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The ProFile system

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Since the introduction of nickel–titanium (NiTi) to endodontics in 1988, NiTi hand files and rotary instruments have become popularized because of their superiority in managing curved canals. The NiTi files have the unique properties of superelasticity and shape memory [1]. The superelasticity of NiTi allows deformation of as much as 8% strain to be fully recoverable, in comparison with a strain of less than 1% for stainless steel. When the stress decreases or stops, NiTi alloy will spring back to its original shape without permanent deformation [1,2]. The ProFile instruments made by Tulsa Dental (Tulsa, Oklahoma) were the one of the first NiTi instruments on the market. In 1994, the first product of the Pro *Series 29* (Tulsa Dental) stainless steel and NiTi hand instruments with a 0.02 taper was marketed. The manufacturer soon developed rotary counterparts due to the canal-centering capacity and less aggressive cutting of NiTi. Further developments included increasing taper, including ProFile *Series 29* 0.04 taper, 0.06 taper rotary instruments, and Orifice Shapers. The 0.04 taper instruments were initially designed for the carrier-based obturation technique. The 0.06 taper instruments were developed for those clinicians who preferred a fuller canal preparation than could be obtained using a 0.04 taper. The Orifice Shapers system comprised six instruments with a shorter working blade and larger taper. These instruments were designed to provide continuous shape in the coronal parts of root canals. In 1996, Dr. Stephen Buchanan proposed a series of even larger taper hand files named Greater Taper (GT) files. GT files had 0.06, 0.08, 0.10, and 0.12 taper and were designed to cut more coronal dentin while the instrument tip passively followed the canal without

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engaging the wall [3]. After the merge of the Tulsa Dental and Dentsply companies in 1998, GT rotary instruments and ProFile 0.04 taper and 0.06 taper with International Standards Organization (ISO)-sized tips were marketed. The ProFile ISO-sized tip system was more popular in Asia and Europe. Today, the ProFile system is one of the best-selling rotary instrument systems in the world. The following section thoroughly reviews this system.

Unique file design

Cross-sectional geometry

The ProFile instrument family, including Profile 0.04 and 0.06 taper, Orifice Shapers, and GT files, all have the same cross-sectional geometry. The shape is made by machining three equally spaced U-shaped grooves around the shaft of a taper NiTi wire. There is a central parallel core inside that may account for the enhanced flexibility compared with Quantec (Tycom, Irvine, California) [4] and ProTaper (Dentsply International, York, Pennsylvania) [5], which possess a tapered central core. It has a 20° negative rake angle at the cutting edge and flat radial lands to cut dentin in a planing motion. These configurations prevent the instrument from "screwing into" the canal while rotating. The radial lands also add peripheral mass that contributes significantly to the strength of the instrument. The U-shaped grooves provide the space to accommodate dentin shavings while planing of the canal wall. The 20° helical angle was designed to remove the shaving debris coronally while the instrument rotates clockwise.

Every ProFile file has a bullet-nosed tip with a rounded transition angle. This noncutting tip will follow a pilot hole and guide the instrument into the canal. The noncutting tip and symmetric radial lands design allow the file to remain self-centered as it rotates through 360°, theoretically decreasing the potential for canal transportation and procedural errors to occur [6,7].

Series 29

The rate of increase between file sizes in this series is at a constant of 29%. It is claimed that fewer instruments are required to enlarge to master apical file size. Table 1 shows the size equivalents of *Series 29* instruments compared with ISO sizing. In contrast to a 50% size increase between ISO size 10 and size 15 and a 33% increase between size 15 and size 20, the 29% increment has the advantage of smooth transition among the smaller sizes. There is a much greater leap of size increment in larger files, however, which may create difficulties and complications while shaping curved canals [3].

The ProFile system with increased tapers has been developed in the hope that the greater flare along the instrument shaft would automatically create the divergence required for obturation. The taper of the instrument affects the increase in diameter along its length. In a standard 0.02 taper file, the diameter increases by 0.02 mm per millimeter from the tip (D_0). Thus, D_{16}, which is the file diameter 16 mm away from D_0, is 0.32 mm wider than D_0.

Table 1
Size equivalents of ProFile *Series 29* and standard ISO sizing

ProFile *Series 29* size	ISO equivalent size (mm)
2	0.129
3	0.167
4	0.216
5	0.279
6	0.360
7	0.465
8	0.600
9	0.775
10	1.000

For a 0.04 taper instrument, D_{16} is 0.64 mm wider than D_0, and for a 0.06 taper instrument, D_{16} is 0.96 mm wider than D_0 [3,8].

The GT file has a fixed D_0 diameter of 0.20 mm and a fixed maximal flute diameter of 1.0 mm. As such, different degrees of taper account for different lengths of blade.

Clinical performance

The clinical performance of the ProFile system in general is rated good and is comparable to other NiTi rotary systems [4,7,9]. For a more detailed discussion, the clinical performance of the ProFile system is divided into the following sections: cutting/machining efficiency, shaping ability, cleaning efficacy, and effect of NaOCl and sterilization.

Cutting/machining efficiency

Machining efficiency has been defined as ‘‘the procedure of removal of simulated canal/tooth substance with the fluted material.’’ Machining efficiency has been shown to relate to the alloy used and to cross-sectional geometry [10]. Haïkel and colleagues [11] defined cutting efficiency as the ‘‘mass of Plexiglass cut per unit of energy used by the test file.’’ Haïkel and other investigators [11,12] found that the NiTi files cut less efficiently than stainless steel files. This reduction in efficiency may be explained by the fact that NiTi has a very low modulus of elasticity and, thus, deformation on contact with simulated canal/tooth substance is induced. Kazemi et al [13] demonstrated that NiTi files are comparable with or better than stainless steel files in terms of machining dentin. The divergent results may be due to the different behavior of files when cutting Plexiglass and dentin substrate.

Dr. Johnson [14] classified all rotary instruments as having active, semiactive, or passive cutting blades. The ProFile system fits into the category of passive instruments. The slight negative rake angle and radial lands make the files cut less aggressively than those having active cutting blades (eg, ProTaper [15], HERO 642 [Micro-Mega, Besancan, France], RaCe File [FKG

Dentaire, Switzerland], Pow-R [Moyco Union Broach, York, Pennsylvania]) and those having semiactive cutting blades (eg, Quantec [14,16]).

Shaping ability

Several studies have confirmed the ability of rotary NiTi files to stay centered [17,18] and to maintain canal curvature better than stainless steel hand files [19–21]. Thompson and colleagues [6,7,9,22] presented a series of studies on the shaping ability of ProFile 0.04 taper *Series 29* and ISO-sized tip using simulated root canals of different curvatures and shapes. None of the canals became blocked with debris in either system. The loss of working length averaged 0.5 mm or less. Intracanal impressions of prepared canal demonstrated that most canals had definitive apical stops, smooth canal walls, and good flows and tapers. Despite their superelastic property, NiTi instruments still tended to straighten within the canals. Several canal aberrations such as zips, elbows, and transportations could be seen on the impressions. Similar phenomena were also found in extracted human teeth [4]. Therefore, not only the ProFile system but also all NiTi instruments must be used with caution when larger sizes and greater taper files encounter severely curved canals.

The instrumentation time required for NiTi rotary instruments is generally less than for stainless steel hand files [8,19–21]. Because fewer instruments are used in the ProFile system, even less instrumentation time is required compared with the LightSpeed (LightSpeed Inc., San Antonia, Texas) and Quantec systems [18,23]. Less instrumentation time could further reduce operator and patient fatigue.

Cleaning efficiency

Numerous studies in the literature have established the role of bacteria and their by-products in the pathogenesis of apical periodontitis. The ultimate goal of endodontic treatment is to prevent or eliminate infection within the root canal system [24]. Classic series of studies regarding antibacteriologic effects of the individual steps in endodontic procedure were performed by Byström and Sundqvist [24–26] using stainless steel hand files. Dalton et al [27] demonstrated that the amount of bacterial reduction after ProFile rotary instrumentation was comparable to stainless steel hand files when saline was used as an irrigant. There was a substantial bacterial reduction with progressive filing to larger sized files. Completion of NiTi instrumentation yielded 28% negative culture samples [27]. The result was comparable to Ørstavik et al's [28] study in which no detectable bacterial growth in 43% of teeth immediately after extensive apical reaming with saline irrigation was found.

Adding 1.25% sodium hypochlorite (NaOCl) as an irrigant further increased the percentage of negative culture to 61.9%. NaOCl, however, requires an appropriate apical size (ProFile *Series 29* size 5 and above) to become effective in bacterial reduction [29,30]. This indicates that NaOCl irrigation is an important step in the reduction of canal bacteria during rotary instrumentation. Mechanical instrumentation with NaOCl irrigation, however, cannot constantly render canals bacteria-free. In the presence of apical periodontitis, intracanal medication with calcium hydroxide for at least 1 week is recommended. One-week calcium hydroxide medicament could render 91.5% of canals void of bacteria [30].

Canal shaping with ProFile and other NiTi instruments usually results in a round preparation and smear layer formation [18]. Therefore, the cleaning efficacy of NiTi rotary instruments was questioned, especially in oval canals such as mandibular incisors and distal roots of mandibular molars [23,31]. Peters and colleagues [31] used micro-CT to access canal geometry after preparation with four different techniques, namely, GT rotary, NiTi K file, Lightspeed, and ProFile 0.04 taper. They demonstrated that approximately 35% to 40% of the canal surface remained untouched after complete instrumentation. This finding proved the necessity of using chemical irrigant to dissolve tissue debris and smear layer while undergoing canal preparation with rotary instruments. The debris score and smear layer score after ProFile instrumentation were reported to be significantly lower in the 2.5% NaOCl/17% EDTA group than in the tap water group [31].

Effect of NaOCl and sterilization on ProFile

Corrosion was the major concern regarding NaOCl irrigation while using NiTi instruments. Chloride corrosion can leave micropitting on instrument surfaces and lead to areas of stress concentration and crack formation. Haïkel et al [11,32] showed that after 2.5% NaOCl treatment for 12 and 48 hours, there was no significant change in the mechanical properties of ProFile instruments. The cutting efficiency also was not affected by the presence of NaOCl. Yared et al [33,34] also demonstrated that when ProFile rotary instruments were used on extracted teeth, irrigation with 2.5% NaOCl did not lead to a decrease in the number of rotations to breakage of the files.

Sterilization had been suggested as a way to rejuvenate NiTi files by reversing the stress-induced martensite transformation to the austenite phase [35]. Yared et al [33,34] demonstrated that sterilization by dry heat or steam autoclave did not shorten the lifespan of ProFile 0.06 taper ISO-sized tip files. According to the results of their studies, the ProFile 0.06 taper ISO-sized tip files could be safely used up to 10 times in vitro or for four molars in vivo. Silvaggio and Hicks [36] also proved that sterilization of ProFile 0.04 taper files in dry heat, steam autoclave, or satim autoclave sterilizer up to 10 times does not increase the likelihood of fracture.

Safety concerns

Although NiTi rotary instruments have the advantages of superelasticity, shape memory, and good efficiency with less fatigue, their use does have safety concerns including loss of tactile sensation, extrusion of debris, and instrument deformation and failure.

Loss of tactile sensation

When using rotary instruments compared to hand files, there appears to be a difference in tactile awareness. There is less feedback from rotary instruments, particularly regarding the direction of the curvature and location of apical terminus. Even with the design of radial lands, larger sized ProFile instruments with greater taper such as the ISO size 35, 0.06 taper file still tends to "thread into" the canal [37]. Therefore, length determination before use of rotary instruments is essential. Properly angulated radiographs and an electronic apex locator are necessary. Preflaring the canal orifice facilitates more accurate and consistent reading of working length [38,39]. After the length is obtained, the clinician should keep this length while operating the rotary instruments. If the file threads in, then the clinician should not stop the instrument rotating, but should try to withdraw the file while still rotating or reverse the direction of rotation to drive the file out of the canal.

Extrusion of debris

When endodontic therapy is performed, mechanical and chemical irritants may be inadvertently introduced into periradicular tissue and cause post-instrumentation flare-ups. Problems with debris extrusion using the ProFile rotary system were investigated by Hinrichs et al [40] and Reddy and Hicks [41]. They demonstrated that the amount of debris extruded with ProFile files was comparable to the balanced-force technique using flex-R files but was significantly less than the step back technique using hand K files. The lesser amount of debris extruded may be due, in part, to the flute design of ProFile instruments that aids in debris removal, and to the reaming motion of the ProFile rotary system and the balanced-force technique that extrudes less debris than the "push-pull"motion of manual stepback technique. The amount of debris extrusion was positively related to the amount of irrigant extruded but irrelevant to canal length, curvature, and foramen size [40].

Instrument deformation and failure

Intracanal instrument separation is the most frustrating mishap that occurs when operating the NiTi rotary system. Breakage of NiTi instruments can occur without any visible sign of unwinding or permanent deformation. Therefore, visual examination is not a reliable method for evaluation of used NiTi instruments [42]. The clinician must recognize the risk factors to prevent separation from occurring.

There are two modes of failure that cause rotary instrument separation; namely, torsional and flexural fractures. Torsional fracture occurs when the torque limit of the instrument is exceeded. Flexural fracture arises from minute surface defects and occurs after cyclic fatigue [43,44]. As an instrument rotates in the canal, it binds against tooth structure, which places friction on the instrument called torque. The amount of torque generated while rotating in the canal is positively related to the mass of the instrument. Larger sized and greater taper files, although being stronger and having better torque resistance, will create more torque value on contact with the canal wall [14,45]. Radius of canal curvature is the most important factor in determining the torque value. If two canals have the same angle of curvature but have a different radius, then the one with smaller radius has the more abrupt canal deviation and results in higher torque on file. Torque also will rise with increased apical force. The ideal amount of pressure to be used for rotary instruments is the equivalent of the pressure applied when using a sharpened pencil without breaking the lead [14]. When using instruments of greater taper, the first thing to cut is the coronal portion of the canal. As the instrument goes deeper into the canal, the torque increases as a consequence of the increased contact area between the file and dentinal wall. Therefore, when the file advances further into the canal, the pressure should be lessened to prevent torque from building up [14]. Use of a lubricant within the canal can reduce the friction between the instrument and canal wall. Avoidance of torque failure requires maintaining adequate lubrication during instrumentation [14].

Cyclic fatigue is synonymous with metal fatigue. When an instrument is rotating around the curve, it is compressed on the inner side of the curve and stretched on the outer side of the curve. With every 180° of rotation, the instrument flexes and stretches over and over again, resulting in cyclic fatigue and, eventually, fractures [14]. The larger sized or greater taper file sustains more compressive and tensile forces due to increased metal mass. Therefore, cyclic fatigue will occur more quickly. The radius of curvature is likely the primary reason for instrument separation due to cyclic fatigue. A smaller radius with an abrupt curve induces greater fatigue than a lager radius with a sweeping curve [14].

In a relatively straight or a gently curved portion of a canal, the clinician should select an instrument with high strength to prevent torsional fracture. Therefore, using a larger diameter instrument such as 0.06 taper rather than 0.04 or 0.02 taper will provide more torque resistance. When encountering a sharp apical curve, the most appropriate choice would be a 0.02 taper file for its least susceptibility to metal fatigue. If the curvature is somewhat in between the two aforementioned conditions, then problems with torsional fracture and cyclic fatigue need to be considered. Consequently, an intermediate taper such as 0.04 taper, which has more torque strength than 0.02 taper yet is less susceptible to cyclic fatigue than a 0.06 taper or a GT file, should be selected [14].

To prevent intracanal breakage of instruments, gaining straight line access (coronal and radicular) is the first step in obtaining an uninhibited path for the file to enter the canal. When the instrument is rotating, it should be used with gentle in-and-out movements (pecking motion) to prevent the stress from building up. Each file is used only for a short time and should never be left rotating in a stationary position. Most important, instruments should be discarded after a certain number of uses [14]. Peters and Barbakow [46] measured the number of rotations to failure in a cyclic fatigue test and then divided this number by the average of rotations for preparing an individual canal. Their result indicated that up to 5 to 10 curved canals could be safely prepared with the ProFile 0.04 taper instrument [46]. Taking the complex anatomy of root canals and the torque generated for torsional fracture into account, the manufacturer of ProFile recommends that the files be discarded after 6 to 8 clinical uses. Because fracture of NiTi instruments can occur without evidence of unwinding and deformation, it is advised to discard instruments after abuse in an extremely curved or narrow canal.

Gambarini [47] suggested the use of low-torque endodontic motors to reduce the mechanical stress on NiTi rotary instruments. The torque value for an individual instrument is set at slightly lower than the limit of elasticity, and these data are preprogrammed in the machine. If the motor is loaded up to the torque limit, the motor stops momentarily or rotates backward to avoid permanent deformation and intracanal breakage [47]. Using a torque-control unit, however, may lead the instrument to repeatedly move in a forward and reverse motion, resulting in increased cyclic fatigue [14]. Yared and Sleiman [48] demonstrated that for an experienced operator, there was no difference in the failure incidence of ProFile instruments used with air, high torque-control motors, or low torque-control motors. In contrast, for an inexperienced operator, use of the low torque-control unit can significantly reduce the incidence of intracanal breakage [48].

ProFile and other NiTi rotary instruments should be operated with constant speed. The recommended speed for the ProFile system ranges from 250 to 350 rpm. For an experienced operator, rotational speed within that specific range may not be as critical as for an inexperienced operator. Yared et al [48,49] demonstrated that use of ProFile in a crown-down manner at 350 rpm is safe for an experienced operator. Daugherty et al's [50] study suggested that the ProFile 0.04 taper *Series 29* rotary instruments should be used at 350 rpm to double the efficiency and halve the deformation rate compared with the 150 rpm group. For an inexperienced operator, however, using the slower speed of 150 to 170 rpm would be more likely to prevent instruments from deformation and fracture [49].

Clinical applications

Cleaning and shaping of the root canal system

The fundamental concepts for cleaning and shaping of a root canal system remain the same regardless of the techniques and instruments used. Obtaining a straight line access into the orifice and canal is the first critical step for successful outcome. Any overhanging dentins from the chamber roof and cervical ledges near the orifices have to be removed. The preparation should be extended to eliminate any coronal interference during subsequent instrumentation [3]. After the coronal access is completed and canal orifices are identified, the chamber is debrided by copious irrigation with NaOCl. Ultrasonics and chelating agents such as EDTA also can be used before canal preparation.

Pre-enlargement of the coronal two thirds of the canal has mechanical and biologic benefits. Mechanically, pre-enlargement allows early removal of coronal interferences, thus aiding in better tactile sensation of the file moving apically. It also minimizes canal deviation and instrument separation by reducing contact with the canal. Biologically, pre-enlargement facilitates rapid removal of contaminated tissue from the canal system and improves the penetration of irrigation solution. It minimizes extrusion of debris apically and subsequent post-treatment flare-ups [38]. Preflaring also provides more accurate and consistent working length determination [39] and, therefore, more precise canal cleaning and shaping. Also, obturation can be accomplished without violating surrounding periradicular tissue.

Pre-enlargement of the coronal two thirds can be accomplished with a variety of instruments such as Gates-Glidden (GG) burs, Orifice Shapers, GT files, and any NiTi rotary system with greater tapers in either crown down or step back manner. Dr. Ruddle [3] suggested using NiTi rotary files in a crown-down technique or GG burs in a stepback technique to complete coronal preparation. The author prefers using GG burs in a crown down direction, with GG bur 4 submerging the cutting head below the orifice and each smaller GG stepping into canal for about 2 to 3 mm until reaching the predetermined depth. No matter what instrument or what sequence is selected, it is important to insert a stainless steel hand file (0.02 taper, size 10, size 15) to the level at least 2 mm deeper than the desired depth for the rotary instruments. The advantages for such a procedure are twofold. First, it gives information about canal anatomy regarding to the curvature and width. Second, it creates a patent pathway for the rotary instruments. The reason for hand files to reach the level 2 mm beyond the rotary instrument is to preserve the most apical canal anatomy for future hand file advancement. The goals for pre-enlargement are to relocate the canal away from the anatomic danger zone and to achieve uninhibited access to the apical third of the canal, yet still preserve enough root structure for prosthetic restoration. The entire pre-enlargement procedure should be done with copious irrigation and frequent recapitulation to ensure canal patency [3,38].

After pre-enlargement of the coronal two thirds, the clinician is ready to advance the stainless steel hand file to the apical terminus. The clinician should mentally picture the canal anatomy before use of rotary instruments. In cases where canals merge (Weine's classification type II), canals divide (Weine's classification type IV), and in bayonet-shaped canals, NiTi rotary instruments will bind to the dentinal wall and fracture. Therefore, these difficult anatomies are better finished with hand instrumentation. Accurate working lengths can be obtained from well-angulated radiographs and an electronic apex locator [39]. The apical extension of working length and the final apical preparation size have long been debated. Although the philosophies may vary, the principles remain the same. Only after a patent pathway to the terminus is established by using small hand files should the clinician start finishing the apical preparation with a rotary instrument. ProFile and other NiTi rotary instruments will perform optimally with less breakage when used with the recommended speeds and correct sequences. Whether the sequence is from large to small or vice versa (Boxes 1, 2) may not be critical, so long as the instruments are used passively within the canal. The clinician should keep the instrument rotating before entering the orifice and use a short-distance pecking motion to advance the file apically. If resistance is confronted, then the file should be withdrawn while rotating. Several possibilities exist for the resistance of apical movement. The most likely cause is encountering curvature; however, the instrument tip may be too big to follow the pathway established by the small hand file. In either case, removal of coronal interferences with a larger file set at a shorter distance or enlargement of the pathway with a smaller file will aid in file advancement. Another possibility for resistance is intracanal or interblade debris accumulation. Copious irrigation with recapitulation or wiping the debris off the file with wet gauze or a sponge will resolve the problem.

Obturation

After complete cleaning and shaping of the root canal system, the obturation procedure can be proceeded when no subjective symptoms or

Box 1. Recommended sequences for use of ProFile by manufacturer

1. Estimate the working length of the canal from a preoperative radiograph.
2. Create a glide path with a size 10/15 stainless steel K file.
3. Use Orifice Shapers sizes 4, 3, 2, and 1 in the coronal one third based on canal size and angle of pathway.
4. Perform crown-down preparation: use ProFile instrument of taper/size 0.06/30, 0.06/25, 0.04/30, and 0.04/25 to resistance (0.06/35, 0.06/30, 0.04/35, and 0.04/30 for larger canal).
5. Determine the working length with size 15 K file.
6. Perform apical preparation with ProFile taper/size 0.04/25, 0.04/30.
7. Finish with ProFile taper/size 0.06/25 short of working length to blend the coronal and apical preparation.

Box 2. Possible sequences for use of ProFile

1. Estimate the working length of the canal from a preoperative radiograph.
2. Create a glide path with a size 10/15 stainless steel K file.
3. Use GG burs 4, 3, 2, and 1 in the coronal two thirds based on canal size and angle of pathway.
4. Determine the working length with size 15 K file.
5. Perform hand instrumentation with taper/size 0.02/15, 0.02/20 stainless steel K file to working length.
6. Perform apical preparation with ProFile taper/size 0.06/25, 0.06/30.
7. Finish with ProFile taper/size 0.06.35 short of working length to blend the coronal and apical preparation.

significant infections exist. There is no one particular obturation technique that is superior to others for those canals prepared with ProFile systems. Any technique in which a clinician is proficient can be used for NiTi instrument–prepared canals. Figs. 1–3 provide some examples of endodontics performed with 0.04 and 0.06 taper ProFile instruments. The manufacturer advocates packages that combine rotary files and integrated obturation systems such as ProFile 0.04 taper and Thermafil, or GT files and corresponding GT obturators. Vertical compaction of warm gutta-percha using traditional Schilder's technique or the continuous wave technique achieves good clinical results. The canal preparation by ProFile provides good taper and smooth flow, thus allowing uneventful plugger penetration and gutta-percha flow. The obturation quality and efficiency of the cold lateral compaction technique were evaluated by Hembrough et al [51] after canal preparation with 0.06 taper ProFile files. Three different master cones with different degrees of taper were chosen; namely, a 0.06 taper gutta-percha cone, a customized point from nonstandardized master cone, and an ISO standardized cone. There was no significant difference in terms of obturation quality; however, the use of greater taper cones such as 0.06 taper cones and customized cones was more efficient than the ISO standardized cones because less accessory points were used [51].

Retreatment

ProFile instruments rotating at higher speeds are very effective tools for removing intracanal gutta-percha. The gutta percha near the orifice area is generally the tightest part, which can be removed by GG burs or by heat. The clinician should select two to three appropriately sized ProFile instruments that fit passively in the canal in a crown-down manner. The recommended speed for gutta-percha removal ranges between 1200 and 1500 rpm. The

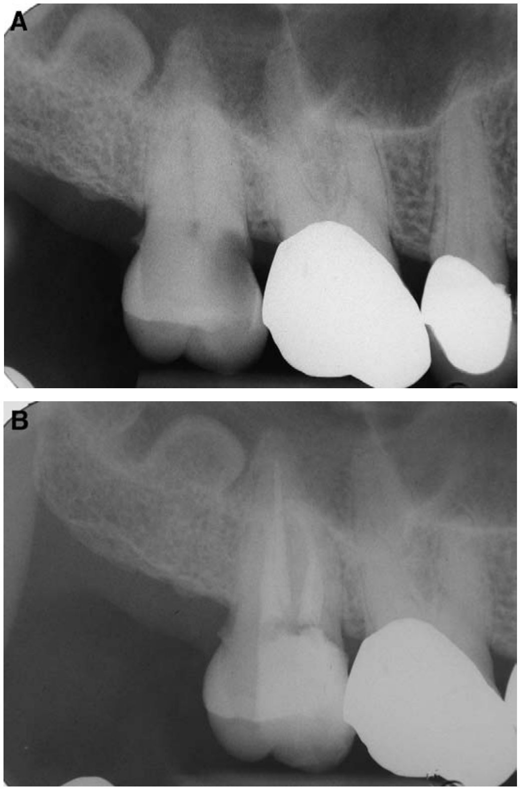

Fig. 1. (*A*,*B*) Prepared with 0.06 taper ProFile in a gently curved maxillary second molar.

friction generated by ProFile instruments can soften the gutta percha and move it coronally [52]. Baratto and colleagues [53] evaluated the effectiveness of the ProFile 0.04 taper to remove gutta-percha. They found that ProFile could reach ideal working length rapidly regardless of the obturation techniques but was inadequate in complete removal of gutta-percha. To ensure the complete removal of gutta percha, the clinician might use ProFile to remove the bulk of gutta-percha, thus providing space for chemical solvent. With the aid of a microscope, the clinician can try to ''wipe'' or ''wick out'' the residual gutta percha from the canal aberrations with paper points.

Summary

NiTi rotary instruments have advanced endodontics into another era. The ProFile rotary instrument system has good clinical performance in managing curved canals and has proved to be more efficient than hand instrumentation. Our professional responsibilities include making the best use of this system and providing the best quality of care to our patients.

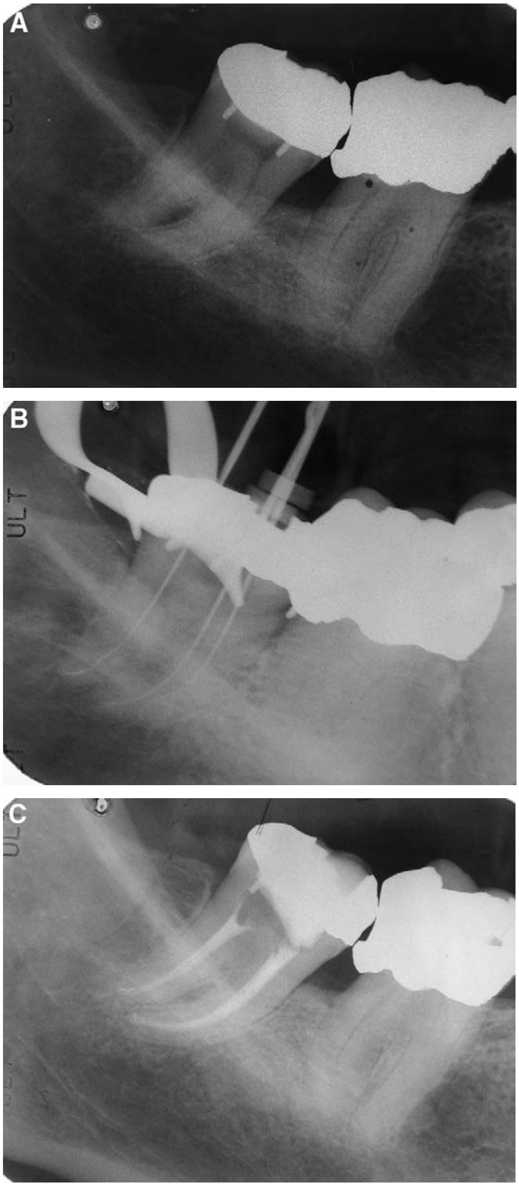

Fig. 2. (*A–C*) Prepared with 0.04 taper ProFile in a moderately curved mandibular second molar. Noted that a separated #10 K hand file in the apical third of distal canal, which was bypassed and filled to the apex.

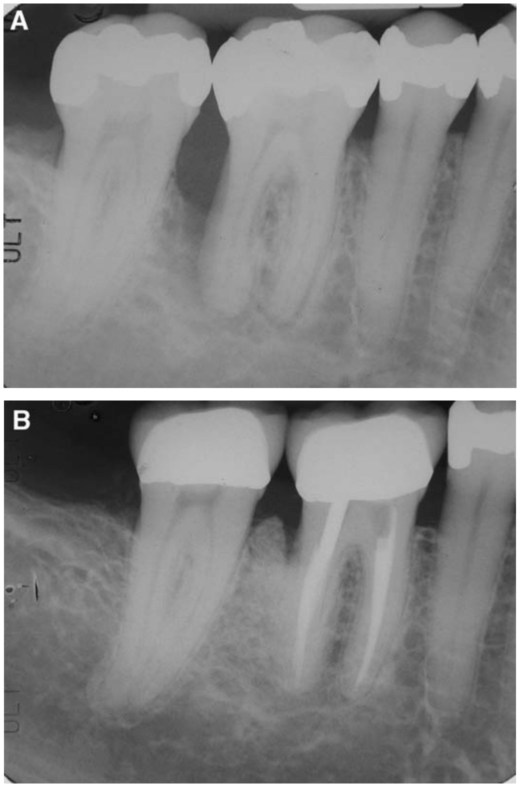

Fig. 3. Prepared with 0.06 taper ProFile.

There is a learning curve before proficiency and ProFile use must follow the principles listed below [3]:

1. Coronal and radicular straight line access are essential to proper cleaning and shaping and to reduce risk of instrument separation.
2. Always use hand instrument to explore canal anatomy and obtain a pathway before introducing rotary instruments.
3. Adhere to the recommended rotational speed. For an inexperienced operator, following the sequences provided by the manufacturer may result in less frustration. Practice on the extracted teeth before use in vivo.
4. Make sure to always have enough lubrication in the canal and work passively on rotary files. Never force the instrument to advance apically.
5. Understand the limitation of NiTi rotary instruments. Difficult canal anatomy such as canal merge, abrupt curvature, and bayonet-shaped canals may not be appropriate for their use.

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