RUDDLE ON

The Radar

THE NITI SHAPING MOVEMENT

FIFTH GENERATION TECHNOLOGY

Since the beginning of modern day endodontics, there has been an evolution of concepts, instruments, and techniques for preparing canals. Over the decades, a staggering array of files has emerged for negotiating and shaping canals. In spite of the design of the file, the number of instruments required, and the surprising multitude of techniques advocated, endodontic treatment is typically approached with optimism for success. This editorial will briefly review the NiTi shaping movement, focusing on the new fifth generation technology.

To appreciate the evolution of NiTi mechanical files, it is useful to know that the first generation of NiTi rotary files has passive cutting radial lands. Each file in any given brand line has a fixed-tapered design over the length of its active blades. As such, it is important to note that all first generation files only have a variably-tapered design between files within any given series. This generation of technology generally requires a series of files to safely achieve the preparation objectives.

The second generation of NiTi rotary files has active cutting edges and requires fewer instruments to fully prepare a canal. The clinical breakthrough occurred when the ProTaper NiTi rotary file system (*Dentsply Tulsa Dental Specialties, or DTDS*) came to market in 2001 utilizing an increasing or decreasing variably-tapered design over the active portion of any given file. The critical distinction between first and second generation technologies is that ProTaper has a variably-tapered design on a single file.

Improvements in NiTi metallurgy became the hallmark of what may be identified as the third generation of mechanical shaping files. In 2007, utilizing heat treatment technology, certain file brands were shown to have significantly greater flexibility and resistance to cyclic fatigue, which improve safety when shaping more curved canals. For example, DTDS utilized heat treatment technology to create the metallurgical super metal, M-wire.

The fourth generation of instruments and related motor technology has largely fulfilled the long hoped-for single-file technique. WaveOne (*DTDS*) utilizes a reciprocating motor to drive any given file in innovative unequal bidirectional angles. The critical distinction is all other reciprocating files utilize equal bidirectional angles. Strategically, after 3 CCW and CW cutting cycles, the WaveOne file will have rotated 360°. This novel reciprocating movement allows a file to more readily progress, efficiently cut, and effectively auger debris out of the canal.

The latest fifth generation of shaping files has been designed with an offset mass of rotation. This design serves to produce a unique mechanical wave of motion that travels along the active length of the file. For example, the recently launched Protaper NEXT (PTN) rotary file system (*DTDS*) is the convergence of the most successful generational design features from the past, coupled with the fifth generation of continuous improvement, the offset design. PTN is a fifth generation system with three unique design features that greatly influence performance.

One strategic feature of PTN is the utilization of the second generation variably-tapered design on a single file. This unique design serves to limit each file's cutting action to a specific region within a canal, which decreases dangerous taper lock and the screw effect. Of clinical significance, a file with a decreasing variably-tapered design strategically improves flexibility, limits shaping in the body of the canal, and conserves coronal two-thirds dentin compared to a similarly-sized, fixed-tapered file.

Another critical PTN design feature utilizes third generation heat treatment technology. Heat treatment significantly improves safety when shaping canals that exhibit curvature or recurvature. Research has shown that M-wire, a metallurgically improved version of NiTi, reduces cyclic fatigue by 400% when comparing files of the same D0 diameter, cross-section, and taper.

The third critical design feature of PTN is related to utilizing fifth generation technology, where shaping files have an offset mass of rotation. There are three major advantages of utilizing shaping files that rotate with an offset mass of rotation.

1. An offset design generates a repetitive mechanical wave of motion along the active portion of a file. This "swaggering effect" serves to minimize the engagement between the file and dentin compared to the action of a fixed-tapered file with a centered mass of rotation. Synergistically, a variably-tapered file with an offset mass of rotation reduces engagement, undesirable taper lock, and the screw effect.
2. An offset design affords more cross-sectional space for enhanced cutting, loading, and augering debris out of a canal compared to a file with a centered mass of rotation. Many instruments break as a result of excessive intrablade debris packed between the file and dentin. Importantly, an offset file design decreases the probability for laterally compacting debris and blocking root canal system anatomy.
3. A PTN file with an offset mass of rotation will generate a mechanical wave of motion analogous to the oscillation noted along a sinusoidal wave. The resulting envelope of motion will more safely and efficiently develop the same-sized preparation as would be required from a larger, stiffer, and fixed-tapered file with a centered mass of rotation.

Each new generation of shaping files has had something to offer, has been described in different ways, and has been intended to improve shaping results. PTN has emerged as a fifth generation system designed to bring the most proven and successful generational design features from the past, coupled with the most recent technological advancements. The ProTaper NEXT system promises to set a new standard for safety, efficiency, and simplicity for shaping canals. Keep this on your radar! EP

Clifford J. Ruddle, DDS, FACD, FICD, is founder and director of Advanced Endodontics (www.endoruddle.com), an international educational source, in Santa Barbara, California. Additionally, he maintains teaching positions at various dental schools. Dr. Ruddle can be reached at info@endoruddle.com.