Scholars Journal of Dental Sciences (SJDS) **ISSN 2394-496X (Online)**
Sch. J. Dent. Sci., 2015; 2(7):393-396 **ISSN 2394-4951 (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjds.2015.v02i07.002

Research Article

Comparative evaluation of centering ability of Hero Shaper and RaCe using computed tomography (C.T)-an in-vitro study

Dr. Kaustubh Khatod, Dr. Ajay Saxena, Dr. Manoj chandak, Dr. Abhilash dass
Department of Conservatives Dentistry and Endodonils, Sharad Pawar Dental College, Sawangi, Wardha, Maharashtra, India

***Corresponding author**
Dr. Kaustubh Khatod
Email: kaustubh.khatod@gmail.com

Abstract: The aim of this study was to compare the centring ability of two nickel-titanium instrumentation techniques in curved canals using CT- Scan. Forty extracted human permanent mandibular first and second molars were divided into 2 experimental groups, each comprising of twenty teeth, and prepared with Hero Shaper and RaCe using the crown-down technique. Computed tomography scans were taken preoperatively and postoperatively, images were superimposed and aberrations were recorded. Image analysis was done using Extended Brilliance Workspace V3.5.02250 software for evaluation of canal transportation and canal centering ability. Data was then statistically analyzed using analysis of variance. There was no statistically significance in transportation and centering ability at any of the three locations (coronal, middle and apical). Canals prepared with RaCe had more canal transportation at all the three levels of root canal (coronal, middle and apical). Canals prepared with Hero Shaper were well centered at all the three levels of root canal (coronal, middle and apical).
Keywords: Hero Shaper, RaCe, canal centering ability, canal transportation, computed tomography.

INTRODUCTION

Although successful root canal therapy depends on many factors, root canal cleaning and shaping are important phases in endodontic therapy. The aim and objectives of instrumentation include debriding the root canal system, continuously tapering in conical form and maintaining the original shape and position of apical foramen. When curvatures are present, endodontic preparation with stainless steel instrument becomes more difficult and there is tendency for all the preparation techniques to divert the prepared canal from the original axis. The problems frequently observed with instrumentation of curved root canals with conventional stainless steel instruments are undesirable abberations such as zips, elbows, ledges and perforations particularly with increasing size [1-3].

To overcome this, several new nickel-titanium (NiTi) instruments used in rotary endodontic handpiece have been developed to improve the quality of root canal preparation. NiTi rotary instrumentation allows for proper shaping and has the ability to maintain curvature in severely curved canals [4-7].

A large number of NiTi instruments are available on the market. They all show different designs with specific taper, cutting blades, direction, tips and specific motion.

The Hero Shaper (Micro-Mega, France) is a newer system of the Hero 642 instruments. It is designed, as the manufacturer claims with triple helix cross-section but the helix pitch and the helix angle have been modified. One of the most important modifications is that the helix angle increases from the tip to shank. The other modification is the adapted pitch that increases with the taper of the instrument. This design reduces threading and avoids the screwing effect of the instrument.

Reamer with Alternating Cutting Edges (RaCe; FKG Dentaire, Switzerland), have a triangular cross-sectional design. The exception is the 0.02 tapered size 20 files, which have a square cross-sectional design. The combination of triangular section with sharp edges and alternating cutting edges eliminates screwing, enhances cutting efficiency, and ensures efficient evacuation of debris. The aim of this study was to compare the centring ability of two nickel-titanium instrumentation techniques in curved canals using CT-Scan.

MATERIALS and METHODS

A total of forty recently extracted human permanent mandibular first and second molars with fully formed apices were included in the study. The teeth were washed off blood and mucous in running tap water, cleaned with #15 scalpel blade to remove tissue tags, and stored in 5% sodium hypochlorite solution until they were used. The occlusal surfaces were flattened to have a comparable 18mm length for all teeth to provide even reference points for instrumentation. The mesiobuccal root of each tooth was selected for the study.

The inclusion criteria was mature teeth with a canal size that allowed a #15 K- file or smaller to pass through the foramen. The working length of all canals was measured and recorded using size 10 file placed 1mm shorter than the length noted when the file tip emerged apically. The canal curvature was determined according to Schneider [8]. Only teeth with canal curvature between 20 and 45 degree were included.

The teeth mounted in clear acrylic were placed on plastic plate, which served as container of teeth during scanning. All teeth were aligned so that buccal surfaces were facing the plastic plate. The plastic plate with teeth was placed in CT scan machine (machine name) and aligned so that the long axes of the roots were perpendicular to the beam. The teeth were then scanned using 0.5 mm thick slices with a table increment of 1mm. the resulting effective slices were 0.1mm in width. Raw data were reconstructed using bone algorithm. The slice data from the scan was archived on the magnetic computer tape for storage.

The tooth were randomly divided into two groups (n=20). The mesiobuccal canals were instrumented with Hero Shaper and RaCe. Canals were prepared with rotary instruments using Crown Down technique. A gear reduction torque control hand piece (X Smart Dentsply) was used. Each file was examined before and after use of any visual defects and was wiped regularly to remove debris. Each set of file, was used to prepare five canals only. The root canals were irrigated with 2ml of 3% sodium hypochlorite and normal saline after each instrumentation. Canal lubrication was accomplished with RC Help canal lubricant. The canals were prepared according to manufacturer's instructions.

In Group I, Simple cases were prepared using the 'blue wave' i.e. two #30 files with decreasing tapers is recommended, the first file with a 0.06 taper and the second with a 0.04 taper.
Intermediate cases were prepared using the 'red wave' i.e. #25 files with 0.06 and 0.04 tapers followed by a #30 file with 0.04taper.

Difficult cases were treated using the 'yellow wave'. #20 file with 0.04 tapers were followed successively by a # 25 file with a 0.04 taper and# 30file with a 0.04 taper to full working length.

In Group II, Instrumentation was carried out with a crown-down technique starting with the 40/.10 instrument at 600 rpm and 2 N/cm torque as suggested by the manufacturers, followed by 35/.08, 25/.06, 25/.04 and 25/.02 if necessary. Then canals were instrumented to working length with 25/.04 and 25/.06. After instrumentation, teeth mounted in clear acrylic were again aligned on the plastic plate. All teeth were again scanned under pre- operative scanning position and specifications. Raw data were reconstructed using bone algorithm. The slice data from the scan was archived on the magnetic computer tape for storage. The pre and post instrumentation scanned images were compared and analysed using Extended Brilliance Workspace V3.5.02250 software.

Evaluation of Canal Transportation and Centering ability

The extent and direction of canal transportation was determined be measuring shortest distance from edge of the uninstrumented canal to edge of the tooth in both the mesial and distal directions and then comparing this with the same measurements taken from instrumented images.

Canal Transportation= [(a1-a2)-(b1-b2)]

Where,

a1 –shortest distance from the outside of curved root to the periphery of uninstrumented canal.

a2 –shortest distance from outside of curved root to the periphery of instrumented canal.

b1 –shortest distance from inside of curved root to the periphery of uninstrumented canal.

b2 –shortest distance from inside of curved root to the periphery of instrumented canal.

Result of "0" from canal transportation formula indicates no canal transportation.

Evaluation of centering ability

Canal Centering Ratio = [(a1-a2) / (b1-b2)]
or [(b1-b2)/(a1-a2)]

It is a measure of the ability of the instrument to stay centered in the canal. The numerator for the centering ratio formula was smaller of the two numbers (a1-a2) or (b1-b2) if these numbers were unequal.

Result of "1" for the centering ratio indicates the perfect centering.

Statistical Analysis

The data were analyzed using analysis of variance (One-way ANOVA) and Multiple Comparison: Tukey Test was used for group wise comparison. The statistical analysis was done with Statistical Package for Social Sciences Version 17.0 (SPSS Inc, USA) statistical analysis software.

RESULTS

Transportation

Mean transportation at coronal, middle and apical levels in two groups under study are shown in Table 1. At coronal level, maximum mean value was obtained for RaCe (0.34 ± 0.27) while minimum value was obtained for Hero Shapers (0.19 ± 0.10).

At middle level, maximum mean value was obtained for RaCe (0.34 ± 0.18) while minimum value was obtained for Hero Shapers (0.15 ± 0.07).

At apical level, maximum mean value was obtained for RaCe (0.25 ± 0.12) whereas, minimum value was obtained for Hero Shapers (0.17 ± 0.13).

Centering ability

Centering ability (ratio) for all the four groups under study is shown in Table 2. At coronal level, maximum mean value was obtained for Hero Shapers (0.52 ± 0.37) while minimum value was obtained for RaCe (0.45 ± 0.15).

At middle level, maximum mean value was obtained for Hero Shapers (0.60 ± 0.12) while minimum was obtained for RaCe (0.49 ± 0.23).

At apical level, maximum mean value was obtained for Hero Shapers (0.50 ± 0.39) whereas, minimum value was obtained for RaCe (0.41 ± 0.19).

Table 1: Mean transportation at coronal, middle and apical levels in two groups under study (mm)

Group	N	Coronal		Middle		Apical	
		Mean	SD	Mean	SD	Mean	SD
I	20	0.19	0.10	0.15	0.07	0.17	0.13
II	20	0.34	0.27	0.34	0.18	0.25	0.12
F (ANOVA)		4.92		10.62		2.25	
" p"		0.09		0.79		0.27	

N: Number of samples, SD: Standard deviation, ANOVA: Analysis of variance, Mean transportation at coronal, middle and apical levels in two groups under study (mm)

Table 2: Mean centering ratio at coronal, middle and apical levels in two groups under study (mm)

Group	N	Coronal		Middle		Apical	
		Mean	SD	Mean	SD	Mean	SD
I	20	0.52	0.37	0.60	0.12	0.50	0.39
II	20	0.45	0.15	0.49	0.23	0.41	0.19
F (ANOVA)		1.82		2.95		2.18	
" p"		0.95		0.76		0.90	

N: Number of samples, SD: Standard deviation, ANOVA: Analysis of variance, Mean transportation at coronal, middle and apical levels in two groups under study (mm)

DISCUSSION

The main purpose of instrumentation is to clean the canal while maintain the anatomy and morphology of the canal. The use of files with insufficient flexibility has been shown to contribute procedural errors such as zip, canal transportation, ledge formation, file separation and perforation when shaping narrow and curved canals. Attempts also have been made to increase the flexibility and cutting efficiency of endodontic file by modifying their design. Nickel titanium rotary instrumentation was introduced in the early 1990s, since then many different instrument systems have been manufactured. NiTi instruments have superior ability to remain centered within the canal during instrumentation compared to stainless steel files thus minimizing the straightening of the canal [9].

The present study was conducted on curved mesio-buccal canals of extracted human mandibular first and second molar teeth. Cunningham *et al.;* [10] reported that the presence of a dumbbell-shaped mesial root in mandibular molars with severe distal concavities creates difficulties in properly instrumenting in three dimensions. Mesiobuccal root canals of extracted human mandibular molars were used herein because they usually present an accentuated curvature [11].

CT imaging techniques have been evaluated as repeatable, non-invasive methods for the analysis of canal geometry and efficiency of shaping techniques [12]. With this technique; it is possible to compare the anatomic structure of root canal before and after instrumentation [13-14]. In present study pre and postoperative evaluation of remaining dentin on the either proximal side was done using CT scan machine, [Philips Brilliance 40 CT Scan Machine, USA] and Extended Brilliance Workspace V3.5.02250 software.

The coronal level, mid-root level and apical level are areas in curved canal that are prone to procedural errors. Hence, measurements were made at coronal, middle and apical levels [15-17].

In the present study, at coronal, middle and apical level Race rotary files showed more canal transportation compared to Heroshapers, M two and K3. Our study is in accordance with previous study done by Al-Sudani D and Al-Shahrani S [18] Ozgur Uyanik *et* *al.;* [19] and Moradi *et al.;* [20]. More canal transportation by Race rotary files may be attributed to stainless-steel nature of the first precoronal flaring files of the Race system. In this study, more aberrations were created using RaCe. The reason might be that the RaCe is stiffer than the Hero Shaper, causing more instrument memory, which in turn would remove more material.

In present study Hero Shaper showed better canal centering ability. This finding may be a result of Hero Shaper instrument having a longer pitch and positive rake angle for better dentin cutting efficacy. The canals prepared with Hero Shaper had less transportation and were better centered probably because of their smaller taper that could tend to reduce instrument stiffness. The result of present study is in accordance with Veltri *et al.;* [21] and Yang *et al.;* [22].

CONCLUSION

Canals prepared with RaCe had more canal transportation at all the three levels of root canal. Better centered canals were prepared with HeroShaper at all the three levels of root canal.

REFERENCES

1. Al-Omari MA, Dummer PM, Newcombe RG; Comparison of six files to prepare simulated root canals. Int Endod J. 1992; 25(2):57-66.
2. Al-Omari MA, Dummer PM, Newcombe RG, Doller R; Comparison of six files to prepare simulated root canals. Int Endod 1992;25(2): 67-81.
3. Hulsmann M, Stryga F; Comparison of root canal preparation using different automated devices and hand instrumentation. J Endod, 1993; 19:141-5.
4. Thompson SA, Dummer PMH; Shaping ability of ProFile .04 Taper Series 29 rotary nickel-titanium instruments in simulated root canals. Part 2. Int Endod J; 1997; 30:8-15.
5. Thompson SA, Dummer PMH; shaping ability of Light speed rotary nickel-titanium instruments in simulated root canals. Part 2. J Endod 1997; 23:742-7.
6. Schafer E, Florek H; Efficiency of rotary nickel-titanium K3 instruments compared with stainless steel hand K-Flexofile. Part 1. Shaping ability in simulated curved canals. Int Endod J, 2003; 36:199-207.
7. Schafer E, Erler M, Dammaschke T; Comparative study on the shaping ability and cleaning efficiency of rotary M two instruments. Part 1 Shaping ability in simulated curved canals. Int Endod J, 2006; 39:196-202.
8. Schneider SW; A comparison of canal preparations in straight and curved root canals. Oral Surg Oral Med Oral Pathol. 1971; 32(2):271-5.
9. Khurana P, Nainan MT, Sodhi KK, Padda BK; Change of working length in curved molar root canals after preparation with different rotary nickel-titanium instruments. J Conserv Dent, 2011; 14:264-8.
10. Cunningham C, Senia SA; three-dimensional study of canal curvatures in mesial roots of mandibular molars. J Endod, 1992: 18: 294–300.
11. Hartmann MSM, Barletta FB, Fontanella VRC, Vanni JR; Canal transportation after root canal Instrumentation: A Comparative Study with computed tomography Endod, 2007; 33: 962–965.
12. Gambill JM, Alder M and DelRio CE; Comparison of Nickel - titanium and Stainless steel hand file instrumentation using Computed Tomography. J Endod, 1996; 22: 369-75.
13. Peters OA, Schonenberger K, Laib A; Effects of four Ni-Ti preparation techniques on root canal geometry assessed by micro computed Tomography Int Endod J, 2001; 34, 221-230.
14. Ganp Y, Gunday M; The use of Computed Tomography when comparing Nickel - titanium and Stainless steel files during preparation of simulated curved canals. Int Endod J, 2001; 34: 452 - 57.
15. Hulsmann M, Schade M, Schafer FA; comparative study of root canal preparations with Hero 642 and Quantec SC rotary Ni-Ti instruments. Int Endod J, 2001; 34: 538-46.
16. Bertrand MF, Pegurier LL, Medioni E, Muller M, Bollo M; Curved molar root canal preparations using Hero 642 rotary Nickel titanium instruments. Int Endod J, 2001; 34: 631-636.
17. Gonzalez - Rodrguez MP, Ferrer Luque CM; A comparison of Profile, Hero 642 and K3 instrumentation systems in teeth using digital imaging analysis. Oral Surg., Oral Med., Oral Pathol. 2004; 97 (1): 112-5.
18. Al-Sudani D, Al-Shahrani S; A comparison of the canal centering ability of ProFile, K3, and RaCe Nickel Titanium rotary systems. J Endod 2006; 32:1198-201.
19. Ozgur Uyanik M, Cehreli ZC, Ozgen Mocan B, Tasman Dagli F; Comparative evaluation of three nickel-titanium instrumentation systems in human teeth using computed tomography. J Endod. 2006; 32(7):668-71.
20. Moradi S, Talati A, Monajem Zadeh A; Centering ability and dentin removal of rotary systems in curved root canals. Iranian Endodontic Journal. 2009; 4(3):91-5.
21. Veltri M, Mollo A, Mantovani L, Pini P, Balleri P, Grandini S; A comparative study of Endoflare–Hero Shaper and M two NiTi instruments in the preparation of curved root canals. Int Endod J 2005; 38: 610–616, 2005.
22. Yang GB, Zhou XD, Zhang H, Wu HK; Shaping ability of progressive versus constant taper instruments in simulated root canals. Int Endod J. 2006; 39(10):791-9.