We have introduced two new endodontic systems, one for shaping and one for obturation. There is in our opinion a need for both, given the unpredictability in gaining safe consistent results with rotary NiTi shaping, rotary NiTi’s requirement of a glide path shaped with K-files and the shrinkage that occurs with all thermoplastic obturation techniques.

Early on, we understood that we simply had to shape canals more efficiently than K-files. Our answer is a system essentially built around relieved K-reamers.

K-files versus K-reamers

In a comparison of K-files with K-reamers, the following distinctions can be made:

1. K-reamers have about half the number of flutes along the 16 mm of working length compared with K-files.
2. The fewer the flutes there are, the less the engagement along the length.
3. The fewer the flutes there are, the less work-hardened the shaft and the more flexible the instrument.
4. The early K-reamers accurately record any curvature that they traverse better than the stiffer K-files, letting the dentist know where a curve may exist, the degree of the curve and the orientation of the curve.
5. The less the engagement along the length, the less the resistance in negotiating apically.
6. Because there are fewer flutes along a K-reamer, they are more vertically oriented than K-files.
7. When used with a watch-winding motion, K-reamers with their more vertical flutes are far more effective cutting instruments than K-files.
8. The horizontal flutes along the length of the K-file tend to engage and disengage without cutting when a watch-winding motion is used.
9. The K-reamers with their more efficient cutting and lower resistance along their length produce a superior tactile perception of what the tip of the instrument is encountering.
10. This superior apical tactile perception allows the placement of a cutting tip.
11. The cutting tip differentiates between a tight canal and hitting a wall.
12. The K-reamers are powered by a 30-degree reciprocating handpiece that prevents the cutting tip from penetrating dentin, while allowing it to pierce soft pulp tissue.

The resistance of the instrument along its length, its efficiency at cutting laterally, its flexibility and its superior apical tactile perception were all improved further by placing a flat along the entire working length of the shaft. The modified K-reamer then had more flexibility and less engagement along length, meaning resistance along length was further reduced. In addition, two columns of chisels were created (where the flat meets the flutes) that cut efficiently with one column cutting when the reciprocating handpiece is going in the clockwise direction and the other cutting in the counter-clockwise direction. The flat creates an asymmetric instrument that can dif-
ferentiate between a round and oval canal. When the flat is lined up with the long diameter of an oval canal, the resistance decreases. When the flat lines up with the short diameter, the resistance increases.

The tactile perception of more and less resistance lets the dentist know that he/she is in an oval canal, which tells him/her to widen the canal to better shape the likely buccal and lingual extensions of the canal and open it further for improved irrigation. The 30-degree reciprocating handpiece oscillates at approximately 3,000 cycles per minute, representing a high-frequency, low-amplitude envelope of motion, which shapes canals with minimum apical pressure and minimum resistance.

Because the arc of motion is limited to 30 degrees, virtually all the torsional stress and cyclic fatigue that rotary NiTi instruments are subjected to is eliminated, which in turn eliminates the two factors that are most responsible for rotary NiTi separation. This frees dentists of a tremendous burden as they negotiate and shape canals of increasing curvature. Having used rotary NiTi, we understood the advantages of greater tapered shaping but never felt comfortable with the increased likelihood of fractured instruments. With the SafeSider system, we can shape canals to a taper greater than we would have dared with rotary NiTi without any concern for instrument separation. The result is a cleaner case with a minimum taper between 0.05 and 0.06 mm.

Because the reciprocating motion virtually eliminates torsional stress and cyclic fatigue, the instruments can be effectively used six to seven times (canals) without any concern for fracture. In fact, the downside of excessive use is dullness, a luxury when compared with the fear of separation. Yes, they will become less efficient over time and should be replaced, but they will not break even if used beyond their recommended number of canals. It should also be noted that even the thinnest SafeSiders can be used in the reciprocating handpiece with virtually no fear of separation.

Abruptly curved canals present no problems because the earlier relieved reamers record the curve that exists, letting us know where and when we must pre-bend them and place them manually into the canal to the initiation of the curve. Once relieved reamers reach this point, they are reattached to the reciprocating handpiece and guided the rest of the way to the apex in a non-distorted fashion. Given their ability to be pre-bent and oriented manually so that the instrument correlates to any curvature in the canal that may exist, there are no limitations to where these instruments may be used. If a canal is very large and has to be opened to a wider diameter than the reamers in the system, we use regular non-relieved reamers sizes 45 to 140 in a step-back manner to create any tip size and taper we need.

The above is a general description of the common sense reasoning behind the reamers’ design and the way they are powered in the canal. Included here are several examples of cases that have been shaped with SafeSiders and filled with the EZ-Fill obturation technique (Figs. 3–5). The lower molar that was sent to us with a fractured instrument in the distal canal is a good example of what we wish to avoid. Please note that while we were unable to remove the fractured rotary NiTi fragment, we were able to instrument along its side to achieve a final fill in the distal that obturated a lateral canal. The even more curved mesials were shaped and obturated safely and without distortion using the SafeSider technique. The other cases presented show the SafeSiders’ ability to shape even the most challenging anatomy in a consistent fashion. Because they are highly resistant to fracture, the technique is far easier to learn, making the knowledge of using them well highly transferable.

**Guidelines for use**

Below is a step-by-step guide for their effective use:

1. Work the #08 reamer to the constriction with it attached to an apex locator for accurate length
control. Then instrument through a 25 to 0.5mm beyond the constriction.

2. Once the length is determined, set a rubber stop to the proper length and place the subsequent reamers in the reciprocating handpiece set so that it runs at approximately 3,000 cycles per minute. We recommend the use of our rubber stops because they abut against the plastic handle and will not ride up the shaft.

3. Using the reciprocating handpiece with a firm pecking motion, negotiate 0.5mm beyond the constriction with #10, 15 and 20 SafeSiders. This usually takes only about two to three strokes. If some resistance along the length is encountered, take the instrument out of the canal and wipe the shaft, removing any debris that may be in the flutes.

4. After the #20 is to 0.5 mm beyond the constriction, straighten the coronal curve (when in a molar) using the tapered peeso (Pleezer). Usually we go apically about 6 mm from the apex, but if significant resistance is encountered you can go 7 or 8 mm from the apex. Please note that straightening of the coronal portion of the canal always occurs at the expense of the outer wall, leaving the important dentine on the furcation side intact.

5. Shape the canals with the #25 beyond the constriction.

6. Shape the canals to the constriction with the 30, 30/04 and 35 using the reciprocating handpiece.

7. Shape the canal 1 mm short with the #40.

8. Finally, shape the entire length of the canal to a 25/06.

Figs. 3a & b. Please note that these are significant curves with shaped canals and no visible distortion, and their shaping is virtually free of separations.

Figs. 4a & b. The maxillary first molar is another good example of the SafeSiders’ versatility. Please note the delicate curves in this long mesial buccal canal and how little to no distortion occurs at its first apical extension. It is also helpful to pick up lateral canals as we did on the palatal.

Figs. 5a & b. This is a patient who had a Rotary NiTi segment left in the distal canal. While it could not be removed, we were able to negotiate along its side and actually fill a lateral canal. The mesial root again shows how the SafeSiders can handle significant curves safely and effectively.
There are some additional points to be noted. Six per cent NaOCl is continually used by irrigating with a 30-gauge needle under low pressure. We define low pressure as four to five drops expressing out of the tip of the needle when hand pressure is applied. We never want to create a stream because it could lead to significant extrusion of NaOCl over the apex causing harm.

If any of the early instruments hit absolute resistance, then a wall has been encountered, which is the signal to take the instrument out of the canal, pre-bend it at the tip about 45 degrees and search for the proper pathway to the apex. Once found, take note of the orientation of the curve so that it can be duplicated with the subsequent instruments. Once the bent instrument has negotiated the curve, the reamer should be reattached to the reciprocating handpiece and guided the rest of the way to the apex. At no time is there any danger of separating the instrument even when the canals are quite curved.

The canal is now ready to be filled with a medium point (EDS).

The canals are coated thoroughly using the bidirectional spiral, which has the ability to coat all but the most apical 2 mm of the canal without driving any cement over the apex with the applicator. The pre-fitted gutta percha point is then thoroughly coated with cement and placed into the canal. Unless the canal is highly elliptical, one point is generally sufficient to obturate the canal thoroughly. If it is highly elliptical, there is no problem in using a spreader to create a lateral space for the placement of a second or third well-coated auxiliary point. Our philosophy of obturation is that the gutta percha is nothing more than a carrier and a driver of the cement, which is what truly seals the canals. Of course, the master point should have excellent tugback, which is routinely achieved using this technique.

**Characteristics**

The cement is an epoxy-resin that has the following superior characteristics:

1. As it is placed at room temperature, it does not shrink because there is no cooling.

2. In fact, both the gutta percha and the cement expand as they warm from room temperature to body temperature.

3. The cement at room temperature has far lower viscosity than thermoplasticised gutta percha, allowing it to penetrate the dentinal tubules, as well as any nooks and crannies that may be present.

4. The cement bonds both chemically and physically to the gutta percha and the dentinal walls.

5. Because the cement is placed lateral to the gutta percha, the case could easily be redone if required or if a post-hole was needed either immediately or at a later date.

6. The cement’s chemistry has been known for over 55 years and it is well documented in the dental literature as an excellent sealer.

Dr Musikant was asked at a lecture he gave to be honest and tell the audience the negative aspects of the system. He honestly replied that he was one of the inventors of the product and that we purposely designed the system to exclude anything that we could conceive of as a potentially negative aspect. For us as practicing endodontists who have several partners who all use the system, we have found no negatives. That does not mean that a practitioner will not get better the more he uses the system but rather when learning to use the system will not be filled with moments of anxiety due to the fear of breaking instruments. Furthermore, because separation is not an issue, we can teach anyone how to use these instruments to negotiate the most complex canal anatomy.

No system should restrain a dentist from tackling increasingly challenging cases simply because he/she is worried about the impact of the canal anatomy on the integrity of the instruments he is using. That was our problem with rotary NiTi. We designed our system to exclude that particular feature. As for the EZ-Fill obturation, hopefully the completed cases that we have included in this presentation speak for themselves._

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

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