations as they arise.

We have presented a discussion of the advantages that come from a system that doesn't rely on either rotation or NiTi to deliver stress-free shaping of significantly curved canals. Being capable of successfully treating the cases above, makes our system well designed to handle less radical cases. By stress-free, we mean the impact of the canal anatomy on the integrity of the instruments and the benign impact on the health of the dentist of using a system that is virtually free of breakage. Without question, the incorporation of this shaping system along with our method of obturation has made the practice of endodontics far more enjoyable than I once thought it was destined to be.

For those wishing to attend the free 2 to 3 hour workshops, please call us at +1 212 582 8161 to set up a mutually agreeable time. For those who might like to join us on our message board, a site of true collegial respect and collaboration, please go to www.endomailmessageboard.com, create a user name and password and become a member. It is loaded with valuable information._

_about the author roots

Dr Barry Lee Musikant is co-director of dental research at and co-founder of Essential Dental Systems, a dental products manufacturing company located in South Hackensack, USA. The company's roots stem from the desire for product improvements. Dr Musikant's lecture schedule has taken him to over 400 international locations. He co-authored over 250 articles in dentistry in various major international and US dental journals. Dr Musikant can be contacted at info@edsdental.com.

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