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Review Article

Quick reference guide to rotary endodontic instruments - A comprehensive review

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Abstract: In the field of endodontics revolution transpired over the years. The modern endodontic specialty practice has little resemblance to the traditional means. There is a lot of transformation, in the materials used and the type of instrumentation. Initially, stainless steel was the material of choice and manual instrumentation was the only means of cleaning the root canals. However, there is a tremendous change in the modern endodontics, due to introduction of NiTi (Nickel Titanium) files and rotary instrumentation. NiTi was developed 40 years ago in the Naval Ordinance Laboratory (NOL) in Silver Springs, Maryland. Therefore, the acronym Nitinol is used worldwide for this unusual type of alloy with better flexibility and fracture resistance**.** Rotary systems that evolved over years in to different generations differ in the series of instruments included. Hence, it is essential for the beginners to understand the differences among all the available systems and their usage which are highlighted in this review article.
Keywords: Endodontics, Instrumentation, Rotary

INTRODUCTION

Endodontic treatment is a major and increasing portion of the activity in Paediatric dentistry. It ought be effective in restoring the function of teeth until exfoliation. Essential part of endodontic therapy includes cleaning and shaping. It evolved from hand instrumentation to rotary, each with its own merits and demerits. The major concern of hand instrumentation in primary teeth is increased preparation time [1] especially in young children with limited cooperation, whereas inconsistency of quality tapered preparation leading to further problems in obturation thereby compromising the clinical prognosis is another concern.

With the introduction of NiTi alloy in endodontics by Walia *et al.;* in 1988 [2] rotary systems were developed with the following objectives: simplicity, speed, safety in addition to stress reduction for both the clinician and patient. For the use in endodontic treatment, NiTi rotary instruments are available in different designs and tapers [3]. Therefore, rotary instrumentation represents a significant evolution in endodontics which increasingly results in a faster, safer and better quality preparation [4]. The use of rotary systems demands a thorough previous training as it reduces the operator's tactile sense. Rotary biomechanical preparation of primary teeth was first described by Barr *et al.;* in 2000 [5, 6] with ProFile 0.04 taper rotary instruments, which was cost-effective and efficient resulting in consistently uniform and predictable obturation [6].

ROTARY SYSTEMS

The introduction of nickel-titanium (NiTi) rotary files to endodontics nearly two decades ago has transformed the system of root canal preparations, permitting complicated root canals to be shaped with fewer practical errors. In 1889, William H. Rollins developed the first endodontic hand piece for automated root canal preparation and used specially designed needles with a 360 degree rotation and 100 Revolutions Per Minute (RPM) [7] limited speed to avoid instrument

fracture. The first description of the use of rotary devices seems to be given by Oltramare in 1892 [8], he used fine needles with a rectangular cross-section, mounted them into a dental hand piece and passively introduced into the root canal up to the apical foramen and initiated rotation. The Cursor filing contra-angle was developed in 1928 by W&H (Burmoos, Austria) which combined rotational and vertical motion of the file. In 1958 W&H company started marketing the Racer-hand piece in Europe which worked with a vertical file motion. Later in 1964, MicroMega (Besancon, France) started marketing the Giromatic in Europe with a reciprocal 90 degree rotation. Endodontic handpieces such as the Endolift (Kerr, Karlsruhe, Germany) with a combined vertical and 90 degree rotational motion and similar devices were marketed during this period. A period of modified endodontic handpieces began with the introduction of the Canal Finder System (now distributed by S.E.T., Grobenzell, Germany) by Levy [8]. Hand instruments made from NiTi were first described by Walia [2]. NiTi rotary instruments which were introduced later are with low speed and 360 degree rotation, follow the mechanical principles given by William H. Rollins. The various rotary systems included in the present paper are summarized in table 1.

Table 1: Rotary systems included in the review

S. No	System	Generation
1	Profile	First generation
2	Quantec	First generation
3	Hero 642	First generation
4	Flex master	First generation
5	RaCe	Second generation
6	Protaper	Second generation
7	K3	Second generation
8	Hero shaper	Second generation
9	Endo sequence	Second generation
10	Bio race	Second generation
11	Twisted	Third generation
12	Hy flex	Third generation
13	Wave one	Third generation
14	Self-adjusting file SAF	Fourth generation
15	Revo S	Fifth generation
16	One shape	Fifth generation
17	Protaper next	Fifth generation

Profile **® [9] (Dentsply Tulsa Dental Specialties,USA) (Figure 1)**

The ProFile® NiTi rotary instrument line includes orifice shapers, ProFile 0.02, 0.04 and 0.06 tapers, Greater Taper (GT) files, Series 29, and Pro Taper instruments. The ProFile 0.02, 0.04 and 0.06 tapers, GT files, and Series 29 files share the same cross sectional geometry and have three radial lands with each containing bi-directional cutting edges. Taper means gradual increase in diameter over the length (conical shape).

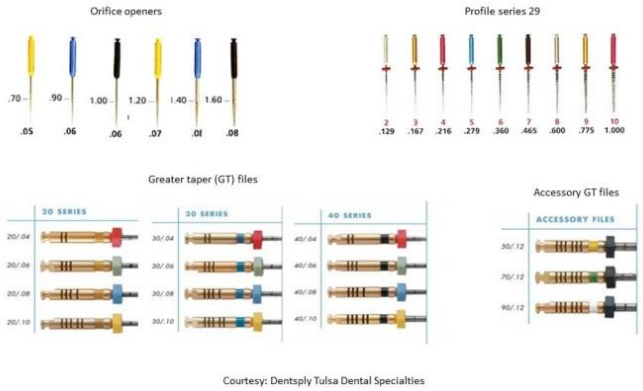


Fig 1: Profile ® rotary system

Orifice openers 0.05, 0.06, 0.07 and 0.08 tapers (D0: #20, #30, #40, #50, #60, and #80)

These extend 19 mm below the head of the hand piece and have 10 mm of cutting blades. This series

comprises of six instruments that are safe-ended, have increasing D0 diameters and are generally used to prepare the coronal two-thirds of the root canal system.

ProFile® Series 29

These are the original nickel titanium rotary instruments from Tulsa Dental. These are manufactured under the Series 29 standard, meaning they feature a constant 29 percent increase in tip diameter between file sizes. The constant percentage increase offers a smooth, progressive enlargement of the canal.

ProFile® 0.02 (#15-50), 0.04 (#20-50) and 0.06 (#20-50)

These ISO instrument lines are the benchmark against which all other rotary shaping files are measured. These rotary shaping instruments are machined with safe-ended non-cutting tips, increasing D0 diameters, and 16 mm of cutting blades. The Profile 0.02 taper series is designed for extremely curved canals. The ProFile 0.04 series was initially designed for subsequent carrier based obturation techniques, while the 0.06 taper instruments provide a fuller shape over the length of the canal.

Pro System® GT® or Greater Taper (GT) rotary files (Small series #20 ISO, Medium #30 series, Large #40 series)

These are made up of a series of four safe-ended instruments with variably pitched flutes and fixed minimal and maximal flute diameters. Each instrument set has a different linear length of cutting blades with a fixed D0 diameter of 0.20, 0.30, or 0.40 mm, and a maximal flute diameter of 1.0 mm. File taper changes as D0 diameters and maximal flute diameter remain fixed. Tapers vary from 0.10, 0.08, 0.06 and 0.04.

Accessory GT® files

These are designed to pre-enlarge the coronal portion of a canal or to prepare the apical one-third of a large root canal system. The set consists of three NiTi instruments with tapers that are 0.12 mm. These files have maximal file diameters around 1.5 mm and D0 diameters 0.35 mm, 0.50mm, 0.70mm, or 0.90mm.

***The Quantec™ system* (Kerr dental, Orange, California, USA) (Figure 2)**

It is the product of two previous Ni-Ti rotary systems (the NT system and the McXim system) developed by McSpadden. Quantec files were introduced in 1996, and are now available from Sybron Endo. These instruments are available in tapers of 0.12, 0.10, 0.08, 0.06, 0.05, 0.04, 0.03, and 0.02 mm/mm. All have a D0 diameter of 0.25mm (Quantec files maintain a tip size of 0.25 mm throughout the shaping sequence). Quantec files vary in taper along their blanks and are available in non-cutting (LX) or safe-cutting (SC) tip (Figure 2). The recommended rotational speed for all instruments by the manufacturer is 340 RPM. Quantec files are also available with Axes handles that are 30% shorter than those of other files. These files when placed into a minihead contra-angle, 7 mm of interocclusal clearance is gained.

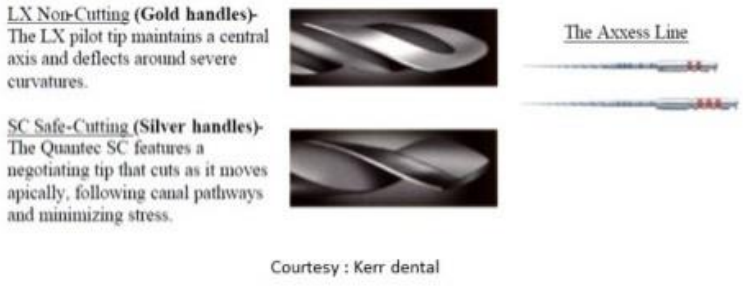


Fig 2: The Quantec™ rotary system

***HERO 642®* [10] (Micro Mega, France)**

The HERO 642® rotary system uses continuously rotating (300 to 600 rpm) NiTi instruments with different tapers (.06, .04 and .02) to clean and shape root canals. Blue sequence should be followed when canals have straight curves (< 5degrees) - 0.06 taper: after opening the pulp chamber, orifice opening is located and explored, following which working length (WL) should be determined by using conventional methods. It is advised to place a 0.06 taper No 30 HERO in the selected canal reducing contra-angle. The (black) rubber stop needs to be adjusted to correspond to 1/2 or 2/3 of the WL. Rotation speed should be chosen between 300 and 600 rpm end and maintain it constant. Instrument is inserted while rotating. Further preparation is preceded apically in a short in and out movement applying normal pressure as if writing with a sharp pencil. The canal need to be penetrated the canal until 1/2. Or 2/3 of its depth is reached (Figure 3).

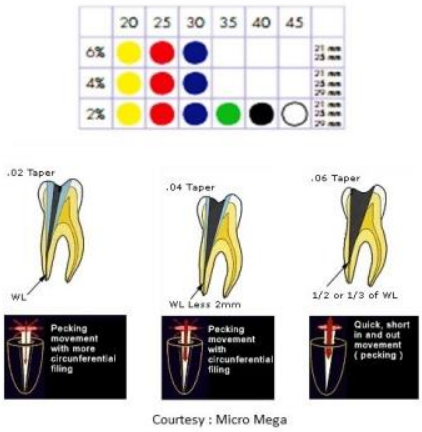


Fig 3: HERO 642® rotary system

Later the instrument needs to be changed to a .04 taper No 30 HERO. The (grey) rubber stop should be adjusted at WL minus 2 mm and same constant rotation speed should be maintained. Procedure is continued the same way as before until WL minus 2 mm is obtained. It can be combined with a circumferential filing. The instrument needs to be changed to 0.02 taper No 30 HERO. The (white) rubber stop should be adjusted at WL. Constant rotation speed needs to be maintained. Procedure is continued with the same quick pumping movement until WL is reached without excessive pressure. It can be combined with a circumferential filing.

For canals with average difficulty with curvature (10 – 25 degrees red sequence can be followed using the "crown-down" method. It is recommended by the manufacturer to begin with the instruments N° 25 and to follow the red sequence. For difficult canals with curvature (>25 degree) yellow sequence can be followed. The "crown-down" method remains the same. Procedure can be started with instruments N° 20 and followed by yellow sequence (Figure 4).

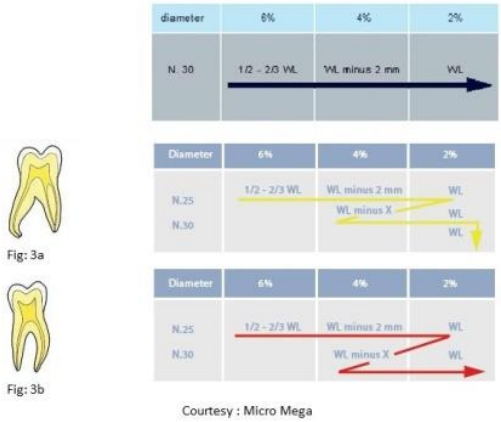


Fig 4: HERO 642® rotary system

***FlexMaster*® [11] (VDW, Munich, Germany) (Figures 5 and 6)**

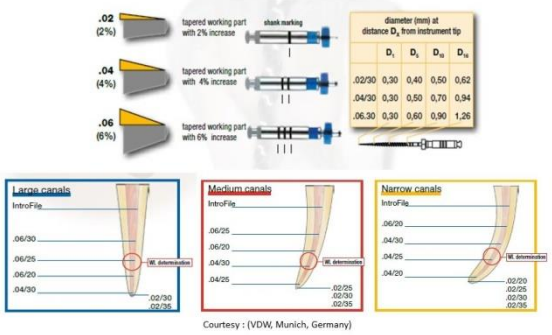
This system uses the efficiency of traditional K-type cutting blades, i.e. a convex cross-section to stabilize the instrument core and a cutting blade angle suitable for rotary use. K type cutting blades have

1. High cutting efficiency
2. Improved torsional resistance
3. Reduced friction
4. Large space for dentin removal
5. Reduced smear layer formation

Traditional steel files have a 2 % taper in compliance with ISO no. 3630, i.e. taper .02. The increase in cross-section diameter from the tip towards the end of the working part is 2 %, or 2/100 mm per 1 mm. A file of ISO size 20 with a 16 mm working part measures 20/100 mm at the tip and 52/100 mm at the end of the working part: (20 / 100) + (16 x 2%) = 0.52. Taper .04 has a cross-section diameter increase of 4 %, i.e. a strongly tapered instrument. Taper .06 means an increase of 6 % taper. Flex Master is available in 02, .04, .06 and .11 tapers. Large taper is used in the straight canal section, medium taper in the curved canal

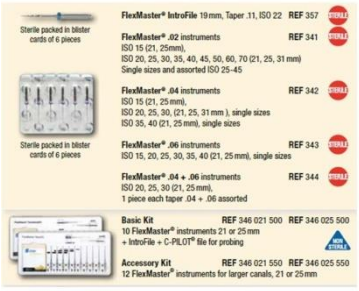
section, small taper for apical enlargement. Large and medium tapers allow speedy dentin removal. The number of instrument changes is reduced to a minimum with this system. Small tapered files are used for better apical shaping and preservation of the original canal axis (centre line).

1. 0.11 used for the IntroFile, for conical enlargement of root canal orifice, replaces 2 or 3 Gates enlargers
2. 0.04 and 0.06 used for crown-down phase
3. 0.02 for safe apical enlargement.



Courtesy : (VDW, Munich, Germany)

Fig 5: FlexMaster® rotary system

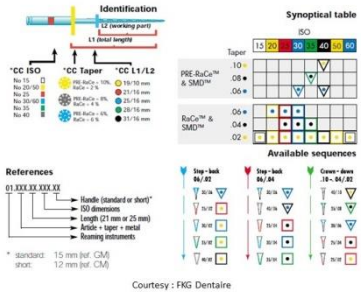


Courtesy : (VDW, Munich, Germany)

Fig 6: FlexMaster® rotary system

***RaCe*™ [12] (FKG Dentaire, Swiss) (Figure 7)**

RaCe™ (Reamer with Alternating Cutting Edges), a totally innovative system, safe and easy, developed to mitigate the limits which are imposed by continuous rotation. This system combines a triangular section with sharp edges and alternating cutting edges, the FKG RaCe™ instruments combine all of the determining advantages of endodontic practice: The alternating cutting edges eliminate the screwing on/ blocking and only leads to a weak working torque. The sharp edges guarantee optimum cutting efficiency; The combination of a triangular section and alternating cutting edges ensures efficient evacuation of chips and cutting debris. The system is available in 2% taper (ISO standard) or 4, 6, 8 or 10%. The FKG safety tip ensures sure guidance/centering in the canal. The reduction of the number of instruments necessary for the preparation of the canal provides comfort and saves time.



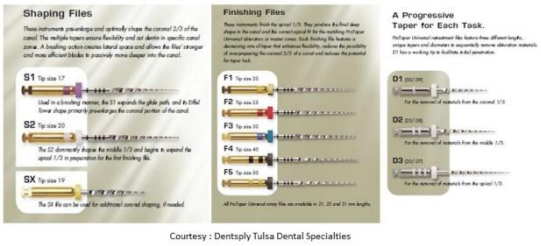
Courtesy : FKG Dentaire

Fig 7: RaCe™ rotary system

***Protaper® file* [13] (Dentsply Tulsa Dental Specialties, USA) (Figure 8)**

The patented progressive taper and advanced flute design of protaper provides the flexibility and efficiency to achieve consistent, successful cleaning and shaping when faced with these challenges. The SX or Shaping X file is used to optimally shape canals in shorter roots, relocate canals away from external root concavities, and to produce more shape, as desired, in the coronal aspects of canals in longer roots. The

shaping 1 (S-1) and shaping 2 (S-2) files have increasingly larger tapers over the length of their cutting blades allowing each instrument to engage, cut and prepare a specific area of the canal. S-1 is designed to prepare the coronal one-third of a canal, whereas, or S-2, enlarges and prepares the middle one-third. Although both instruments optimally prepare the coronal two-thirds of a canal, they do progressively enlarge its apical one-third. The finishing files, or F-1, F-2 and F-3 instruments, have been designed to optimally finish the apical one-third, as well as subtly and progressively expanding the shape in the middle one-third of the canal. Generally, only one finishing instrument is required to prepare the apical one-third of a canal and the one selected is based on the canal's curvature and cross-sectional diameter.

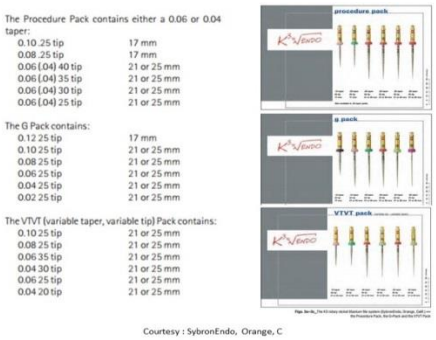


Courtesy : Dentsply Tulsa Dental Specialties

Fig 8: Protaper® rotary system

***K3*™ [14] (SybronEndo, Orange, California) (Figure 9)**

The Procedure Pack is generally used in a straight crown down method, using the files from larger tapers to smaller and from larger tip sizes to smaller. Because of the diminishing tip sizes, each K3 file should and does advance slightly apically relative to its precursor as it is inserted (which is inherently crown down). For straight canals and mild to moderate curvatures, as would be treated by most general practitioners, this is an excellent choice for a single pack configuration.



Courtesy : SybronEndo, Orange, C

Fig 9: K3™ rotary system

The G Pack is preferred by some because the files may progress more rapidly toward the apex than with some of the other configurations. Diminishing taper (as opposed to diminishing tip sizes) allows the K3 file to move apically with efficiency. Some believe, with various tapers, that this pack can treat a slightly greater range of anatomy than with the Procedure Pack. The VTVT Pack is favored by some because with the variation in taper, with progressive insertions, torsional stresses on subsequent files decrease due to minimized engagement relative to a reinsertion of the taper. Many endodontists favor the VTVT Pack for this reason.

***HERO shaper*® (Bombay dental and surgical private limited) (Figure 10)**

This system uses the rotation speed around 450 to 600 rpm with torque 1.2 N cm. The first penetration is performed with a conventional hand instrument to confirm working length after which endoflare is recommended to achieve good straight line access. G files are recommended to use for glide path, whenever needed to negotiate extremely narrow, curved calcified canals. 0.06 taper files (black rubber stopper) are brought to 2/3rd of the working length and 0.04 taper files (grey rubber stopper) are brought to WL. An accurate determination of working length between the passage of the 0.06 and 0.04 file is strongly recommended. Motor is started after positioning it at canal orifice and maintained at constant speed while file is working and untill it is completely withdrawn from canal. File is inserted to the desired working length with a short in and out movement using light pressure. Circumferential filing also should be achieved which permits to shape lateral zones.

Fig 10: HERO shaper® rotary system

***Endosequence*® [15] (Brasseler, USA) (Figure 11)**

Before starting with the endosequence coronal patency is confirmed with a #10 hand file. The file only needs to go approximately 1/2 the working length. Canal size is estimated based on the pre-op x-ray, the fit of the #10 stainless steel hand file and the depth of penetration of the Expeditor™. Canal size is generally small, medium or large. Preparation can be started using crown down with a file from the appropriate package size. After the second file from the appropriate package, working length need to be established with a #10 hand file and an apex locator. Rotary preparation should be completed in a crown-down fashion. (Figure 11).

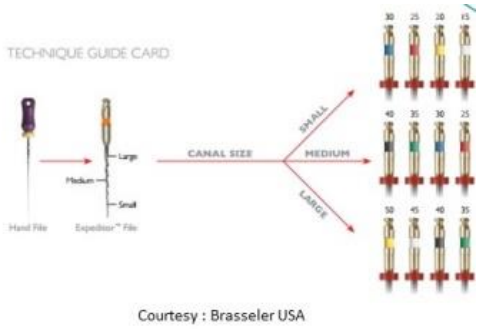


Fig 11: Endosequence ® rotary system

***BioRaCe*™ [16] (FKG Dentaire, Swiss) (Figure 12)**

Access opening should be done by using BR0 instrument. Working length should be established with a K-file #15 and motor is adjusted to 500-600 rpm and 1 Ncm. The canals and pulp chamber should be filled with irrigant. Manufacturers recommend using BR0 with "only" 4 gentle strokes and clean the flutes. Procedure should be repeasted until approximately 4-6mm of coronal part of the canal has been prepared. It is recommended to establish Working Length (WL) with BR1 to BR3. After use of BR0, irrigation should be repeated. Recapitulation should be done to full WL with a SSt file #15. The canals and pulp chamber should be again filled with irrigant. BR1 should be used with 4 gentle strokes. If this instrument does not reach the WL, the instrument should be cleaned and procedure repeated until the WL is achieved (If necessary, WL can be reconfirmed with an Electronic Apex Locator). BR2 and BR3 should be used in same fashion as described for BR1. Manufacturers recommend not to use BR3 to full WL on canals with severe apical curvatures. Irrigation is mandatory between instruments. Final apical preparation should be performed with BR4 to BR7. In most cases, the final apical preparation is achieved with instruments BR4 and BR5. Depending on the root canal anatomy (see anatomical chart), two additional instruments BR6 and BR7 can be used for larger canals. The same principle as explained for BR1-3 should be used for the apical preparation. For severe apical curvatures, instruments BR4C and BR5C should be used to prepare the apical canal. If the instrument does not reach the WL with 4 gentle strokes, force should not be applied on the instrument. Irrigating the canals and repeating the procedure is recommended. For complicated curvatures it is recommended to use additional FKG instruments (e.g. S-Apex inverted taper instruments).

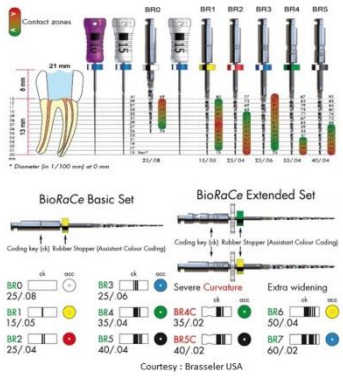
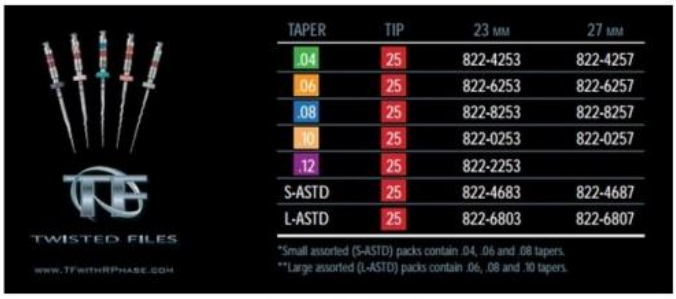


Fig 12: BioRaCe™ rotary system

***Twisted files* - TF™ [17] (Sybron Endo, Orange, California) (Figure 13)**

TF™ (Sybronendo) is a recently introduced Nickel Titanium engine-file manufactured with a twisting method. It was reported to have a higher fracture resistance than ground files. The manufacturer claimed that TF has a different surface texture (natural grain structure) that runs in the longitudinal direction and that the instrument is made of the R phase of Nickel Titanium alloy (although no transition temperature data are presented). It was further claimed that these features serve to raise the flexibility and the fracture resistance of the instrument. There is also an absence of transverse running machining marks (as a result of electropolishing) that would result in slower crack initiation and propagation. To date, only very few reports of the fatigue behavior of this new twisted.



Courtesy : Kerr dental

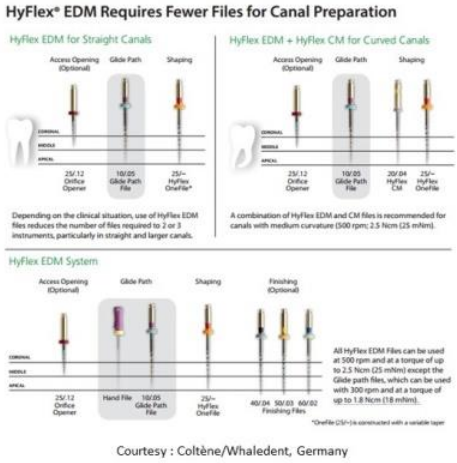
Fig 13: Twisted files - TF™ rotary system

Coronal Patency should be confirmed prior to using TF, straight line access should be achieved and an apical glide path with at least a #15 hand file. Crown Down method is recommended with the file rotating while entering the canal, the file should be advanced with controlled motion until it engage 1–2 mm of dentin (avoid using force). It is not recommended to engage the dentin for more than 2–3 seconds. Following settings recommended with handpiece: Motor speed – 500 - 600 RPM's, Torque settings – Nouvag motor: AP 40; Endotouch TC: 4-5. With the file rotating as it enters the canal, file should be advanced with a single continuous and controlled motion until the file engages dentin, then the file should be withdrawn. It is not recommended to use pecking motion and forcing the file apically. This is a "counterforce" technique. Focus more on the removal of the file rather than the advancement of the file. The flutes are wiped and procedure should be repeated until the working length is achieved. Irrigation is recommended with NaOCl. Canal patency can be checked with patency K-File. Procedure is repeated with next file in chosen sequence until final working length and desired shape is achieved. If working length is not achieved, patent apical glide path is checked with hand file #20, then irrigation is recommended. Procedure is repeated with same TF file up to 5 times to reach working length. If significant resistance is met, glide-path patency can be assured with patency K-File.

***HyFlex*® [18] (Coltène/Whaledent, Germany) (Figure 14)**

HyFlex® Controlled Memory (CM) NiTi Files have been manufactured utilizing a unique process that controls the material's, making the files extremely flexible but without the shape memory of conventional memory NiTi Files. This gives the file the ability to follow the anatomy of the canal very closely, reducing the risk of ledging, transportation or perforation. Furthermore the files can be pre-bent, similar to the way of stainless steel. Particularly in root canals with abrupt curvatures this can help to avoid the creation of steps. HyFlex® Controlled Memory NiTi Files are up to 300 % more resistant to cyclical fatigue compared to

conventional NiTi Files which substantially helps reducing the incidence of file separation.



Courtesy : Coltène/Whaledent, Germany

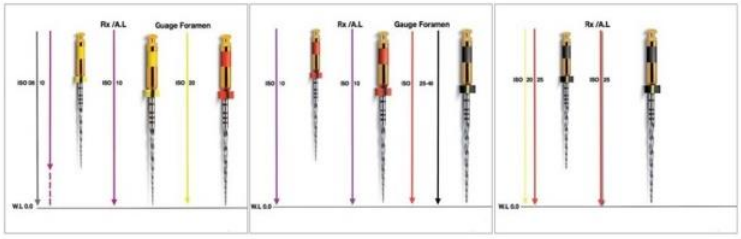
Fig 14: Hyflex® rotary system

Depending on the clinical situation, HyFlex EDM files can be used which reduces the number of files required to 2 or 3 instruments, particularly in straight and larger canals. A combination of HyFlex EDM and CM files is recommended for canals with medium curvature (500 rpm; 2.5 Ncm (25 mNm). All HyFlex EDM Files can be used at 500 rpm and at a torque of up to 2.5 Ncm (25 mNm) except the Glide path files, which can be used with 300 rpm and at a torque of up to 1.8 Ncm (18 mNm).

***Wave one*™ [19] (Dentsply Tulsa Dental Specialties, USA) (Figure 15)**

Wave One single-file reciprocating system has three files at present, in the available lengths of 21, 25 and 31mm :

1. The WaveOne Small file is used in fine canals. The tip size is ISO 21 with a continuous taper of 6%.
2. The WaveOne Primary file is used in the majority of canals. The tip size is ISO 25 with an apical taper of 8% reduces towards the coronal end.
3. The WaveOne Large file is used in large canals. The tip size is ISO 40 with an apical taper of 8% reduces towards the coronal end.



Courtesy : Dentsply Tulsa Dental Specialties

Fig 15: Wave one™ rotary system

***Self adjusting file* [20] (Redent nova, Israel) (Figure 16)**

The SAF (ReDent-Nova Israel) is a hollow file designed as a compressible, thin-walled pointed cylinder either 1.5 or 2.0 mm in diameter composed of 120- mm-thick nickel titanium lattice .

Mode of operation: The 1.5-mm file may easily be compressed to the extent of being inserted into any canal previously prepared or negotiated with a # 20 Kfile. The 2.0-mm file will easily compress into a canal that was prepared with a #30 K-file. The file will then attempt to regain its original dimensions, thus applying a constant delicate pressure on the canal walls. When inserted into a root canal, it adapts three dimensionally to the canal's shape, both longitudinally and along the cross-section. In a round canal, it will attain a round cross-section, whereas in an oval or flat canal it will attain a flat or oval (Fig. 15).

Advantages and characteristics features of SAF

- An Self-adjusting file that adapts itself to the three dimensional anatomy of root canals
- Uniform removal of dentin and remaining wall thickness
- Prevention of canal transportation
- High durability
- Removal of the smear layer in the apical part of the canal

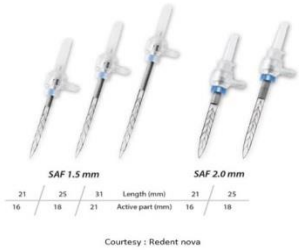


Fig 16: Self adjusting file rotary system

***Revo – S* ™ (Micro – Mega, France) (Figure 17)**

Revo-S, is a unique and innovative system which uses only 3 instruments. It is meant for initial endodontic treatment. It has asymmetrical cross section. Initiates a snake like movement inside the canal. It has 3 cutting edges, all located at 3 different radiuses, R1, R2 and R3. The smaller section allows more flexibility and offers a better ability to negotiate curves. The asymmetrical cross section increases the available volume for upward debris removal. Revo-S instruments should be used with a rotation speed ranging between 250 and 400 rpm. Shaper® & Cleaner (SC) 1 recommended to use with slow and unique downward movement in a free progression and without pressure. (SC) 2 should be used with a progressive 3 wave movement (up and down movement). Shaper® Universal (SU) should be used with a slow and unique downward movement in a free progression and without pressure. Apical patency should be checked and if necessary, an upward circumferential filing movement should be performed. For apical finishing the Apical Shaper (AS) instruments should be used without apical pressure, after using the SU. If necessary and according to the root canal anatomy, it is recommended to use the AS30, AS35 and AS40 to enlarge the apical region. Their penetration depth corresponds to the working length. This length is shortened in thin root canals or with a marked curvature. They are then used in a step back motion (AS30 at WL, AS35 at WL -0.5 mm, AS40 at WL -1 mm if necessary).

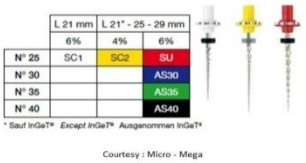


Fig 17: Revo – S ™ rotary system

For a perfect apical finishing, it is recommended to use the sequence:

- AS30 only for an apical finishing at 30/100.
- AS30 then AS35 for an apical finishing at 35/100.
- AS30 then AS35 and finally AS40 for an apical finishing at 40/100.
- If an AS instrument fails to reach the working length, the preparation should be continued using the former instrument in order to work without any apical pressure.

***One shape*® [21] (Micro – Mega, France) (Figure 18)**

One Shape, the one and only Nickel Titanium instrument in continuous rotation for quality root canal preparations. One Shape allows for curved canal negotiation with an instrument and easy dynamic. Its non-working (safety) tip ensures an effective apical progression avoiding obstructions which are often preceded by instrument separation. The instrument is with a variable cross-section. It has an original and innovative instrument design. A micro-mega innovation .i.e. the instrument presents with a variable cross-section along the blade. One Shape principle: 3 different cross-section zones are present. The first zone presents a variable 3-cutting edge design. The second, prior to the transition, has a cross-section that progressively changes from 3 to 2 cutting edges. The last (coronal) is provided with 2 cutting edges.

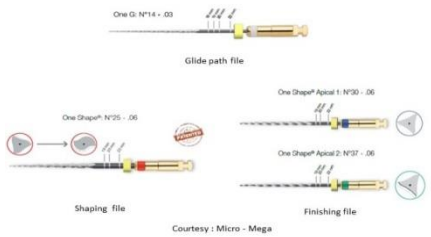


Fig 18: One shape® rotary system

Glide path development is an important and indispensable step in the root canal preparation. The initial scouting is performed with an MMC hand file no. 10. In case of canals difficult of access, mechanized NiTi files must be used. For this purpose, MICRO-MEGA® has designed One G, a sterile, single-use rotary NiTi file for glide path development which is indicated in case of canals difficult of access when hand files are not sufficient. One Shape® is one single NiTi instrument in continuous rotation for quality root canal shaping.

***ProTaper Next*™ [22] (Dentsply Tulsa Dental Specialties, USA) (Figure 19)**

The ProTaper Next files offer improved efficiency with fewer files when compared with the ProTaper Universal files.

It has following features:

Variable taper like ProTaper Universal files. Rectangular off-center cross-section design for greater strength. Unique Asymmetric Rotary Motion that further enhances ProTaper canal shaping efficiency. The patented design's axis of rotation differs from the center of mass. As a result, only two points of the rectangular cross section touch the canal wall at a time. Proven M-Wire Nickel Titanium alloy for increased flexibility and resistance to cyclic fatigue as compared to traditional NiTi.

Fig 19: ProTaper Next™ rotary system

Procedure: The canal should be explored using small-sized hand files, working length should be determined, verifyng the patency and confirming a smooth, reproducible glide path. Always irrigation is recommended and if necessary, the glide path should be expanded using small-sized hand files or dedicated mechanical glide path files. PathFiles P1 and P2 are recommended. In the presence of NaOCl, it is recommended to brush and follow the glide path, with the PROTAPER NEXT™ X1 (017/04) file, in one or more passes until the working length is reached. Manufacturers recommend to use PROTAPER NEXT X2 (025/06), exactly as described for PROTAPER NEXT X1 file, until the working length is passively reached. Foramen should be gauged with a size 025 hand file and, if this file binds at length, the canal is shaped and ready for disinfection. If the size 0.25 hand file is loose at length, then it is recommended to continue shaping with the PROTAPER NEXT X3 (30/07) and, when necessary, the PROTAPER NEXT X4 (040/06) or PROTAPER NEXT X5 (050/06), gauging after each instrument with the 030, 040 or 050 hand files, respectively.

CONCLUSION

As technology is advancing in instrumentation, it is crucial to know different generations in rotary instruments and their sequence of instrumentation. Hence, to avoid procedural errors, the present article highlighted the information regarding available rotary systems for ease of understanding.

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