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RESEARCH ARTICLE

IN VITRO COMPARISON OF CLEANING ABILITY OF ONESHAPE AND WAVEONE ROTARY SYSTEMS

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ABSTRACT

Introduction: The purpose of this study was to evaluate & compare cleaning ability of two different single file rotary files.
Methods: 20 canals of 10 extracted molars were selected. After preparing an access cavity, K-file size #15 was introduced into the root canal and India ink was injected. Twenty samples were randomly divided in to experimental groups in group I (n=10), root canals were prepared with OneShape file; in group II (n=10), WaveOne were used for instrumentation. After clearing, the removal of India ink from cervical, middle, and apical thirds was scored.
Results: Thus, clening ability in One shape group is better than group Wave one or the Scores for coronal, middle and apical third of root is better in One shape as compared to wave one (i.e. $p<0.01$)
Conclusions: Cleaning efficiency of OneShape system is better than WaveOne system.

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INTRODUCTION

Effective cleaning and shaping of the root canal system is essential for achieving the biological and mechanical objectives of root canal treatment. The objectives are to remove all the pulp tissue, bacteria and their by-products whilst providing adequate canal shape to fill the canal. (Schilder, 1974) Introduction of nickel-titanium (Ni-Ti) instruments offer many advantages over conventional stainless steel files. They are flexible (Walia *et al*., 1988), have increased cutting efficiency (Kazemi *et al*., 1996) and have improved time efficiency. (Ferraz *et al*., 2001) Numerous studies have reported that NiTi instruments efficiently create smooth, funnel-form shapes, with minimal risk of ledging and transportation. (Esposito and Cunningham, 1995; Short *et al*., 1997) With all these apparent advantages, the use of Ni-Ti rotary systems has increased considerably since their introduction. However, their cost and instrument fracture (Alapati *et al*., 2003) are notable disadvantages. The clinician faces two major concerns when considering the use of Ni-Ti rotary instruments: (i) possibility of instrument fracture associated with increased instrument fatigue caused by the repeated use and (ii) the possibility of cross-contamination associated with the inability to adequately clean and sterilize endodontic instruments. (Spongiform Encephalopathy Advisory Committee 2006) Tooth structure and organic debris were observed on the surface of Ni-Ti rotary instruments, and appeared to accumulate in the surface cracks despite meticulous ultrasonic cleaning and decontamination. (Alapati *et al*., 2003; Alapati *et al*., 2004; Sonntag and Peters, 2007) Therefore, the single use of endodontic instruments was recommended to reduce instrument fatigue and possible cross-contamination. However, the single use of endodontic instruments and, mainly the more expensive Ni-Ti rotary instruments, may become an economical burden on the endodontist and the general dentist especially as the available techniques involve the use of at least three to four Ni-Ti rotary instruments. (Yared, 2008) This resulted in introduction of newer systems involving use of single rotary file for canal preparations. There are many dentists who, for many reasons, are reluctant to use NiTi rotary instruments to prepare canals, despite the recognized advantages of flexibility, less debris extrusion and maintaining canal shape. (Walia *et al*., 1998; Pettiette *et al*., 2001) For them, the use of a single file will be very attractive both in terms of time and cost saving. Wave One (DENTSPLY Maillefer, Ballaigues, Switzerland) is a SINGLE-use, SINGLE-file system to shape the root canal completely from start to finish. 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.

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The tip size is ISO 40 with an apical taper of 8% that reduces towards the coronal end. In most cases, the technique only requires one hand file followed by one single WaveOne file to shape the canal completely. The specially designed NiTi files work in a similar but reverse "balanced force" action using a pre-programmed motor to move the files in a back and forth "reciprocal motion". (Roane *et al*., 1985) Each file is having varying cross sectional design as modified convex triangular design in apical portion while convex triangular in coronal region of instrument. One shape file (Micro-Mega, Besancon, France) is recently introduced single file system operating in continuous rotation for quality root canal preparation. This system simplified the endodontic instrument sequence due to presence of a single file. The instrument presents a variable cross-section along the blade. 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. The variable pitch of One Shape also reduces instrument screwing effects.

MATERIALS AND METHODS

10 extracted permanent molars out of which 4 maxillary molars and 6 mandibular molars with intact roots were selected. Mesiobuccal and mesiolingual roots of mandibular teeth and mesiobuccal and distobuccal roots of maxillary teeth were selected. Teeth with root resorption, root fractures & previous root canal treated teeth were excluded. Selected teeth were stored in 0.5% sodium hypochlorite for 1 week for disinfection & after that stored in distilled water. (Kiumars Nazari Moghaddam *et al*., 2009; Yang *et al*., 2007) Coronal access was made with spherical diamond burs. After irrigation of the root canal with distilled water, a K-file size #15(DENTSPLY Maillefer) was introduced into the root canal and the canal length was determined. A K-file size #15 (DENTSPLY Maillefer) was introduced into the root canal and 1-2 ml India ink was injected with an insulin syringe into the orifice until the ink leaked from apical foramen. The ink was reapplied after diffusion and drying. (Kiumars Nazari Moghaddam *et al*., 2009) The teeth were stored in wet conditions & left at room temperature for 48 hours. (Yang *et al*., 2007) The teeth were divided into 2 groups with 3 mandibular & 2 maxillary teeth in each group, i.e. 10 root canals in each group.

Group I: The root canals were prepared with One Shape (Micro-Mega, Besancon, France) file using endodontic motor (X-Smart; DENTSPLY Maillefer, Ballaigues, Switzerland)

Group II: The root canals were prepared with Wave One (DENTSPLY Maillefer, Ballaigues, Switzerland) file of Red series using endodontic motor (X-Smart; DENTSPLYMaillefer, Ballaigues, Switzerland)

Distilled water was used for irrigation. The teeth were cleared for cleaning efficacy analysis. Each tooth was transferred to a separate glass vial & demineralized in 11% nitric acid until the texture of each tooth was rubbery. The teeth were washed thoroughly with water for 8 hours to remove all traces of acid before dehydration. They were then dehydrated by immersing in 70%, 95% & 100% ethyl alcohol, respectively for 24 hours each & rendered transparent by storing in methyl salicylate. (Zand *et al*., 2007) At first the canals were separated from CEJ and were cut at 1 mm above the working length with a #11 scalpel, so that the apical section could be observed. Then the roots were cut from the mid part of the remaining canal (middle section). The removal of India ink from the cervical, middle, and apical thirds was analyzed with a stereomicroscope under 40X magnification (Fig 1) and scored as:

0= total cleaning
1= more than 50% ink removal
2= less than 50% ink removal of total intra-canal space
3= no ink removal

Statistical analysis

All scores were collected and data were expressed as means ± standard deviation. All data was processed by SPSS software version 19.0 (SPSS Inc, Chicago, IL, USA) using Mann-Whitney *U* and Friedman tests.

RESULTS

From Table no 1, the scores for coronal, middle and apical third of root is better in One shape as compared to wave one i.e. clearing ability in One shape group is better than group Waveone ($p<0.01$) . The scores for Oneshape file were 1.4, 1.1 and 0.4 at coronal, middle and apical section while Waveone file shows 2, 1.7 and 1 respectively. According to Mann – Whitney U and Friedman test, It is clearly seen that highly significant difference in cleaning ability of files seen at coronal i.e. $U = 143$, $p<0.01$, Middle i.e. $U = 146$, $p<0.01$ and Apical i.e. $U = 149$, $p<0.01$.

Table 1. Comparison of mean and SD values of clening ability in One shape and wave one group (n=10)

	One shape (n=10)	Wave one (n=10)
	Mean ± SD	**Mean ± SD**
Coronal score	1.40±1.075	2.0±0.6667
Middle score	1.10±0.5676	1.70±0.8233
Apical score	0.70±0.4830	1.0±0.6667

DISCUSSION

Several factors contribute to the clinical success of root canal treatment, such as biomechanical cleaning, type of restoration, number of visits and root canal filling material. Chemo-mechanical preparation of the root canal includes both mechanical instrumentation and canal irrigation, and is principally directed towards the elimination of microorganisms from the root canal system. Canal preparation is one of the most important phases of primary root canal treatment and is mainly aimed at the debridement of the canal. (Kiumars Nazari Moghaddam *et al*., 2009) The smear layer is a superficial film of dentin particles, and vital or necrotic pulp remnants that are produced when a canal is instrumented. It is desirable to remove this layer due to its potential deleterious effects. (Zand *et al*., 2007) Debris was defined as dentin chips, and vital or necrotic pulp remnants loosely attached to the canal walls. There is no doubt that debris removal is a critical issue for elimination of the microorganisms from the root canal system. In the current study, the cleaning efficacy two rotary systems were examined in the root canals, by means of microscopic evaluation. (De alencar *et al*., 2010; Short *et al*., 1997) Clinicians are facing problem of cross contamination with the use of NiTi rotary systems involving series of files. (Spongiform Encephalopathy Advisory Committee, 2006)

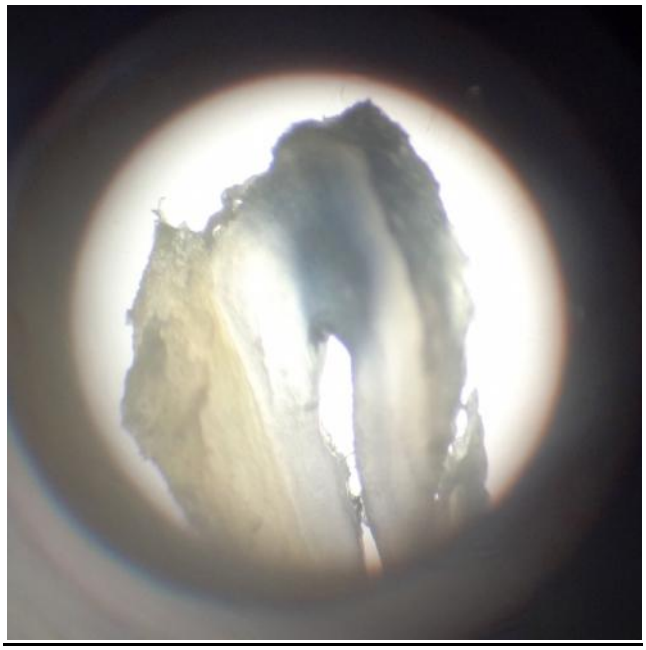

Figure 1. Cervical Section of canal showing score 1

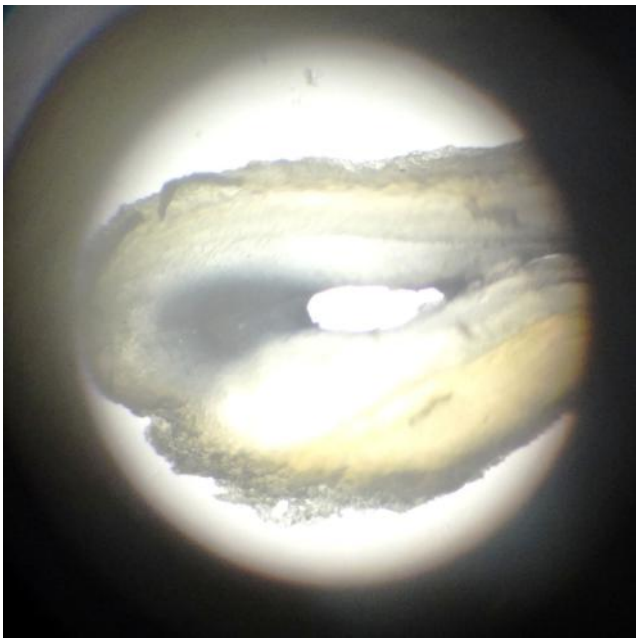

Figure 2. Middle Section of canal showing score 1

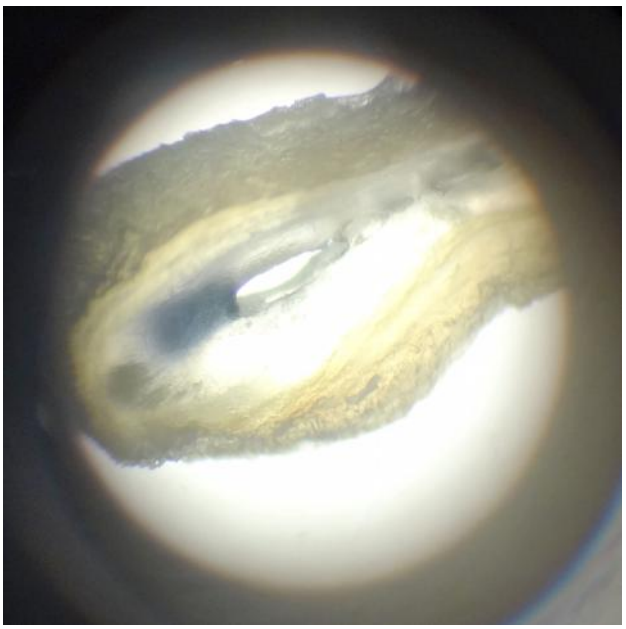

Figure 3. Apical Section of canal showing score 1

To overcome this problem various newer single file systems were introduced. The most important objective of endodontic treatment which is, the elimination of microorganisms from the root canal system, is achieved through removal of vital tissues, residual necrotic material, infected dentin and debris. In the present study, the ability of two single file systems namely Oneshape file (Micro-Mega, Besancon, France) and WaveOne (DENTSPLY Maillefer, Ballaigues, Switzerland) to achieve these goals was examined. Different approaches have been used to evaluate the cleaning ability of instruments. Debris removal was the focus of at least one study and another used scanning electron microscopy to examine smear layer removal. In the present study, the root canals were examined after the ink penetration and clearing technique which is useful for studying the cleaning ability of the instrumentation and the morphology of human teeth because it makes the teeth transparent so that the pulp cavity and root canal walls can be diagnosed. (Yang *et al*., 2007; Thompson, 2000) In the present study, canals were prepared with the single rotary file of OneShape (Micro-Mega, Besancon, France) with tip diameter of 25 and taper of 6% and second file of WaveOne (DENTSPLY Maillefer, Ballaigues, Switzerland) which is with tip diameter of 25 and taper of 8% as per instructions provided by manufacturer. Many pulpal ramifications cannot be reached mechanically, copious irrigation during cleansing and shaping must be maintained. The authors support the view that both chemical and mechanical cleaning affects root canal cleanliness. Hence irrigation was performed with distilled water, avoiding any associated variations of different irrigating solutions. (Esposito and Cunningham, 1995) By applying coefficient of variation technique it is seen that cleaning efficacy of OneShape (Micro-Mega, Besancon, France) file

shows better cleaning ability with average score of 1.40, 1.1 and 0.70 respectively from coronal, middle and apical thirds as compared to WaveOne (DENTSPLY Maillefer, Ballaigues, Switzerland) which is 2.0, 1.7 and 1.0 respectively. WaveOne (DENTSPLY Maillefer, Ballaigues, Switzerland file have varying cross sectional designs, as modified convex triangular design in apical portion while convex triangular in coronal region of instrument. This variation reduces the contact with canal wall. Waveone system works in reverse "balanced force" action using a pre-programmed motor to move the files in a back and forth "reciprocal motion". Variable pitch and helical angle provided to Waveone file increases its cutting efficiency. But in present study it shows greater scores i.e. less clearing ability than OneShape. (Micro-Mega, Besancon, France) One shape file (Micro-Mega, Besancon, France) is recently introduced single file system operating in continuous rotation having variable cross-section along the blade. The apical zone presents a variable 3-cutting-edge design. The middle zone has a cross-section that progressively changes from 3 to 2 cutting edges. The coronal is provided with 2 cutting edges prove better clearing ability of file. These files are provided with variable pitch and helix angle still uniform taper of 6% which is lesser compare to WaveOne i.e. 8% resulting in better cleaning and shaping of curved root canal system. In addition to this, OneShape file does not require any special rotary motor system for operating in canal but WaveOne requires special motor system for reciprocal filling action which is also cost effective. Use of reciprocating motion produces more debris extrusion as compared to the use of complete rotation. (Sebastian Burkley *et al*., 2012) Therefore, the use of continuous rotation enables better upward debris elimination than the reciprocating movement.

Conclusion

OneShape and WaveOne file shows good clening ability in apical third of canal followed by middle and coronal third of canal. OneShape shows better cleaning ability compared to WaveOne in Apical, middle as well as coronal third of canal

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