CDA JOURNAL, VOL 35, Nº9

Simplifying Endodontics With EndoSequence Rotary Instrumentation

GREGORI M. KURTZMAN, DDS, MAGD

ABSTRACT Recent advances in endodontic instrumentation have simplified the treatment process and improved long-term success. Ten years ago the vast majority of endodontic instrumentation was being performed with hand files and reamers. Today, most practitioners providing endodontic therapy are utilizing rotary instrumentation.

AUTHOR

Gregori M. Kurtzman, DDS, MAGD, is in private general practice in Silver Spring, Md., and is a former assistant clinical professor at the University of Maryland School, Baltimore College of Dental Surgery, Department of Endodontics, Prosthetics and Operative Dentistry. He earned diplomat status in the International Congress of Oral Implantologists.

DISCLOSURE

Dr. Kurtzman has been provided honoraria for lecturing on EndoSequence and has participated in funded research on Resilon/Epiphany.

Rotary instruments have allowed the instrumentation process to become easier and more productive. The introduction of greater taper instruments has allowed the practitioner to "mill" the canals thereby creating shapes that are easier to obturate. As a result of improved technology, file breakage has decreased and cutting efficiency has increased along with improvements in file flexibility.

Rotary NiTi Endodontic Files

In contrast to stainless steel hand files, nickel titanium endodontic files are not formed by twisting, but from grinding a blank. The design of the blank will influence a file's flexibility and how much lateral resistance is generated when the file is working within the canal. File designs that incorporate radial lands, in an attempt to reinforce the cross section of the file, and thereby decrease file separation (e.g., K3 file from SybronEndo), also significantly increase the percentage of contact within the canal wall and subsequently increase lateral resistance (**FIGURE 1**). The greater the file's lateral resistance, the greater the torque required to instrument the canal. Increasing the lateral resistance of a nickel titanium file will increase the torque requirement, making the file less efficient.

Radial lands that increase the stiffness of a file decrease its flexibility in curved canals. Files with essentially triangular cores (e.g., ProTaper file, Dentsply Tulsa) will have greater flexibility than those with wide radial lands (K3), but may transport the canal if they lack a centering device. Furthermore, those files with a constant pitch (e.g., Profile from Dentsply Tulsa) have a tendency to create "suck-down," particularly in larger sizes. Suck-down refers to the tendency of the file to be pulled apically as it engages the canal walls. File manufacturers have incorporated variable pitch and variable helical angles in an attempt to reduce suck-down.

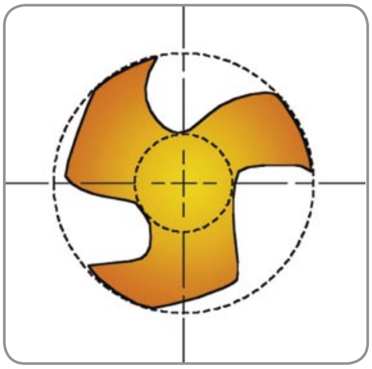

FIGURE 1. Graphic image demonstrating a file with lands and its contact with the canal walls.

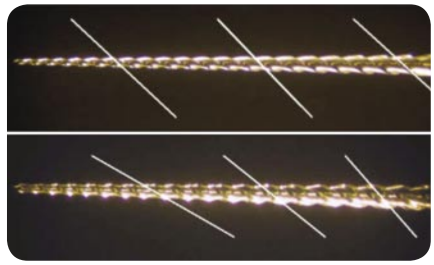

FIGURE 2. Comparison of a file with constant helical angle (top) and one with variable helical angle (bottom).

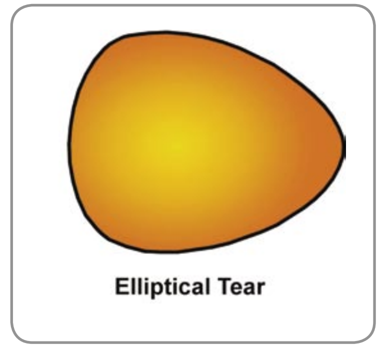

FIGURE 3. Graphic representation of an elliptical tear that may occur apically with a file that has a cutting tip.

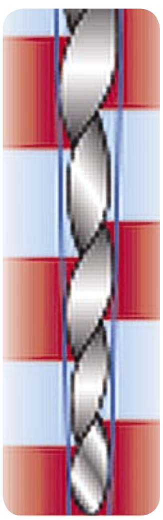

FIGURE 4. Graphical representation of alternating contact point between the file and canal.

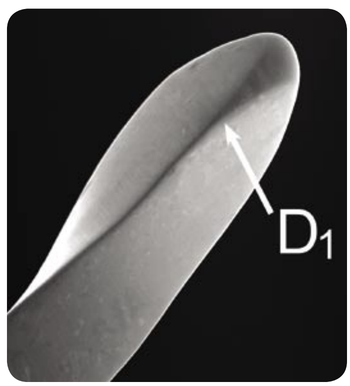

FIGURE 5. SEM demonstrating the noncutting tip of the EndoSequence file.

Pitch is defined as the number of spirals or flutes per unit length on the file. The larger the number of spirals on a file, the greater the file's resistance. The lower the resistance, the more efficient the file and the smoother the instrumentation process. Consequently, a reamer design (triangular blank) will result in a more efficient cutting instrument.

As previously mentioned, a variable pitch file will decrease the tendency for suck-down, especially in files that are .06 taper or greater. Helical angles, defined as the angle where the flutes intersect the long axis of the file, determine debris removal as the file moves apically. Constant helical angles may lead to debris accumulation, which increases torque demand and can lead to file separation. Variable helical angles aid in moving debris coronally out of the canal (**FIGURE 2**).

File tip design can be either cutting or noncutting. Cutting tips can lead to transportation of the canal in less experienced hands. Additionally, should a cutting tip pass through the apex an elliptical orifice may be created, making apical sealing more difficult (**FIGURE 3**). A noncutting tip is less aggressive and less likely to transport the canal. Should the noncutting tip be passed longer than the working length (through the apex) a round orifice is more likely created, which is easier to seal.

Rotary speed is dependent on the torque requirements of the file system. As the torque requirement is decreased, file speed can be increased. The greater the speed, the more efficient and the smoother the file works in the canal. However, as file speed increases, there is a decrease in time to cyclic failure and consequently, the files cannot be used as many times before cyclic fatigue is encountered and instrument separation results. Files of any design run at low speed (150 rpm to 175 rpm) have an increased tendency for instrument separation. This results because the files efficiency is decreased and the practitioner tends to apply greater apical pressure to get the file to advance.

EndoSequence Files

The EndoSequence file (Real World Endo, Brasseler USA, Savannah, Ga.) addresses the concerns of previous file design by creating an efficient, safe file with a short learning curve that allows the practitioner to create well-instrumented (milled) canals.[1,2]

The file design employed by the EndoSequence instrument provides for alternating contact points, ACP, along the instrument's cutting length (**FIGURE 4**). The use of ACP allows the file to remain centered in the canal, while simultaneously reducing the torque requirements. The lack of radial lands provide a sharper instrument as a result of a decreased thickness of metal, thereby providing a more flexible file. This is true even in the greater tapers. Combined with a precision tip, the alternating contact points provide an efficient instrument that will not transport the canal.

In addition to its unique ACP design,

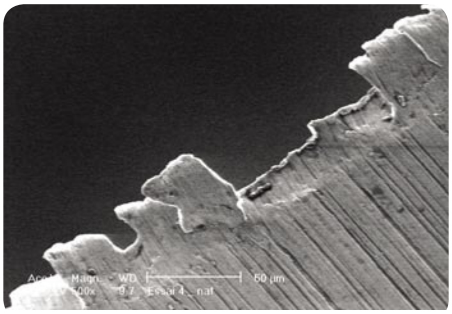

FIGURE 6a. SEM of file. Rough surface following grinding.

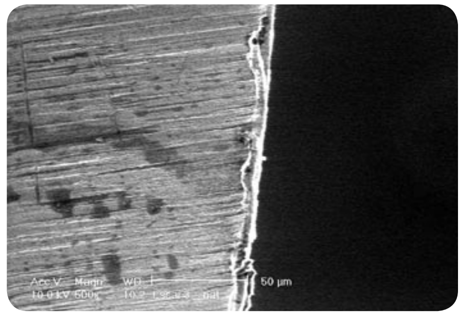

FIGURE 6b. Surface following traditional polishing.

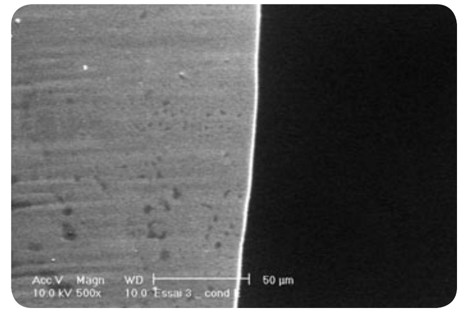

FIGURE 6c. Surface following electropolishing.

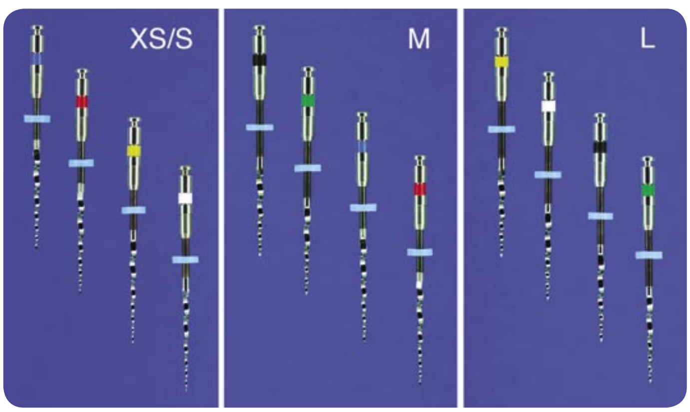

FIGURE 7. Representation of the file contents of the small, medium, and large EndoSequence file packs.

FIGURE 8. The EndoSequence Expeditor file.

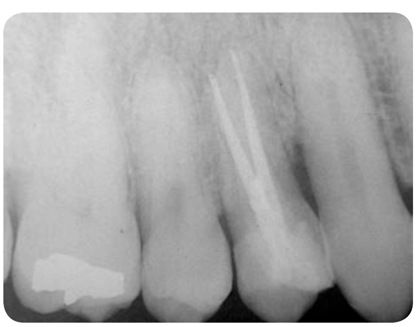

FIGURE 9. Maxillary first premolar (No. 5) instrumented with a small EndoSequence pack. Final size for both buccal and lingual canals was a 30/.06.

FIGURE 10. Maxillary lateral incisor (No. 7) instrumented with a medium EndoSequence pack. Final size was a 40/.06.

FIGURE 11. Mandibular second premolar (No. 20) instrumented with a large EndoSequence pack. Final size was 50/.06.

the EndoSequence file takes advantage of a precision tip. A precision tip is defined as a noncutting tip that becomes fully engaged 1 mm from the tip (D-1). (**FIGURE 5**). This design allows the instrument to be both safe and efficient.

Metal treatment has long been ignored in dental applications. Recent research has shown that the grinding process used in the fabrication of nickel titanium endodontic instruments, leaves microcracks in the metal that may propagate into fractures when the instrument is subjected to stress (**FIGURE 6A**). Electropolishing removes the greatest majority of these microimperfections and produces a sharper instrument with increased cutting efficiency (**FIGURES 6B, C**). The EndoSequence file undergoes electropolishing and the result is visible in its mirror-like finish that remains sharper longer and stays cleaner during use.

In addition to its use of ACPs and lack of radial lands, the EndoSequence file utilizes variable pitch and variable helical angles. As a result of these improved design features that reduce the torque requirements, an increased rate of speed (600 rpm) may be used with the EndoSequence file. The increased rate of speed will result in greater tactile awareness. The ideal range for the EndoSequence file is between 500 rpm and 600 rpm. Should an audible clicking noise be heard during instrumentation, this is an indication too much apical pressure is being applied to the file and is not an indication of excessive revolutions per minute. This sound is common for files with a triangular cross section.

The EndoSequence file system is available in both .04 (size 15-60) and .06 (size 15-50) taper instruments, in lengths of 21, 25, and 31 mm instruments. It is also available in both single instrument packs and procedural packs (small, medium, and large) (**FIGURE 7**). An initial rotary instrument called an "Expeditor" is included with the system to assist in determining the initial canal diameter and which EndoSequence package to open.

The Expeditor is a size-27 file, with a .04 taper and is 21 mm long (**FIGURE 8**). After coronal patency has been confirmed with a hand file, the Expeditor is introduced into the canal and taken to initial engagement. If engagement is met within the apical half of the Expeditor's cutting shank, the EndoSequence package opened will be a "small." Should the Expeditor advance to about the midway point before engagement is met, then a "medium" package is selected and the initial file used in a crown down manner will be a size 40. If the Expeditor does not meet any engagement, or is loose at full insertion, then a "large" package is utilized. The files are available in packs of individual sizes or as small (15-20-25-30); medium (25-30-35-40); and large (35-40-45-50) packs.

Precision instrumentation can be accomplished selecting which EndoSequence instrument pack is appropriate for that canal, based on the initial fit of the Expeditor. The canal is then enlarged using four sequential files, creating a shape to the canal that will allow thorough obturation (**FIGURES 9-11**).

Conclusion

Scientific advances in both file design and obturation materials have greatly improved the long-term success of endodontics. The EndoSequence file system has taken advantage of electropolishing, which has been used historically in both precision medical instruments, and in high-end machining. The result is a sharper, more efficient instrument. Lateral resistance is also decreased with the EndoSequence file by use of its unique alternating contact point design. Combined with variable pitch and helical angles, the result is greater file control that helps achieve precision-based endodontics.

Endodontics has begun to take advantage of the scientific improvements touching other aspects of dental care. Precision-based instrumentation allows the practitioner to create constant tapered shapes making obturation easier and more predictable. Treatment predictability from precision-based instrumentation has allowed a leap forward in how we provide endodontic therapy. ■■■■

REFERENCES

1. Koch K, Brave D, The EndoSequence file: a guide to clinical use. *Compend Contin Educ Dent* 25(10A):811-3, October 2004.

2. Koch K, Brave D, Endodontic synchronicity. *Compend Contin Educ Dent* 26(3):218, 220-4, March 2005.

TO REQUEST A PRINTED COPY OF THIS ARTICLE, PLEASE CONTACT dr_kurtzman@maryland-implants.com.