Review Article

Single file niti-rotary systems

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Received: 16-07-2014
Revised: 10-08-2014
Accepted: 22-08-2014

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ABSTRACT

The cleaning and shaping of root canals is a major step in root canal treatment procedure, which aims at removal of all the tissue debris from the root canal space while removing the inner layers of root canal dentin. With Nickel titanium (NiTi) rotary instruments this goal is easier to achieve, even in curved root canals. The recently introduced Single file NiTi-rotary systems such as WaveOne, Reciproc, OneShape & F360 claim to be able to completely prepare and clean root canals with only one instrument. Use of single file rotary systems, are cost effective, time saving, reduce instrument fatigue and possible cross-contamination. The purpose of this article is to review single file Niti-Rotary systems for canal preparation.

Keywords: *M wire, wave one, reciproc, oneshape, rotary*

Introduction

The cleaning and shaping of root canals is a key step in root canal treatment procedures. This can be achieved using a proper chemo-mechanical preparation [1, 2] and is thus essential for successful endodontic treatment. Currently no instrument can predictably clean the entire root canal system [1, 3-6] and especially in the apical portion of the root canals, the cleaning efficiency is limited. [7-14] Thus, there is still controversy regarding the optimal size of apical root canal enlargement to maximize cleaning efficiency in this crucial part of the root canal. [15-17] Traditionally the shaping of root canals was achieved by the use of stainless steel hand files. However, using stainless steel hand files have several drawbacks. [18] They require the use of numerous hand files and drills to adequately prepare the canals (Schilder 1947). Hand instrumentation with stainless steel files is time consuming. (Ferraz et al 2001).

Nickel titanium being super elastic, allows preparation of curved canals with minimal transportation. [19] Nickel-titanium (NiTi) rotary files decrease the procedural errors especially in the apical area of the curved canal. [20] The disadvantages of NiTi files are their high cost and unexpected fracture. [21] The recently introduced nickel-titanium (NiTi) files such as, WaveOne (Dentsply Maillefer, Ballaigues, Switzerland) Reciproc (VDW, Munich, Germany), and One shape (Micro-Mega,France) systems are claims to be able to completely prepare and clean root canals with only one instrument.

The reciprocating working sequence consists of a counter-

clockwise (cutting direction) and a clockwise 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.

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 time and 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.

Single file niti-rotary systems was classified into Single file systems using Reciprocating motion which includes Wave one and Reciproc and Single file systems using Continuous motion which includes One Shape and F360.

Single file Niti-Rotary systems

Wave One: The new WaveOne NiTi file from Dentsply Maillefer is a single-use, single-file system to shape the root canal completely from start to finish. Shaping the root canal to a continuously tapering funnel shape not only fulfills the biological requirements for adequate irrigation to clean the root canal system of all bacteria, bacterial by-products and pulp tissue [21] but also provides the perfect shape for three-dimensional obturation with gutta percha. [22, 23] The specially designed NiTi files work in a similar but reverse 'balanced force' action [24] using a pre-programmed motor to move the files in a back and forth 'reciprocal action'. 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. [25]

There are three files in the WaveOne single-file reciprocating system available in lengths of 21, 25 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 noncutting modified guiding tip. These files have two distinct cross-sections along the length of their active portions. [26] D1-D8 (Apical) Modified convex triangular cross-section and D9-D16 (Coronal) Convex triangular cross-section. The WaveOne motor is rechargeable battery operated with a 6:1 reducing handpiece. The pre-programmed motor is preset for the angles of reciprocation and speed for WaveOne instruments. The counter-clockwise (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.

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: [27]

- Straightline access, accepted protocol
- WaveOne file selection
- Single-file shaping
- Copious irrigation with 5% NaOCl and EDTA before,during and after single-file shaping.

The plastic color coding in the handle deforms if sterilized, preventing the file from being placed back into the handpiece. The advantages of WaveOne files are:

- Improve flexibility.
- Conserve remaining dentin in the coronal two-thirds of the finished preparation.
- File safely progress through virtually any secured canal. [28]

Reciproc: This new system uses single file reciprocation without prior use of hand files. This was developed by VDW GmbH, Munich, Germany. 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. [29] 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 a regressive taper.

• 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 available

VDW: Silver without integrated apex locator and VDW: Gold with integrated apex locator. The motor is programmed with the angles of reciprocation and speed for the three instruments. The values of the CW and CCW rotations are different. When the instrument rotates in the cutting direction it will advance in the 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 when using the reciprocating instrumentation. The advantages of Reciproc files are

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

Curved root canals can be instrumented with only minor canal straightening by only one instrument used in a reciprocating motion. [30, 31] The reciprocating files can only be used for one patient, as it cannot be sterilized, so the transmission of bacteria is definitively avoided. It has been shown that a single-file reciprocating shaping technique utilizing unequal CW/CCW angles is over 4 times safer and almost 3 times faster than using multiple rotary files to achieve the same final shape. [28]

One Shape

One Shape is a new concept of single-file instrumentation where a single instrument is used in a full clockwise rotation. This system was developed by Micro Mega, Besancon, France. The One Shape system consists of only one instrument made of a conventional austenite 55-NiTi alloy.

The One Shape system consists of only one instrument, which has a tip size of 25 and a constant taper of 0.06, and is characterised by different cross sectional designs over the entire length of the working part. [32, 33]

- At the apical part there are three symmetrical cutting edges.
- In the middle the number decreases to two cutting edges; this part is asymmetrical.
- In the coronal part there are two S-shaped cutting edges.

The advantages of One Shape are [32]

- Root canal shaping with one single instrument
- Root canal treatment is done approximately 4 times faster than a conventional treatment.
- Minimal fatigue along the length of the file virtually eliminates the risk of separation
- The variable pitch of One Shape reduces instrument screwing effects
- ABC (Anti Breakage Control): The instrument will unwind to avoid separation

The file has a non-cutting safety tip. As recommended by the manufacturer, the rotational speed for One Shape is 400 rpm. One Shape protocol is easy to learn, safe and quick. Therefore, it might be a good alternative to existing reciprocating single file systems without the need to use a special endodontic motor generating the reciprocating motion. [33]

F360

F360 is a single instrument used in continous rotation. The F360 (Komet, USA) endodontic file system permits preparation of most root canals with a simplified, time-saving sequence requiring only two files. 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. [34]

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 permits

ideal 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, [35] and all F360 files are available 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. [36]

The advantages of F360 are [35]

- Highly flexible
- Minimize canal transportation

Conclusion

WaveOne, Reciproc, One Shape and F360 are the new single file NiTi-rotary systems in endodontic instruments. Use of single-file rotary systems, are cost effective, time saving, reduce instrument fatigue and possible cross-contamination. Further research and clinical results are required for better application of these file systems.

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Cite this article as: Kumar SR, Gade V Single file niti-rotary systems. Int J Med and Dent Sci 2015; 4(1):701-707.

Source of Support: Nil
Conflict of Interest: No