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The Ultimate Shaping System
An Opening for 3D Cleaning and Filling Root Canals

by Dr. Clifford J. Ruddle

New and potentially disruptive technologies come to market each year, proclaiming to improve on what came before. Many of these newcomers have virtually no evidence-based research to support claims of better, easier, or faster. Oftentimes, these new brands are merely copies of existing products, launched by dental companies in search of market share. That said, there are only a few endodontic products that have endured over time *and* continue to grow, with each new generation designed with the singular focus of continuous improvement. The ProTaper rotary file system is one of these technologies and has become the most utilized system worldwide.[1]

ProTaper came to market in 2001, evolved to ProTaper Universal (PTU) in 2006, progressed to ProTaper Gold (PTG) in 2014, and its legacy continues with the launch of ProTaper Ultimate in 2021. Each iteration brought the best that technology had to offer in any given era. ProTaper has become renowned for its ability to safely prepare both anatomically complex and more straightforward canals, while offering a simple clinical workflow ***(Figure 1)***. To appreciate the ProTaper success story, in just over 20 years, 371 million files were sold, 200 million teeth were saved, and 1,200 peer-reviewed scientific articles were published.[1] Before we look at ProTaper Ultimate, let's review a few critical concepts for shaping canals.

Concepts for Shaping Canals

The goals of contemporary endodontics are directed toward shaping canals, 3D cleaning, and filling root canal systems… oftentimes referred to as the 3 pillars of the endodontic trifecta or triad ***(Figure 2)***. However, certain clinicians have declared that preparing canals has been "decoupled" from the triad and advocate minimal instrumentation of a canal or no instrumentation at all. This preparation debate is centered on the noble, yet frequently misunderstood, concept of minimally invasive endodontics (MIE). Yet, conceptually, the question remains, can a minimally prepared canal and its related root canal system be predictably cleaned and filled?[2]

The apical one-third is considered the *critical zone* because this portion of the root canal system is the most difficult to clean and disinfect.[3] The anatomical complexity in this zone represents a niche that harbors pulpal tissue and, when present, harmful microorganisms and biofilms.[4] Therefore,

Figure 1. *Left: The ProTaper system safely shapes canals with significant curvatures and recurvatures (Courtesy of Dr. John West; Tacoma, Washington). Right: This bicuspid features a deep subcrestal division and smooth-flowing Ultimate shapes (Courtesy of Dr. Jason West; Tacoma, Washington).*

Figure 2. *The endodontic triad is comprised of root-appropriate shaping, which, in turn, promotes 3D cleaning, and filling root canal systems.*

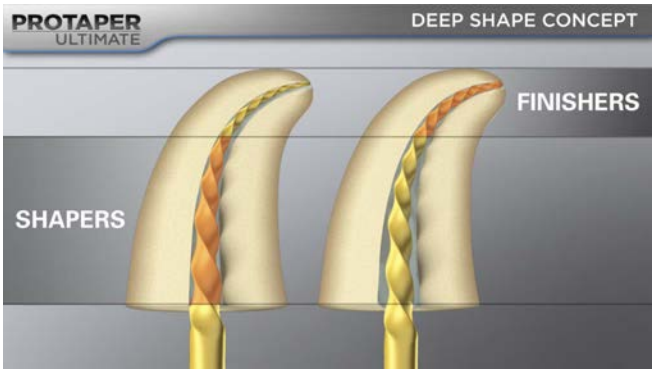

Figure 3a. *ProTaper Shapers prepare the coronal two-thirds of a canal, whereas the Finishers prepare deep shape in the apical one-third of the same canal.*

Figure 3b. *This collage of post-treatment endodontic images shows the results of deep shape, active irrigation, and treating root canal systems.*

from a biological point of view, it makes sense to create a preparation that exhibits *deep shape*…defined as a preparation that emphasizes a smaller terminal diameter, but with a larger apical one-third taper to optimize 3D cleaning and filling root canal systems.[5] Dismissing the importance of preparing canals, while placing fanatical faith in controversial disinfection technologies and unproven obturation methods is, regrettably, single-variable thinking.

The ProTaper Ultimate system keeps the iconic apical one-third deep shape feature with the critical distinction that the coronal two-thirds preparation respects, without compromise, the concept and trend of MIE ***(Figure 3a)***. To encourage deep shape, the ProTaper shaping system first introduced Finishing files with tapers of 7%, 8%, and 9% in their apical 3 mm, followed by regressive tapers from D4 to D16.[6-7] Deep shape serves to shorten the length of lateral canals, increase the volume of irrigant, and improve the active exchange of irrigant into both the instrumentable and noninstrumentable aspects of the root canal system ***(Figure 3b)***.[8] As such, root-appropriate shaping emphasizes preparing a canal with a conservative body and deep shape.

This article will describe a novel canal preparation system that is efficient, simple to use, and produces root-appropriate shapes. Root-appropriate shaping is an *essential* pillar of the triad, as it facilitates 3D cleaning and filling root canal systems. Let's get started.

ProTaper Ultimate Files

There are 5 ***core*** ProTaper Ultimate files that are the most frequently used: the Slider, the Shaper, and 3 differently sized Finishers ***(Figure 4a)***. Additionally, there are 3 auxiliary files: the Auxiliary Shaping file, the Auxiliary Finishing file, and the large Auxiliary Finishing file. All Ultimate files have 11 mm length handles to facilitate access to posterior teeth, are available in 21 mm, 25 mm, and 31 mm lengths, and are offered in both mechanical and manual versions. Manually-driven files provide unsurpassed control and safety when preparing the more apical portions of canals that divide, abruptly curve, or exhibit an irregular glide path ***(Figure 4b)***.

The ProTaper Ultimate file system utilizes file-specific heat treatment based on each file's diameter, taper, and cross-section ***(Figure 5)***. All ProTaper Ultimate files are produced from NiTi and the color of any given file is determined by the thin surface oxide that forms from the file-specific heat treatment utilized. Heat treatment is designed to significantly improve flexibility, increase the resistance to cyclic fatigue, and optimize performance. In general, each ProTaper Ultimate file has a cross-section that starts as a rhomboid from D1–D3 and evolves as an ever-changing parallelogram from D4–D16.

ProTaper Ultimate benefits from a proprietary alternating offset machining (AOM) process. AOM reduces contact between the file and dentin, improves flexibility, and creates more chip

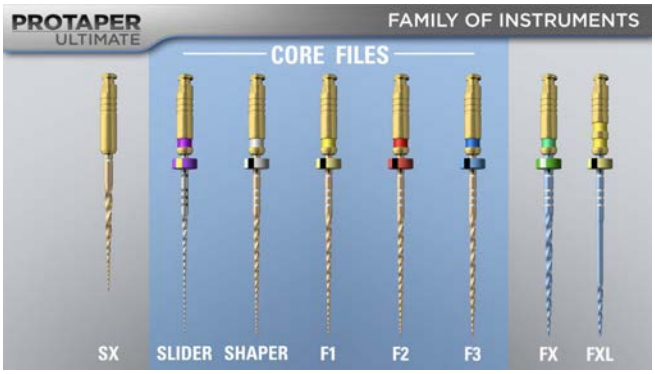

Figure 4a. *The ProTaper Ultimate system provides safety, anatomical versatility, and efficient performance when preparing root-appropriate shapes.*

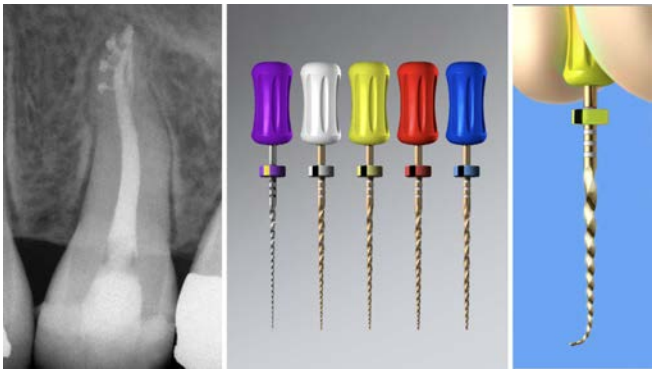

Figure 4b. *The ProTaper Ultimate manually-driven files provide control and safety when preparing the apical portions of anatomically challenging canals.*

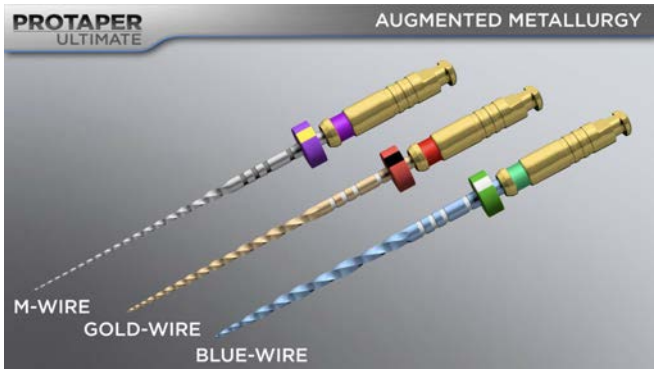

Figure 5. *To maximize safety and performance, ProTaper Ultimate utilizes file-specific heat treatment featuring M-wire, Gold-wire and Blue-wire.*

space for augering debris out of a canal ***(Figure 6)***. All ProTaper Ultimate files are validated at a speed of 400 RPM and a torque between 4.0 and 5.2 Ncm, as this speed and torque reduces file separation while increasing file efficiency. Finally, all Ultimate files have 3 non-colored rings on the proximal end of each handle to distinguish these files from the previous version PTG files. Let's now take a closer look at each file that comprises the ProTaper Ultimate system.

SLIDER

The Slider provides a ***rotary first*** approach and is the file with a purple silicone stop and identification ring on its handle. The Slider has a progressively increasing percentage tapered design from 2%-8% along its active portion, with cross-sectional diameters at D0, D4, D8, D12 and D16 of 0.16 mm, 0.26 mm, 0.44 mm, 0.68 mm, and 0.99 mm, respectively. In combination, this novel cross-section, AOM, and a progressively tapered design allows this file to safely and selectively cut on its bigger, stronger, and more efficient blades between D4 and D12.

The Slider utilizes a pre-machining, proprietary M-Wire heat treatment process, which has been shown to increase the resistance to cyclic fatigue by more than 400%.[9] The Slider represents a breakthrough in glide path management, as it is the ***first*** file selected and utilized to *negotiate*, *catheterize*, and *secure* the majority of canals. By definition, a secured canal is a canal that has a smooth, reproducible glide path from orifice to terminus.[10] International Key Opinion Leaders (KOLs) validated that the Slider reached the desired working length 63% of the time in posterior teeth, typically in 2–3 passes, and required no hand files.[1]

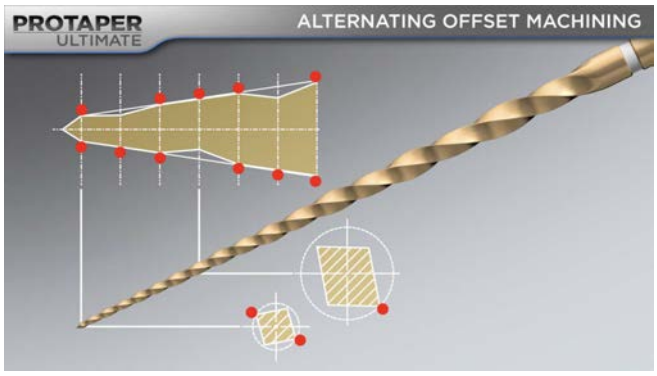

Figure 6. *Alternating offset machining provides advantages by producing a file that alternatingly contacts dentin at 2 points, then 1 point, along its active portion.*

SHAPER

The ProTaper Ultimate Shaper is the file with a white silicone stop and identification ring on its handle. Whereas the PTG system has 2 shaping files constructed from 1.2mm NiTi wire, the Ultimate system has 1 Shaper produced from 1.0mm NiTi wire and utilizes a post-machining Gold-wire heat treatment. The Shaper has a progressively increasing percentage tapered design over its active portion with cross-sectional diameters at D0, D4, D8, D12, and D16 of 0.20 mm, 0.40 mm, 0.65 mm, 0.88 mm, and 1.0 mm, respectively. The Ultimate Shaper is utilized to optimally pre-enlarge the coronal two-thirds of a canal, which in turn, provides access to the typically more anatomically challenging apical one-third of the same canal.[7]

FINISHERS

The ProTaper Ultimate system has 3 Finishing files in the core set of files and, like the Shaper, they utilize a post-machining Gold-wire heat treatment. The Finishers are termed F1 (20/07), F2 (25/08), and F3 (30/09) and have yellow, red, and blue silicone stops and identifications rings on their handles, respectively. As previously stated, the core Finishers all have fixed tapers from D1–D3, then decreasing percentage tapers from D4–16. This design feature selectively prepares *deep shape*, which provides a greater fluid volume, improving the potential to actively exchange a reagent. Importantly, deep shape serves to safely confine irrigant within the preparation while creating a capture zone for controlled 3D filling.[8,11]

AUXILIARY SHAPING FILE (SX)

The ProTaper Ultimate Auxiliary Shaper, or SX, is 19 mm in overall length, has a newly designed parallelogram-shaped cross-section, and has a progressively increasing percentage taper along its active portion. SX has diameters at D0, D5, D6, D8, and D9, that correspond to cross-sectional diameters of approximately 0.20 mm, 0.50 mm, 0.70 mm, 0.90 mm, and 1.10 mm, respectively. The Slider is oftentimes used to expand a canal so as to readily accommodate the apical extent of the SX file. SX is used in a lateral brushing motion on the outstroke to eliminate coronal interferences, pre-enlarge the body of a canal, and to move the coronal aspect of a canal away from furcal danger, which promotes a root-centered preparation ***(Figure 7)***.[12]

AUXILIARY FINISHERS (FX & FXL)

The ProTaper Ultimate system has 2 Auxiliary Finishing files. The file with the green silicone stop and identification ring on its handle is the Auxiliary Finisher, termed FX (35/12). FX has a fixed taper of 12% from D1-D3, regressive tapers from D4-D16, and is constructed from 1.2mm NiTi wire. The file with the yellow silicone stop and double identification rings on its handle is the Large Auxiliary Finisher, termed FXL (50/10). FXL has a fixed taper of 10% from D1-D3, then regressive tapers

Figure 7. *After the Slider, use the SX file, as desired, to pre-enlarge a canal and improve access to the apical one-third of this same canal.*

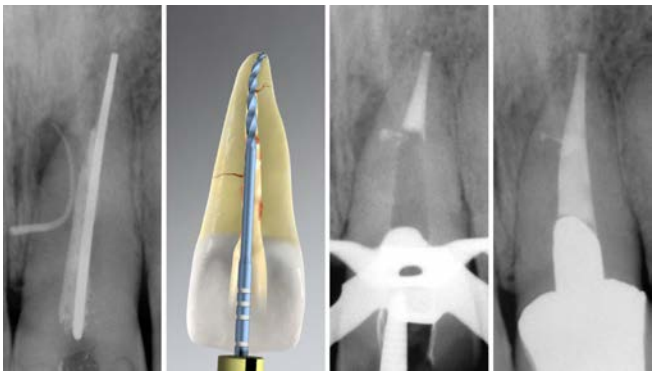

Figure 8. *This endodontically treated tooth is failing apically and laterally. Auxiliary Finishers produce deep shape, promoting complete treatment and healing.*

from D4-D7, where its maximum flute diameter approaches 1.0mm. FX and FXL are designed to be used in larger diameter and anatomically straighter root canals and in canals that exhibit pathologic or iatrogenic defects ***(Figure 8).***

Clinical Technique

Following access, the vast majority of all teeth visually exhibit an identifiable orifice(s). Yet, filling the access chamber with NaOCl does not guarantee the presence of NaOCl below the orifice, as any file selected would serve to largely displace the small volume of irrigant present. In these instances, the pulp chamber is filled with a lubricating agent, such as RC Prep, ProLube, or Glyde. The Slider is the first file selected and is utilized to negotiate, catheterize, and secure any given canal. As such, its purple silicone stop is positioned on the shaft of this file to correspond to the diagnostic working length.

GLIDE PATH MANAGEMENT

Glide path management procedures are initiated by cradling the handpiece between the thumb and fingers so as to passively allow the Slider to progressively advance deeper into the canal.[13] It is wise for clinicians to keep their fingers off the head of the handpiece to discourage dangerous inward pressure ***(Figure 9)***. As the silicone stop approaches the chosen reference point, the lead of an electronic apex locator (EAL) is attached to the shaft of this file. When the EAL displays "APEX," working length is established and apical patency is verified ***(Figure 10)***. Alternatively, a working film provides a second opinion and is useful to visually confirm working length.

In the instances when the Slider bogs down and ceases to advance deeper into a canal, remove it! Clear the blades of debris, place more viscous chelator, if necessary, and re-insert this file, as oftentimes, it will require a few passes to reach the desired working length. However, in the event the Slider ceases to passively advance toward the working length, remove this rotary file and utilize small-sized manual files to negotiate, catheterize, and determine if there is a smooth, reproducible glide path to the working length.[10,12-13] After manually securing the canal, carry the mechanically-driven Slider to length to expand, smooth, and refine this glide path.

Once the Slider has achieved the desired working length, lift this file away from the working length 1 stop, then passively let this file move back to length. Then lift the Slider away from the working length 2 stops, then 3 stops, each time letting this file run inward and back to the working length. In this method of glide path management, there is no desire to work short of the canal terminus; rather, every canal is deemed "secured" when there is a smooth reproducible *slide path* to length *and* its apical terminus is patent. Mechanical glide path management is a significant breakthrough in clinical endodontics as it reduces post-op pain, is super efficient, and provides a spacious tapered pathway to length for the Shaper to follow.[14]

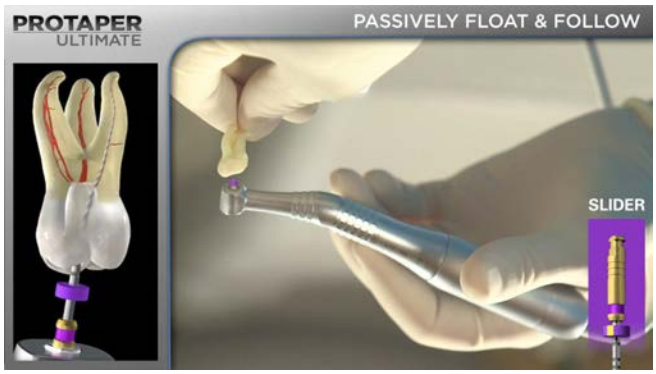

Figure 9. *Let the Slider passively move inward, keeping your fingers off the head of the handpiece to discourage dangerous inward pressure.*

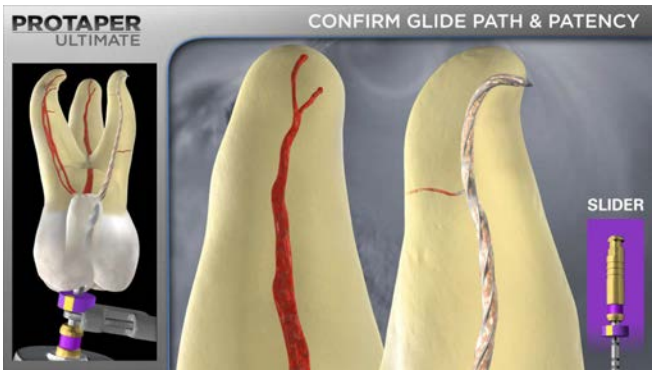

Figure 10. *In the presence of a lubricant, use the Slider to negotiate, catheterize, and reproduce the original canal pathway.*

SHAPE THE CORONAL TWO-THIRDS

When the apical one-third of the canal has been secured, the lubricant is flushed out and the pulp chamber is filled brimful with NaOCl. The Shaper is carried into the canal and allowed to passively advance toward the working length. In those canals that exhibit an irregular cross-section, a selective "brushing" motion on the outstroke is particularly useful as it enables the file to contact more of the dentinal walls. If the Shaper bogs down and ceases to passively advance, this file is removed. After removing any file, always irrigate, recapitulate with either a Slider or an activated polymer tip attached to the EndoActivator (Dentsply Sirona), then re-irrigate. Depending on the length, diameter, or curvature of any given canal, continue in this manner with the Shaper until the terminus of the canal is reached ***(Figure 11)***.

FINISH THE APICAL ONE-THIRD

Once the Shaper has reached length, this file is removed and the pulp chamber is replenished with a fresh reservoir of 6% NaOCl. Now proceed to the Ultimate F1 (20/07) Finishing file, which is designed to prepare the apical one-third and smoothly blend the deep shape into the body of the same canal. The F1 is used passively, in a *nonbrushing* manner, to move deeper into the canal. If the F1 ceases to readily advance toward length, recognize its blades are loaded with debris, which, in turn, limits its capacity to engage, cut, and get pulled deeper into the canal. In these instances, remove the file, irrigate, recapitulate with the Slider or EndoActivate, then re-irrigate. Continue with F1, in one or more passes, until the terminus is reached ***(Figure 12)***.

FINISHING CRITERIA

The ProTaper Ultimate "Finishing Criteria" is fulfilled whenever visual evidence confirms that the most apical few millimeters of any given Ultimate Finishing file are fully loaded with dentin ***(Figure 13)***.[15] Clinically, the preparation sequence is oftentimes as simple as 1, 2, 3, or in ISO color workflow: purple, white, yellow. Yet, upon removing any given Finisher, the clinician may observe the apical flutes are partially loaded or not loaded at all. In these instances, generally proceed to the next sequential Finisher. Alternatively, the terminus of virtually any canal can be gauged with a 2% tapered NiTi hand file whose D0 diameter is equal to the D0 diameter of the last Finishing file carried to length.[16]

If the gauging file is snug at length, the shape is done. If, on the other hand, the gauging file is loose at length, it simply means the terminus of the canal is bigger than the gauging file. As stated, the clinical choice is to generally proceed to the next sequential Finisher, or be prepared to apically trim the correspondingly-sized system-based gutta percha master cone (GPMC) that matches the last Finisher carried to length. To summarize canal preparation, the clinical question is, "When am I ready to fill?" Answer: "When you can fit the GPMC." Question: "When can you fit the GPMC?" Answer: "When you have the shape ***(Figure 14)***." As we have read, the shape is confirmed when the apical flutes of the last Finisher to length are loaded with dentin. The ProTaper Ultimate shapes enable the utilization of any obturation method ***(Figure 15-16)***.

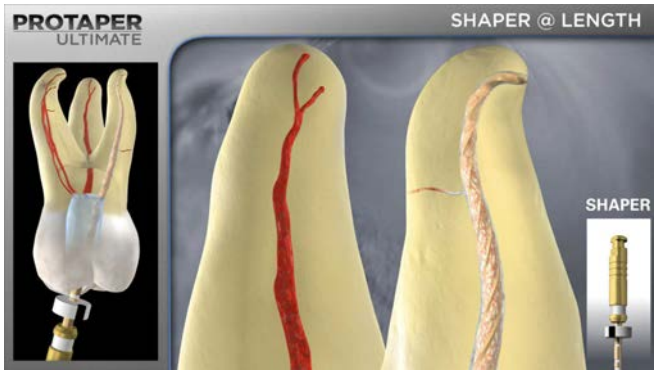

Figure 11. *The Shaper may require a few passes to reach the working length, depending on the length, diameter, and curvature of a canal.*

Figure 12. *In the presence of NaOCl, the F1 is used passively and in a non-brushing manner to follow the canal to the working length.*

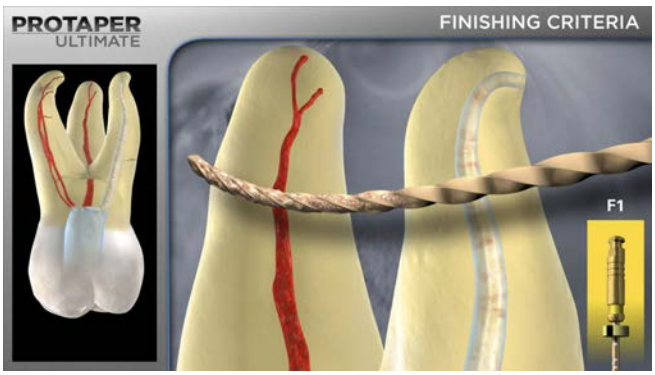

Figure 13. *When the apical flutes of an Ultimate Finishing file are fully loaded with dentin, then the shape is cut and the deep shape finishing criteria is fulfilled.*

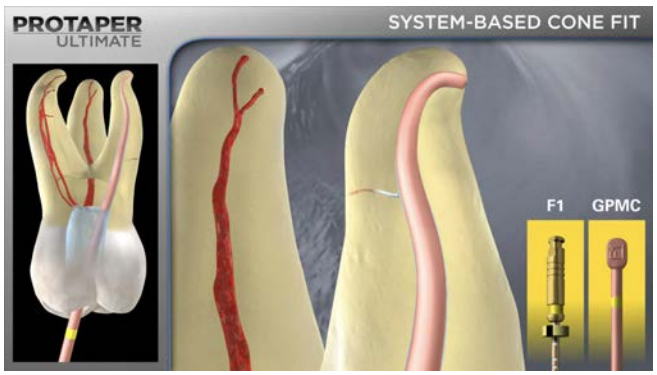

Figure 14. *The ProTaper Ultimate Finishing files have industry leading, system-based GPMCs that precisely match the last Ultimate file carried to length.*

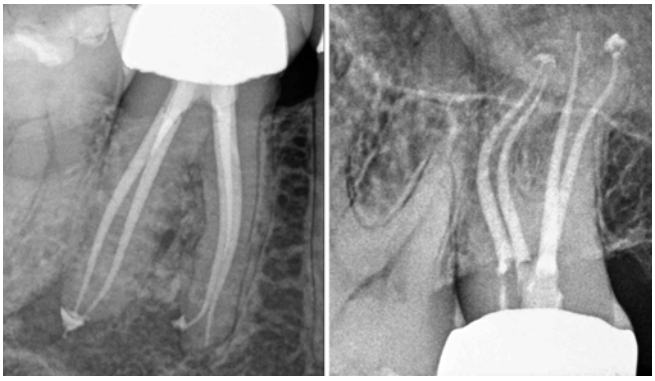

Figure 15. *ProTaper Ultimate was used to prepare these root-appropriate, flowing, tapered shapes (Courtesy of Dr. Jason West; Tacoma, Washington).*

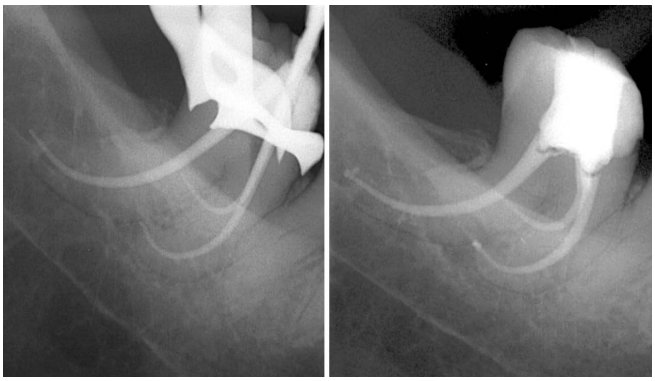

Figure 16. *ProTaper Ultimate files enable fulfilling all subsequent steps that comprise start-to-finish endodontics (Courtesy of Dr. Jacob Amor; Paris, France).*

Closing Comments

ProTaper Ultimate represents a significant advancement in preparing canals by uniting the most successful ProTaper shaping features from the past with the most recent advances in technology, metallurgy, and design. Ultimate shapes respect tooth structure and allow clinicians to employ system-based 3D disinfection and obturation technologies that are highly effective, easy to use, and readily affordable. ProTaper Ultimate files are not just a stand-alone shaping system; rather, this shaping system is an essential pillar of the Triad, as root-appropriate shaping facilitates 3D cleaning and filling root canal systems, ultimately promoting predictably successful results. ▲

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