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## RESEARCH ARTICLE

# SINGLE FILE NITI ROTARY SYSTEMS: SIMPLE APPROACH TO ROOT CANAL

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**ABSTRACT**

Biomechanical preparation is a very essential step for successful endodontic treatment, which removes the root canal debries and disinfect the root canal. Practitioner will be able to achieve this aim easily with nickel titanium (niti) rotary instuments. The recently introduced Single file NiTi-rotary systems such as Neoniti rotary file system, WaveOne, Reciproc, OneShape, Neoniti, Hyflex EDM & F360, Self Adjusting File claim to be able to completely prepare and clean root canals with only one instrument. With the use of these single file systems, practitioner can save time, it is cost effective, reduces instrument fatigue and cross contamination. The purpose of this article is to review single file Niti-Rotary systems for canal preparation.



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## INTRODUCTION

Successful endodontictherapy depends upon proper biomechanical preparation of root canal (Hulsmann *et al*., 2005; Averbach *et al*., 2006). Predictably no instrument can clean whole root canal system currently (Hulsmann *et al*., 2005). Specially cleaning efficiency is limited in apical portion of root canals (Roane *et al*., 1985; Johnson *et al*., 2008; Burklein *et al*., 2012; Julian Webber *et al*., 2012; www.kometdental.de; Komet, 2013; www.micro-mega.com and Christian *et al*., 2013). Therefore , there is still controversy about the optimal size of apical root canal enlargement so that clean apical third of root canal effectively (Yared *et al*., 2008; Paque *et al*., 2011 and Clifford *et al*., 2012). Traditional hand instrumentation with stainless steel file is time consuming as they require numerous hand files (Ruchi Gupta *et al*., 2015). Use of stainless steel hand files may lead to canal transportation in severely curved canals or multiple curved root canals. Its use can also cause legde formation and possible perforation as stainless steel files have tendancy to restore themselves to their original linear shape during canal preparation (GhassanYared *et al*., 2010). To avoid these difficulties, niti rotary techniques have developed which prepare the root canal more efficiently. Because of unique property of alloy which improves the morphological characteristics and safety of canal shaping (GhassanYared *et al*., 2003).

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High cost, unexpected fracture are disadvantages of niti rotary files (Kumar *et al*., 2015). Traditional rotary systems are more time consuming, as more number of files are required, more instrument fatigue. More chances of cross contamination. So recently introduced single file systems minimizes all these problems. The recently introduced niti files such as-Neoniti Rotary File, Wave one, Reciproc, One shape, F 360, Hyflex EDM (Kumar *et al*., 2015). These Systemsclaim to be able to completely prepare and clean root canal with only one instrument. The reciprocating workingsequence consists of a counter-clockwise (cutting direction) and aclockwise motion (releasing of the instrument), while the angle of the counter-clock- wise cutting direction is almost three times greater than the angle of the reverse direction. The advantages of the reciprocating technique are only one single Ni-Ti file to shape most root canals, no changing of NiTi instruments during the root canal shaping procedure, decreases the shaping time by up to 40% when compared with traditional rotary technique in continuous motion (Kumar *et al*., 2015). Single file endo concept is said to require a minimum or no glide path and only a single file for complete instrumentation for majority of root canals. The recommendation for single use has added advantage of reducing instrument fatigue. This concept reduce the working timeand lower cross contamination between patients, a common problem associated with the use of multiple files, use of a single file will save both time and cost (Kumar *et al*., 2015). The purpose of this article is to review single file niti-Rotary systems for canal preparation.

**Neoniti rotary file system**

NeoNiTi (Neolix, France) system is made of a nickel-titanium alloy and is used for the root canal treatment till the apex. The NeoNiti file system is an efficient file system which shapes the root canal completely to a continuously tapering funnel shape. Its cross section is non-homothetic rectangle. The NeoNiTi file system is made up by the EDM (Electric Discharge Machining) process which differentiate this file system from others. EDM process can avoid the complication of instrument fracture (Ruchi Gupta *et al*., 2015). Neoniti file system has of two files- 1) NeoNiTi C1 for coronal enlarging 2) NeoNiTi A1 for canal shaping upto the apex. First access cavity preparation is done and the working length is measured by a # no10 K file. Then widening of the canal orifices and removing dentin interferencesis done by Neoniti C1. This file is used in coronal third only by a circumferential brushing action. Neoniti A1 file shapes the middle and apical thirds. First it is used till the middle thirds using 3 or 4 circumferential brushing actions. Thenupto working length the file is used by pecking motion. In curved canals, glide path is made first by hand or rotary glide path file systems. The neoniti file system operates at a speed of 300 to 500 rpm and a torque limit of 1.5 Ncm. The file is used in a circumferential motion in the middle thirds and then in a pecking motion till the working length. The canal is irrigated constantly in standardized protocol for the sterilization of the instrument system. The instruments are washed in an appropriate detergent solution (eg: Quaternary Ammonium) and then brushed with a metallic brush. The instruments can be placed in an ultrasonic bath for 15 min. Properly dried instruments are then placed in sterilization bags and autoclaved at 134 °C/273.2 °F for 18 minutes. The manufacturer claims that the NeoNiTi file system can also be used for retreatment procedures. Solvent may be used for removal of obturating material using NeoNiTi file system if required. It is more efficient and less time consuming as compared to the other retreatment file systems used.

**WaveOne system**

The newly introduced waveoneniti file from Dentsplymaillefer is a single use, single file system to shape the root canal completely from start to finish. In most cases, the technique only requires one hand filefollowed by one single WaveOne file to shape the canal completely. The special design of this system work in a similar but reverse 'balanced force' action (Ruchi Gupta *et al*., 2015) using a pre-programmed motor to move the files in a back and forth 'reciprocal action' (Roane *et al*., 1985). The files are manufactured with M-Wire technology improving strength and resistance to cyclic fatigue by up to nearly four times in comparison with other brands of rotary NiTi files (Johnson *et al*, 2008). At present there are three files in the WaveOne single file reciprocating system available in lengths 21mm, 25mm and 31mm.

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

Waveone files have a reverse helix and non cutting modified guiding tip (Burklein, 2012). These files have two distinct cross sections. D1-D8 (Apical) Modified convex triangular cross-section and D9-D16 (Coronal) Convex triangular crosssection. The WaveOne motor is rechargeable battery operated with a 6:1 reducing handpiece. The preprogrammed motor is preset for the angles of reciprocation and speed for WaveOne instruments. The counterclockwise (CCW) movement is greater than the clockwise (CW) movement. CCW movement advances the instrument, engaging and cutting the dentin. CW movement disengages the instrument from the dentin before it can lock into the canal. Three reciprocating cycles complete one complete reverse rotation and the instrument gradually advances into the canal with little apical pressure required (Kumar *et al*., 2015). WaveOne files have their own unique reverse design, they can only be used with the WaveOne motor with its reverse reciprocating function.

The WaveOne technique involves the following stages (Julian Webber *et al*., 2012)

- Straightline access, accepted protocol
- WaveOne file selection
- Single-file shaping
- Copious irrigation with 5% NaOCland EDTA before, during and aftersingle-file shaping.
- The plastic colour coding in the handledeforms if sterilized, preventing the file from being placed back into the handpiece.
- The advantages of WaveOne files are:
- Improve flexibility.
- Conserve remaining dentin in thecoronal two-thirds of the finishedpreparation.
- File safely progress through virtuallyany secured canal (Kumar *et al*., 2015).

**F360**

F360 is a single instrument used in continous rotation. The F360 (Komet, USA) endodontic file system requires only two files which simplifies root canal preparation and saves time.The files have a unique S-curve design and a thin instrument core to deliver a high level of cutting efficiency while respecting natural root canal morphology (www.kometdental.de). F360 files are available in two sizes 025 (Red F360) and 035(Green F360) are required for most root-canal preparations. Their 0.04 taper promotes optimal debridement of the canal, maintains file flexibility and thus reduces preparation errors and permitsideal shaping of the root canal for subsequent obturation with any method, according to the company. In addition to sizes 025 and 035, the F360 files are offered in sizes 045 (White F360) and 055(Red F360) to meet additional clinical situations such as wide roots, and all F360 files areavailable in three lengths L21, L25 and L31.The pre-sterilized, single-use files are designed to prevent cross contamination, eliminate the need to clean, disinfect, and sterilize the instruments and reduce the risk of fracture due to cyclic fatigue (Kumar *et al*., 2015).

The advantages of F360 are (Komet *et al*., 2013)

- Highly flexible
- Minimize canal transportation

**One shape system**

One Shape is a new concept of singlefile instrumentation where a singleinstrument is used in a full clockwiserotation.

This system was developed byMicro Mega, Besancon, France. The OneShape system consists of only oneinstrument made of a conventionalaustenite 55-NiTi alloy (Kumar *et al*., 2015). The one shape system is unique as it is characterized by different cross sectional designs over the entire length of the working part (www.micro-mega.com; Christian *et al*., 2013).

- Apical part- there are threesymmetrical cutting edges.
- Middle part - there are two asymmetrical cutting edges.
- Coronal part- there are two Sshapedcutting edges.

One shape system has a tip size of 25 and constant taper of 0.06.The advantages of One Shape are (www.micro-mega.com) –

- Root canal shaping with one singleinstrument.
- Root canal treatment is doneapproximately 4 times faster than aconventional treatment.
- Minimal fatigue along the length ofthe file virtually eliminates the riskof separation
- The variable pitch of One Shapereduces instrument screwing effects
- ABC (Anti Breakage Control): Theinstrument will unwind to avoidseparation

The file has a non-cutting safety tip. Asrecommended by the manufacturer, therotational speed for One Shape is 400rpm. One Shape protocol is easy tolearn, safe and quick. Therefore, itmight be a good alternative to existingreciprocating single file systems withoutthe need to use a special endodonticmotor generating the reciprocatingmotion (Christian *et al*., 2013).

**Reciproc**

Reciproc system was developed by VDW GmbH, Munich, Germany. This new system works on reciprocating motion without prior use of hand files. This system includes three Reciproc instruments R25, R40 and R50. Only one Reciproc instrument is used for the canal preparation depending on the initial size of the canal. These instruments are made from an M-Wire nickel-titanium that offers greater flexibility and resistance to cyclic fatigue than traditional nickel-titanium. They have an S shaped cross-section. Reciproc files have a continuous taper over the first 3 mm of their working part followed by a decreasing taper until the shaft. These three instruments have aregressive taper (Kumar, 2015).

- The R25 has a diameter of 0.25 mm at the tip and an 8% (0.08 mm / mm) taper over the first 3 mm from the tip. The diameter at D16 is 1.05 mm.
- The R40 has a diameter of 0.40 mm at the tip and a 6% (0.06 mm / mm) taper over the first 3 mm from the tip. The diameter at D16 is 1.10 mm.
- The R50 has a diameter of 0.50 mm at the tip and a 5% (0.05 mm / mm) taper over the first 3 mm from the tip. The diameter at D16 is 1.17 mm.

The Reciproc motor is battery operated. Two motors are availableVDW: Silver without integrated apexlocator and VDW: Gold with integratedapex locator. The motor is programmedwith the angles of reciprocation andspeed for the three instruments. Thevalues of the CW and CCW rotations aredifferent. When the instrument rotates in the cutting direction it will advance inthe canal and engage dentine to cut it. When it rotates in the opposite direction (smaller rotation) the instrument will be immediately disengaged. The manufacturer of Reciproc instruments does not strictly recommend creating a glide path whenusing the reciprocating instrumentation.

The advantages of Reciproc files are (Kumar, 2015)

- Maintain centering ability
- Less work steps &Time-saving
- Less risk of contamination

Curved root canals can be instrumentedwith only minor canal straightening byonly one instrument used in areciprocating motion (Yared *et al*., 2008; Paque *et al*., 2011). Thereciprocating files can only be used forone patient, as it cannot be sterilized, sothe transmission of bacteria is definitively avoided. It has been shown that a single-file reciprocating shapingtechnique utilizing unequal CW/CCW angles is over 4 times safer and almost 3 times faster than using multiple rotaryfiles to achieve the same final shape (Clifford *et al*., 2012).

**Hyflex EDM**

HyflexEDM (COLTENE) is a new generation one file NiTi system. It offers the dental practitioner enhanced ease of mechanical preparation of the root canal so that even new comers to endodontics can achieve reliable results quickly and easily. It is made up by EDM process which results in file that is extremely flexible and fracture resistant. Hyflex EDM files are up to 700% more resistant to cyclic fatigue compared to traditional niti files (31328A_HyFlexEDM_Brochure_US). Hyflex EDM provides a modular system of sterile instruments. It includes shaping, glidepath, one file, orifice opener and finishing files and may be used in combination with Hyflex CM files for curved canals. All Hyflex EDM files can be used at 500 rpm and at a torque of up to 2.5 Ncm(25mNm) except the glidepath files which can be used with 300 rpm and at a torque of up to 1.8 Ncm(18 mNm).

Advantages (31328A_HyFlexEDM_Brochure_US)–

- Hyflex EDM files follow the anatomy of the canal, which can significantly reduce the risk of ledging, transportation and perforation.
- The combination of flexibility, fracture resistance and cutting efficiency of hyflex EDM make it possible to reduce the number of files required for cleaning while preserving anatomy.

**The Self-Adjusting file (SAF)**

The Self Adjusting File is hollow and designed as a thin cylindrical nickel-titanium lattice that adapts to the cross-section of the root canal. A single file is used throughout the procedure. It is inserted into a path initially prepared by a # 20 K-file and operated with a transline- (in-and-out) vibration. The resulting circumferential pressure allows the file's abrasive surface to gradually remove a thin uniform hard-tissue layer from the entire root canal surface, resulting in a canal with a similar cross-section but of larger dimensions. This holds also for canals with an oval or flat cross-section, which will be enlarged to a flat or oval cross-section of larger dimensions. The straightening of curved canals is also reduced

because of the high pliability of the file and the absence of a rigid metal core. Thus, the original shape of the root canal is respected both longitudinally and in cross-section. The hollow SAF file is operated with a constant flow of irrigant that enters the full length of the canal and that is activated by the vibration and is replaced continuously throughout the procedure. This results in effective cleaning even at the cul de sac apical part of the canal. The SAF has high mechanical endurance; file separation does not occur; and mechanical failure, if it occurs, is limited to small tears in the latticework.

**Conclusion**

The new single systems introduced in endodontics are Neoniti, WaveOne, Reciproc, One Shape and F360, hyflex EDM, self adjusting file system. Use of single-file rotary systems are more beneficial as they are cost effective, time saving, reduce instrument fatigue and possible cross contamination. Further research and clinical results are required for betterapplication of these file systems.

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