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The ProTaper technique

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Background

ProTaper NiTi instruments (Dentsply Maillefer, Ballaigues, Switzerland) represent a new generation of instruments for shaping root canals. A unique feature of ProTaper instruments is each one has changing percentage tapers over the length of its cutting blades. ProTaper instruments also have convex, triangular cross-sections, a changing helical angle and pitch over their cutting blades and a non-cutting, modified guiding tip. The ProTaper system is comprised of three Shaping and three Finishing instruments (Fig. 1).

The ProTaper instruments

Shaping instrument no. 1 (S1) and Shaping instrument no. 2 (S2), have purple and white identification rings on their handles, respectively. The S1 and S2 instruments have D_0 diameters of 0.17 and 0.20 mm, respectively, and their D_{14} maximal flute diameters approach 1.20 mm. The Auxiliary Shaping instrument (Sx) has no identification ring on its gold-colored handle and a shorter overall length of 19 mm. The Sx has a D_0 diameter of 0.19 mm and a D_{14} diameter approaching 1.20 mm. The shaping instruments 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' preparation. Because Sx has a much quicker rate of taper between D_1 and D_9 as compared with the other ProTaper Shaping files, it is primarily used to optimally shape canals in coronally broken down or shorter teeth.

Three finishing instruments 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 to D_{14} each instrument has a decreasing percentage taper.

The ProTaper technique

Canal preparation is 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 (Fig. 2).

Scout the coronal two-thirds

When straight-line access is completed, the pulp chamber should be filled with a viscous chelator and/or irrigant. Based on pre-operative radiographs, ISO 0.02 tapered sizes #10 and #15 K-files are measured and precurved to match the anticipated full length and

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

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 K-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 K-file is measured and this length transferred to the ProTaper S1 and S2 instruments.

Shape the coronal two-thirds

Once a reproducible glide path is verified this portion of the canal should be pre-enlarged by first utilizing S1 then S2. Prior to initiating shaping procedures, the pulp chamber is filled with a 5.25% solution of NaOCl. Without pressure, and in one or more passes, the ProTaper Shaping instruments are allowed to passively 'float' into the canal and 'follow' the glide path. To optimize safety and efficiency, the Shaping instruments are used, like a 'brush', to laterally and selectively cut dentine on the outstroke. A brush-cutting action creates lateral space, which will facilitate the larger, stronger and more active cutting blades on the Shaping instruments to safely and progressively move deeper into the canal. If any ProTaper instrument ceases to advance within the verified 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 instrument, 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 instrument, 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 K-file is reached.

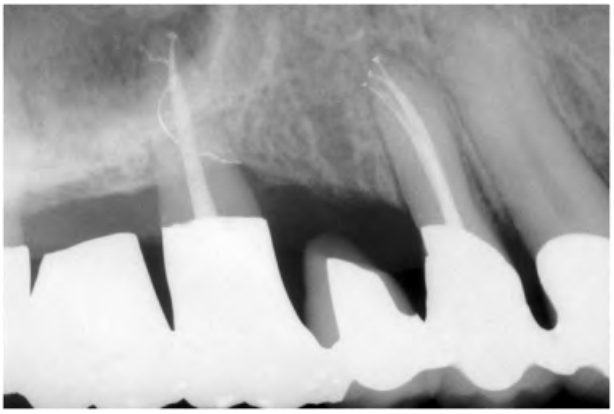

Fig. 2. Sequencing the preparation facilitates shaping canals and cleaning root canal systems. Complete endodontic treatment is the foundation of perio-prosthetics.

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 with a viscous chelator or irrigant, the apical one-third of the canal is fully negotiated and enlarged to at least a size #15 K-file, working length confirmed and patency established. 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. However, certain canals exhibit anatomical challenges that necessitate a reciprocating handle motion in order to move pre-curved #10 and #15 files to length. When there is an irregular glide path then the apical one-third of a canal may be finished with pre-curved ProTaper hand instruments (Fig. 1).

Shape the apical one-third

When the apical one-third of the canal has been scouted and a glide path created, then the pulp chamber is filled 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 instrument, irrigate, recapitulate with a #10 file, then re-irrigate. After using the Shaping instruments, 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 instruments 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 dentine,

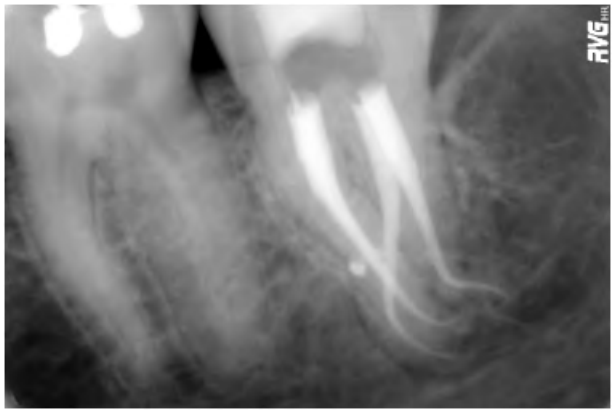

Fig. 3. The canals of this mandibular molar were shaped with ProTaper files and three-dimensionally filled. Note the flowing shapes, apical one-third curvatures and multiple portals of exit. (Courtesy of Dr Jason West, Tacoma, Washington.)

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 K-file to determine if this instrument is snug or loose at length. If the #20 K-file is snug at length then the canal is fully shaped and, if irrigation protocols have been followed, ready to fill. Following the use of F1, if the #20 K-file is loose at length, then gauge the size of the foramen with a 25/02 tapered K-file. If the #25 file is snug at length, then the canal is fully shaped and ready to fill. 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 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 straightforward canals. ProTaper shapes are easy to fill utilizing a ProTaper matching gutta percha master cone in conjunction with a warm vertical condensation technique (Fig. 3).

Experimental description of canal shapes with ProTaper instruments

Using μCT analysis, dentine removal during shaping procedures can be demonstrated and evaluated quantitatively. In this example, the green colour represents the

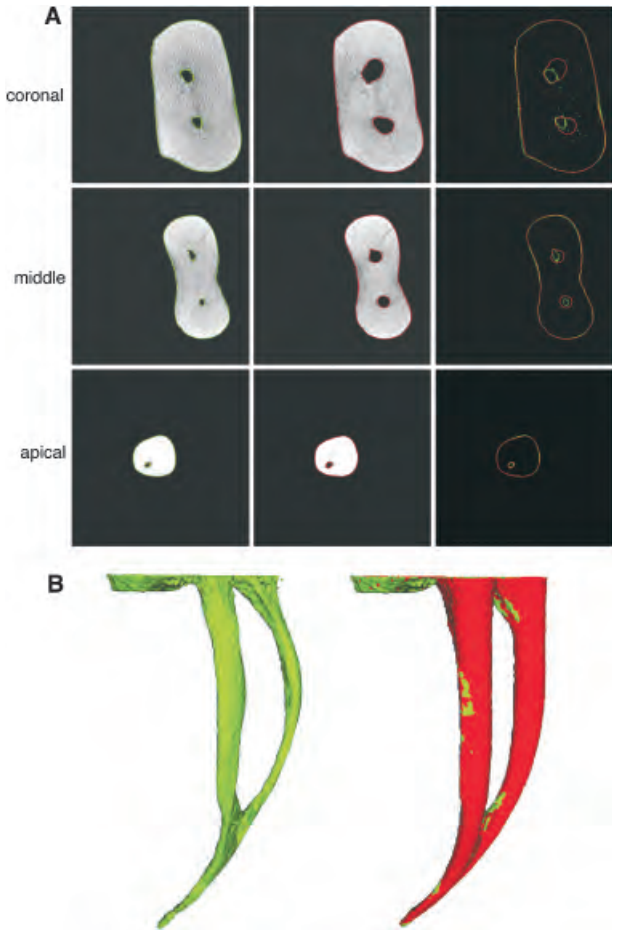

Fig. 4. Evaluation of root cross sections using μCT (4A) and comparison of canal shapes before (green) and after preparation (red, 4B). Note the smooth and centered preparation with the ProTaper files having contacted virtually all the canal surface. (Courtesy of Dr Lars Bergmans and BIOMAT Research Cluster, Catholic University, Leuven, Belgium.)

anatomical contours before instrumentation whilst the red colour indicates the shape after instrumentation (Fig. 4). These images demonstrate the ability of the ProTaper Shaping instruments to relocate the canal orifices away from the furcation, produce a centered preparation and contact a significant portion 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,

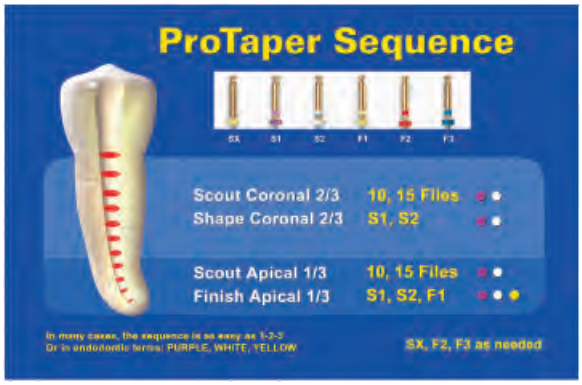

Fig. 5. This chart summarizes the ProTaper shaping technique. The ProTaper sequence is always the same regardless of the length, diameter or curvature of the canal.

afford extraordinary flexibility, efficiency, safety and simplicity. The ProTaper sequence is always the same regardless of the tooth or anatomical configuration of the canal being treated (Fig. 5).

Further reading

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