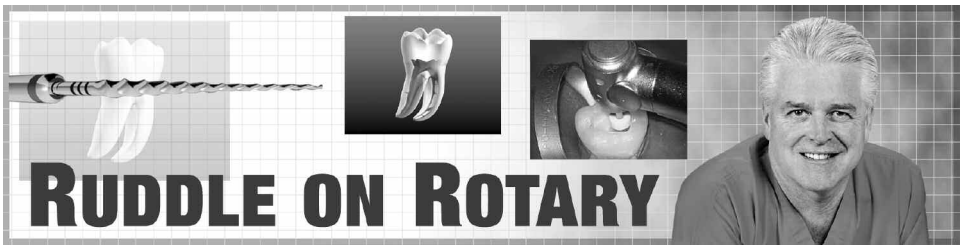

The ProTaper Technique: Shaping the Future of Endodontics

by Clifford J. Ruddle, D.D.S.

The ProTaper NiTi files *(Dentsply Tulsa Dental; Tulsa, Oklahoma)* represent a new generation of instruments for shaping root canals.[1] This article will briefly review the ProTaper geometries, then describe the ProTaper technique and finishing criteria that may be utilized to fulfill the mechanical and biological objectives for shaping canals. Learning the ProTaper concept will lead to discovery then appreciation for the efficiency, safety and simplicity of this shaping technique.

ProTaper Geometries

A unique feature of the ProTaper files is each instrument has changing percentage tapers over the length of its cutting blades. This progressively tapered design serves to significantly improve flexibility, cutting efficiency and safety.[2] Another feature of the ProTaper instruments relates to their convex, triangular cross-section which enhances the cutting action while decreasing the rotational friction between the blade of the file and dentin.[3] ProTaper files have a changing helical angle and pitch over their cutting blades which reduces the potential of an instrument from inadvertently screwing into the canal.[4] The ProTaper files each have a noncutting, modified guiding tip. This feature allows each instrument to safely follow the secured portion of a canal while the small flat on its tip enhances its ability to find its way through soft tissue and debris.[5] The ProTaper system is comprised of just three Shaping and three Finishing files ***(Figure 1)***.

THE SHAPING FILES

Shaping File No. 1 and Shaping File No. 2, termed S1 and S2, have purple and white identification rings on their handles, respectively. The S1 and S2 files have D_0 diameters of 0.17 mm and 0.20 mm, respectively, and their D_{14} maximal flute diameters approach 1.20 mm. The Auxiliary Shaping File, termed SX, has no identification ring on its gold-colored handle and, with a shorter overall length of 19 mm, provides excellent access when space is restrictive. The SX file has a D_0 diameter of 0.19 mm and a D_{14} diameter approaching 1.20 mm. The shaping files have increasingly larger percentage tapers over the length of their cutting blades allowing each instrument to engage, cut and prepare a specific area of the canal and perform its own "crown down" work. Because SX has a much quicker rate of taper between D_1 and D_9 as compared to the other ProTaper Shaping files, it is primarily used to optimally shape canals in coronally broken down or anatomically shorter teeth.

THE FINISHING FILES

Three Finishing files named F1, F2 and F3 have yellow, red and blue identification rings on their handles corresponding to D_0 diameters and apical tapers of 20/07, 25/08 and 30/09, respectively. From D_4-D_{14} each instrument has a decreasing percentage taper which serves to improve flexibility while reducing the potential for dangerous taper-lock.

Figure 1. *Both the rotary and manual ProTaper files represent a revolutionary progression in flexibility, efficiency, safety and simplicity when preparing root canals.*

THE PROTAPER TECHNIQUE

Endodontic outcomes are improved when instruments pass through the access opening, effortlessly slide down smooth axial walls and are easily inserted into the orifice. The potential to consistently shape canals and clean root canal systems is significantly enhanced when the coronal two-thirds of the canal is first pre-enlarged followed by preparing its apical one-third ***(Figure 2)***.[6]

SCOUT THE CORONAL TWO-THIRDS

When straightline access is completed, the pulp chamber may be filled brimful with a viscous chelator. Based on the pre-operative radiographs, ISO 0.02 tapered sizes 10 and 15 hand files are measured and precurved to match the anticipated full length and curvature of the root canal. However, in this method of canal preparation, these instruments are initially limited to the coronal two-thirds of a root canal. The 10 and 15 hand files are utilized within any portion of the canal until they are loose and a smooth reproducible glide path is confirmed. The loose depth of the 15 file is measured and this length transferred to the ProTaper S1 and S2 files.

SHAPE THE CORONAL TWO-THIRDS

The secured portion of the canal can be optimally pre-enlarged by first utilizing S1 then S2. Prior to initiating shaping procedures, the pulp chamber is filled with a full strength solution of NaOCl. Without pressure, and in one or more passes, the ProTaper Shaping files are allowed to passively "float" into the canal and "follow" the glide path. To optimize safety and efficiency, the Shaping files are used, like a "brush", to laterally and selectively cut dentin on the outstroke. A brush-cutting action creates lateral space which will facilitate the Shaping file's larger, stronger and more active cutting blades to safely and progressively move deeper into the canal. If any ProTaper file ceases to easily advance within the secured portion of a canal, withdraw it, and recognize that intrablade debris has deactivated and pushed the instrument off the wall of the canal. Upon removing each Shaping file, visualize where the debris is located along its cutting blades to better appreciate the region within the canal that is being prepared. Following the use of each Shaping file, irrigate, recapitulate with a 10 file to break up debris and move it into solution, then re-irrigate. Without pressure, and in one or more passes, S1, then S2, is used in this manner until the depth of the 15 hand file is reached.

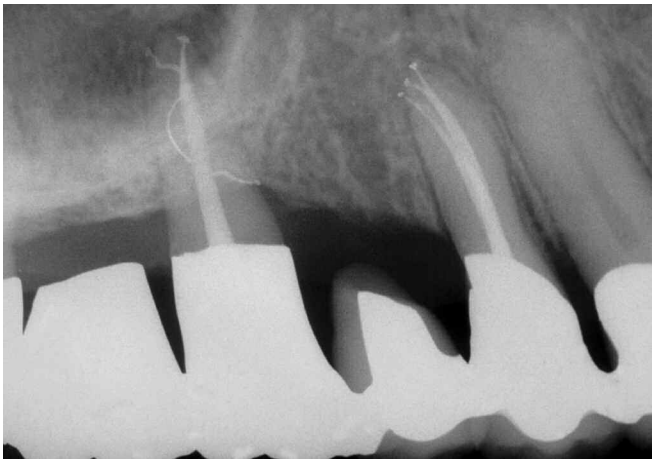

Figure 2. *Sequencing the preparation facilitates shaping canals and cleaning root canal systems. Complete endodontic treatment is the foundation of perio-prosthetics.*

SCOUT THE APICAL ONE-THIRD

When the coronal two-thirds of the canal is shaped, then attention can focus on apical one-third procedures. With the pulp chamber filled brimful with a viscous chelator, the apical one-third of the canal is fully negotiated and enlarged to at least a size 15 hand file, working length confirmed and patency established.[7] At this time, a decision must be made between whether to finish the apical one-third with rotary or hand instruments. If a new and straight 15 file can gently "slide" and passively "glide" to length, then rotary instruments will generally follow this confirmed and "reproducible glide path".[6] However, certain canals exhibit anatomical challenges that necessitate a reciprocating handle motion in order to move precurved 10 and 15 files to length. When there is an "irregular glide path" then the apical one-third of a canal may be advantageously finished with precurved manual ProTaper instruments ***(Figure 1)***.

SHAPE THE APICAL ONE-THIRD

When the apical one-third of the canal has been secured, then the pulp chamber is filled brimful with NaOCl. The ProTaper sequence is to carry the S1, then the S2, to the full working length. Float, follow and brush as previously described until the terminus of the canal is reached. S1, then S2, will typically move to length in one or more passes depending on the length, diameter and curvature of the canal. Following each ProTaper file, irrigate, recapitulate with a 10 file, then re-irrigate. After using the Shaping files, particularly in more curved canals, working length should be reconfirmed, as a more direct path to the terminus has been established. At this stage of treatment, the preparation can be finished using one or more of the ProTaper Finishing files in a "non-brushing" manner. The F1 is selected and passively allowed to move deeper into the canal, in one or more passes, until the terminus is reached. When the F1 achieves length, the instrument is removed, its apical flutes are inspected and if they are loaded with dentin, then visual evidence supports the shape is cut. Following the use of F1, flood the canal with irrigant, recapitulate and confirm patency, then re-irrigate to liberate debris from the canal.

ProTaper Finishing Criteria

Following the use of the 20/07 F1, the "ProTaper Finishing Criteria" is to gauge the size of the foramen with a 20/02 tapered hand file to determine if this instrument is snug or loose at length. If the 20 hand file is snug at length then the canal is fully shaped and, if irrigation protocols have been followed, ready to pack. Following the use of F1, if the 20 hand file is loose at length, then gauge the size of the foramen with a 25/02 tapered hand file. If the 25 file is snug at length, then the canal is fully shaped and ready to pack. If the 25 file is short of length, proceed to the 25/08 F2 and, when necessary, the 30/09 F3, gauging after each Finisher with the appropriately sized hand files. If the 30 file is loose at length, then use an alternative NiTi rotary line or manual files to finish the apical extent of these larger, easier and more

Figure 3. *The canals of this mandibular molar were shaped with ProTaper files and three-dimensionally filled. Note the flowing shapes, apical one-third curvatures and multiple portals of exit. (Courtesy of Dr. Jason West; Tacoma, Washington)*

straightforward canals. ProTaper shapes are easy to fill utilizing a ProTaper matching gutta percha master cone in conjunction with a warm vertical condensation technique ***(Figure 3)***.

EVIDENCE FOR CLINICAL SUCCESS

A clinical investigation of the ProTaper technique, emphasizing method of use, was conducted on mesial canals of extracted mandibular molar teeth using μCT-Analysis. In this particular study, horizontal sections from different radicular levels were analyzed using μCT slices and volume renderings. The green color represented the anatomical contours before instrumentation whereas the red color indicated the shape after instrumentation. The results from this investigation are clinically relevant and a portion of the data is available for review in ***Figure 4***. The advantages of the Shaping files to brush laterally and selectively cut dentin on the outstroke are summarized as follows:

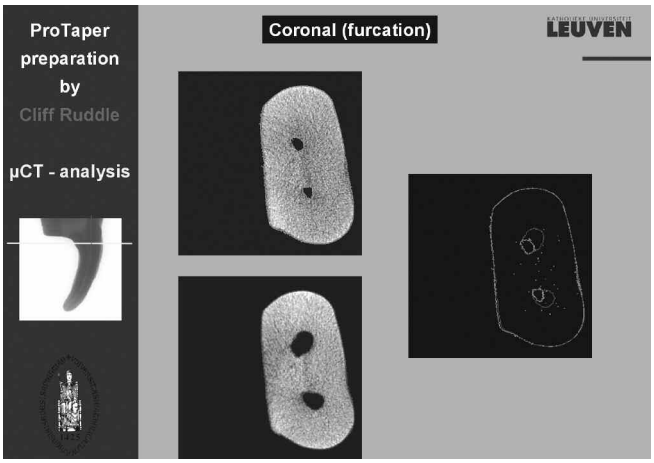

Figure 4a. *This figure shows horizontal μCT sections through the "coronal" one-third of the root. Note the successful relocation of the canals at this level.*

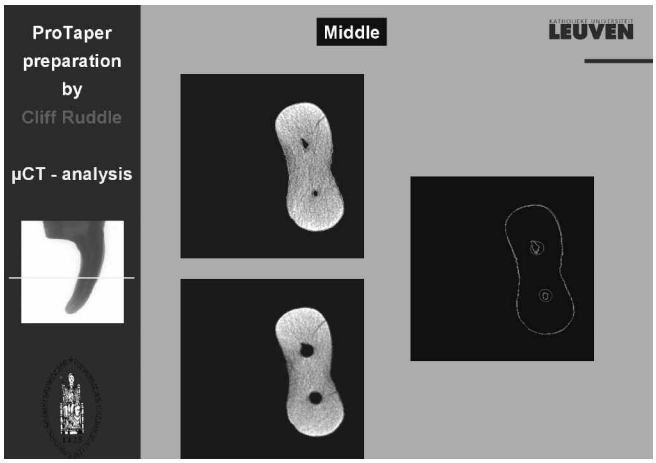

Figure 4b. *This figure reveals horizontal μCT sections through the "middle" one-third of the root. Note the ProTaper shapes are round and centered within the root.*

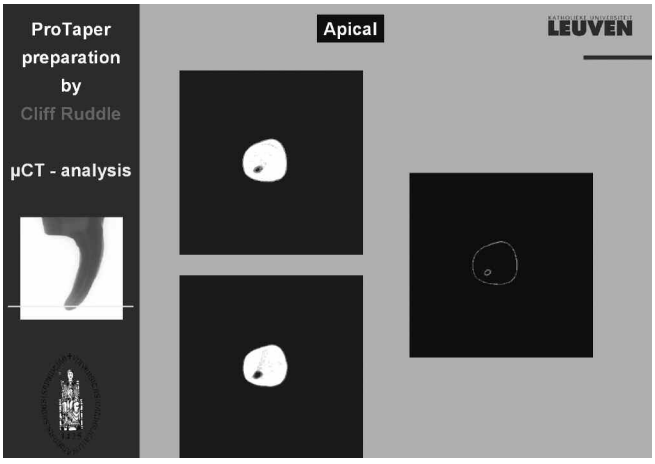

Figure 4c. *This figure shows horizontal μCT sections through the "apical" one-third of the root. Note the ProTaper shape perfectly includes the original canal diameter.*

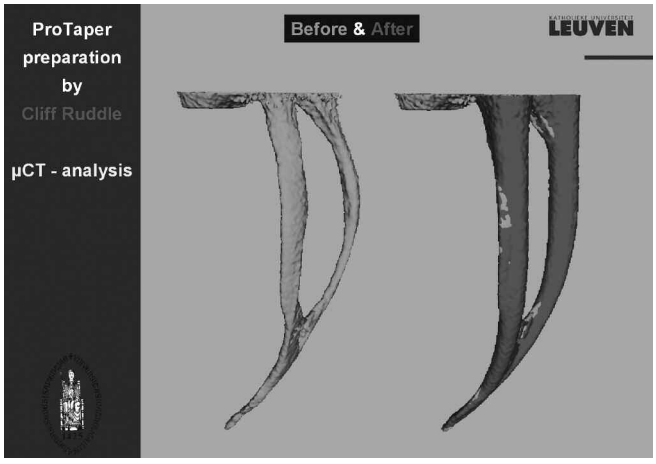

Figure 4d. *This figure compares before and after instrumentation with the S1, S2, and F1 files. Note the shapes are full, smooth flowing and centered, and the files have physically contacted virtually all the internal anatomy.*

1) The Shaping files were essentially loose within a canal during the majority of their work.
2) The coronal aspect of the canals were safely relocated away from an external root concavity.
3) A brush-cutting action achieved a centered preparation and maximized remaining dentin.
4) The Shaping files physically contacted over 90% of the internal walls of the canals.

CONCLUSION

This article has described the ProTaper geometries, technique and finishing criteria. ProTaper instruments may be used safely and effectively by dental students and both inexperienced and experienced NiTi rotary users. The ProTaper instruments provide unique geometries that when sequenced and used correctly, afford extraordinary flexibility, efficiency, safety and simplicity.[8] The ProTaper sequence is always the same regardless of the tooth or anatomical configuration of the canal being treated ***(Figure 5)***. In many cases it's as easy as one, two, three or, in endodontic language, purple, white, yellow. ▲

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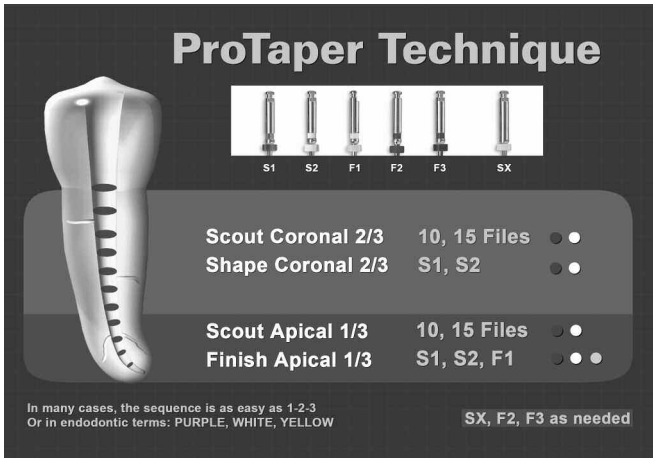

Figure 5. *This chart summarizes the ProTaper shaping technique. The ProTaper sequence is always the same regardless of the length, diameter or curvature of the canal.*

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