



**COMPARISON OF THE CLEANING EFFICACY OF VARIOUS ROTARY FILES
(PROTAPER UNIVERSAL, HERO SHAPER, REVO -S AND MTWO) SYSTEMS IN THE
APICAL THIRD OF OVAL SHAPED CANALS.**

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ABSTRACT

Oval-shaped canals are a challenge when using rotary files because buccal and lingual recesses are commonly left uninstrumented. The purpose of this study was to evaluate the cleaning efficacy of various rotary file systems (MTwo, Hero-Shaper, Revo-S and Protaper universal) in the apical third of the oval-shaped canals. Fifty single-rooted mandibular first premolars were selected and randomly assigned to four groups according to the rotary file system used and one uninstrumented control group. After decalcification, apical 5mm segment was sectioned and histologic processing was done. Analysis was done under optical microscope. Statistical Analysis was done using ANOVA. Under the conditions of the study, the use of MTwo and Revo-S resulted in the best canal cleanliness in the apical third with statistically no significant difference. Protaper universal has the least cleaning efficacy. MTwo and Revo-S seem to be effective in cleaning the apical third of the canal.

KEYWORDS: Rotary Instrumentation, Tooth apex, Canal preparation.

INTRODUCTION

Biomechanical preparation of the root canal system is recognized as being one of the most important step in root canal treatment. It includes the removal of vital and necrotic tissues from the root canal system, along with infected root dentin, which gives the canal system a shape that allows easy debridement and predictable placement of locally used medicaments and a permanent root filling of high technical quality.^[1]

The introduction of nickel-titanium (NiTi) rotary file systems has resulted in significant progress in the biomechanical preparation of the root canal space.

However, the rotary motion of these files tends to prepare the main root canal space into a circular shape. This leaves unprepared buccal and lingual extensions as well as overprepared mesial and distal aspects, which

favors the retention of tissue and bacterial remnants, especially in oval-shaped canals.^[2]

Thus, although many advances have been made in endodontics in the last decades, canal preparation is still adversely influenced by highly variable root canal anatomy.^[3]

Thus, the present study was designed to compare the cleaning efficacy of various rotary files (Protaper universal, Hero-shaper, Revo-S and MTwo) systems in the apical third of oval shaped canals.

MATERIALS AND METHODS

Selection of teeth

Fifty freshly extracted non-carious single-rooted human mandibular premolar teeth with fully formed apices were selected and stored in 9°C aqueous 0.1% thymol solution. (Fig i)



Fig i: 50 mandibular premolar teeth

After being washed in running water for 48 hours, the root canal was accessed by using round bur no. 4 (MANI, INC) in a high speed handpiece (NSK). The apical patency was determined by inserting a size 10 K-file into the root canal until its tip was visible at the apical foramen, and the working length (WL) was set 0.5 mm short of this measurement. The teeth were randomly divided into five groups depending upon the rotary file system used, first group being the uninstrumented control group. The teeth in group 2 were prepared with Protaper universal, group 3 with Hero – Shaper and group 4 with MTwo file systems.

Biomechanical preparation was done with the rotary file system used for each group. Copious irrigation with 2.5% NaOCl was done after each instrument change. All the file systems used had a taper of 0.04% and preparation was done till ISO size 30 to standardize all the specimens. The teeth were decalcified by 10% nitric acid for 15 days. The apical thirds of the decalcified roots were cut perpendicularly to their long axis with a scalpel at 5 mm from anatomic apex. (Fig ii).

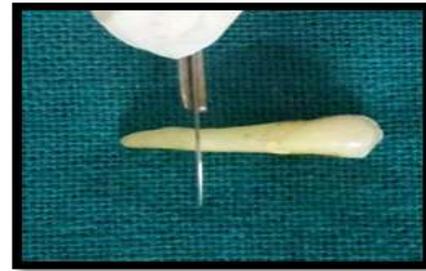


Fig ii: 5mm segment cut with a scalpel

Serial sections (10 semi-serial sections of each specimen), with the microtome (Fig iii)



Fig iii: Microtome

Set at 6- μ m thickness were then cut. (Fig iv)

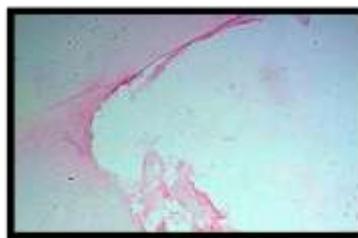


Fig iv: Serial section obtained

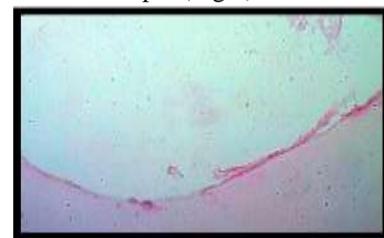
The sections were stained with hematoxylin–eosin and examined under an optical microscope. (Fig v)



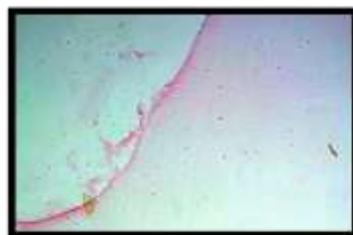
Group 1: Uninstrumented



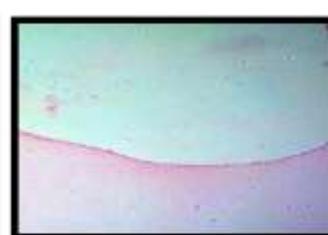
**Group 2: Protaper
Universal**



Group 3: HERO Shaper



Group 4: Revo – S



Group 5: MTwo

Fig v: Sections after haematoxylin and eosin staining as observed under optical microscope

The percentage of debris was calculated by placing an integration grid over the cross-section images to allow counting the points in the root canal that coincided with either clean areas or areas containing debris.

The data was analyzed using one – way analysis of variance and Tukey – Kramer multiple comparison test. Statistical analysis was performed at the 0.05 level of significance.

RESULTS

Results of the present study showed that all the rotary file systems did not completely clean the apical third of the canals and some amount of remaining debris was seen in all the groups irrespective of the file system used as shown in graph 1.

The means and standard deviations of percentage of remaining debris in the apical third of the canal are detailed in Table 1.

The use of MTwo and Revo- S resulted in the best canal cleanliness in the apical third with statistically no significant difference as depicted in table 2.

Protaper universal has the least cleaning efficacy when compared with the other file systems included in the study with a significant difference.

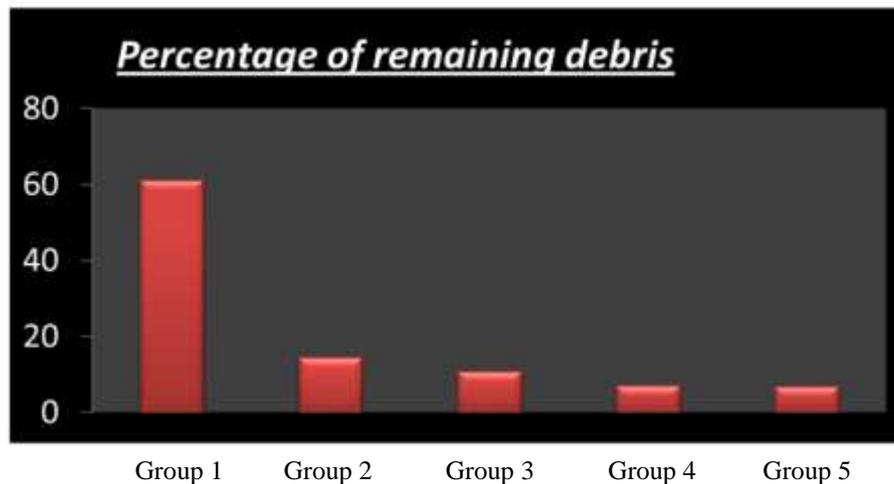
All experimental groups revealed significantly less debris than the uninstrumented control group. ($p < .05$).

Table 1: The means and standard deviations of the percentage of remaining debris in the apical thirds of the canal

	Number of samples	Mean	Std. Deviation	Std. error
UninstrumentedControl Group (Group 1)	10	61.18	.53	2.963
Protaper Universal (Group 2)	10	14.57	.43	.136
Hero Shaper (Group 3)	10	10.77	.54	.172
Revo S (Group 4)	10	7.12	.39	.123
Mtwo (Group 5)	10	.82	.36	.116

Table 2: Tukey Kramer multiple comparison test

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
UninstrumentedGroup	Mtwo	54.3600(*)	.2059	<.001**	53.752	54.968
	RevoS	54.0600(*)	.2059	<.001**	53.452	54.668
	HeroShaper	50.4100(*)	.2059	<.001**	49.802	51.018
	ProTaperUniversal	46.6700(*)	.2059	<.001**	46.062	47.278
ProTaperUniversal	Mtwo	7.6900(*)	.2059	<.001**	7.082	8.298
	RevoS	7.3900(*)	.2059	<.001**	6.782	7.998
	HeroShaper	3.7400(*)	.2059	<.001**	3.132	4.348
	UninstrumentedGroup	-46.6700(*)	.2059	<.001**	-47.278	-46.062
HeroShaper	Mtwo	3.9500(*)	.2059	<.001**	3.342	4.558
	RevoS	3.6500(*)	.2059	<.001**	3.042	4.258
	ProTaperUniversal	-3.7400(*)	.2059	<.001**	-4.348	-3.132
	UninstrumentedGroup	-50.4100(*)	.2059	<.001**	-51.018	-49.802
RevoS	Mtwo	.3000	.2059	1.000	-.308	.908
	HeroShaper	-3.6500(*)	.2059	<.001**	-4.258	-3.042
	ProTaperUniversal	-7.3900(*)	.2059	<.001**	-7.998	-6.782
	UninstrumentedGroup	-54.0600(*)	.2059	<.001**	-54.668	-53.452
Mtwo	RevoS	-.3000	.2059	1.000	-.908	.308
	HeroShaper	-3.9500(*)	.2059	<.001**	-4.558	-3.342
	ProTaperUniversal	-7.6900(*)	.2059	<.001**	-8.298	-7.082
	UninstrumentedGroup	-54.3600(*)	.2059	<.001**	-54.968	-53.752



Graph 1: Percentage of remaining debris

DISCUSSION

The main objective of root canal therapy is the elimination of microorganisms from the root canal system and the prevention of recontamination after treatment.^[4] Ni-Ti instruments were introduced to improve root canal preparation in association with irrigating solutions to facilitate the debridement of the canals.^[5]

Because oval canals represent a challenge to any file and/or irrigation system, this type of canals were selected for the present study.⁶ It has been demonstrated that cleaning of the root canal is not always easily accomplished, especially during the preparation of oval shaped canals.^[2, 7]

Debridement of the apical portion of the root canal is a big challenge to endodontic treatment, especially because of the complexity of the root canal anatomy and the limitations of instrumentation techniques.^[8] Thus, to secure effective apical cleaning, the instruments should be in contact with every part of the canal wall. To deal with this complex problem, several instrumentation techniques and modified instrument designs have been proposed.

Debris may be defined as dentin chips, tissue remnants and particles loosely attached to the root canal wall, whereas the smear layer is a surface film of debris retained on dentin or other surfaces after instrumentation with either rotary instruments or endodontic files.^[9] Overall, no completely cleaned root canals could be found regardless of the instrumentation technique investigated.^[10]

In this study, optical microscopy was used as a tool to quantify the presence of debris in the root canal as well as the action of the instruments at the dentin walls, according to previous studies.^[11, 12] Histologic methods have been considered old when compared with micro-computed tomography evaluation; however, they provide

valuable information that cannot otherwise be obtained.^[6]

Despite some structural differences, modern rotary Ni-Ti instruments are able to remove the smear layer produced during instrumentation and subsequently dissolved by the irrigants used. Rotary Ni-Ti instruments produce fine dentine particles and shavings that are spread and compacted along dentine walls and then partially dissolved by the irrigant and removed coronally via flute spaces.^[4]

The use of MTwo and Revo- S resulted in the best canal cleanliness in the apical third with statistically no significant difference. Protaper universal has the least cleaning efficacy when compared with the other file systems included in the study with a significant difference.

The difference in the result obtained is because of the difference in the design of the file systems used.

Mtwo, because of their “italic S” cross-section with only two cutting edges, and Revo-S, with asymmetrical section and three cutting edges located on different radiuses, favoured debris elimination and hence show greater canal cleanliness with no significant difference.^[4] Also, MTwo and Revo-S have positive rake angles which allow cutting dentine chips that curl away from the edge of the blade leading to a superior cutting efficiency.

HERO shaper has a noncutting tip, a negative cutting angle, a triangular cross-section with three cutting edges.^[12]

ProTaper files have a triangular cross-section presenting no active cutting edges and a zero rake angle which is why it has the least cleaning efficacy.^[13]

Thus, the design of the file is an important factor that determines the cutting efficiency.

CONCLUSION

Taken together, file design is an important factor in selecting the file system to be used for the efficient biomechanical preparation of the root canal in conjunction with the irrigant used.

Within the limitations of this study, it can be concluded that Mtwo and Revo – S can be used to clean the apical thirds of oval shaped canals.

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REFERENCES

1. Haapasalo M, Endal U, Zandi H, Coil J. Eradication of endodontic infection by instrumentation and irrigation solutions. *Endod Topics* 2005; 10: 77–102.
2. Taha NA, Ozawa T, Messer HH. Comparison of three techniques for preparing ovalshaped root canals. *J Endod* 2010; 36(3): 532–5.
3. Peters OA, Laib A, Rueggegger P, Barbakow F. Three-dimensional analysis of root canal geometry by high-resolution computed tomography. *J Dent Res* 2000; 79(6): 1405–9.
4. Poggio C, Dagna A, Chiesa M, Beltrami R, Marco C. Ultrastructural analysis of the root canal walls after preparation with two rotary nickel-titanium endodontic instruments. *Contemp Clin Dent* 2014; 5(3): 357-60.
5. Yesilsoy C, Whitaker E, Cleveland D, Phillips E, Trope M. Antimicrobial and toxic effects of established and potential root canal irrigants. *J Endod* 1995; 21(10): 513-5.
6. De-Deus G, Souza EM, Barino B, et al. The self-adjusting file optimizes debridement quality in oval-shaped root canals. *J Endod* 2011; 37(5): 701–5.
7. Nadalin MR, Perez DE, Vansan LP, et al. Effectiveness of different final irrigation protocols in removing debris in flattened root canals. *Braz Dent J* 2009; 20(3): 211–4.
8. Wu MK, van der Sluis LW, Wesselink PR. The capability of two hand instrumentation techniques to remove the inner layer of dentine in oval canals. *Int Endod J* 2003; 36: 218–24.
9. American Association of Endodontists. Glossary of Endodontics Terms, 7th ed. Chicago: American Association of Endodontists; 2003.
10. Hulsmann M, Peters O, Dummer P. Mechanical preparation of root canals: shaping goals, techniques and means. *Endod Topics* 2005; 10: 30–76.
11. Barbizam JV, Fariniuk LF, Marchesan MA, et al. Effectiveness of manual and rotary instrumentation techniques for cleaning flattened root canals. *J Endod* 2002; 28(5): 1234-8.
12. Hulsmann M, Gressmann G, Schafers F (2003) A comparative study of root canal preparation using FlexMaster and HERO 642 rotary Ni-Ti instruments. *Int Endod Journal* 2013; 36: 358–66.
13. Burklein S, Hinschitza K, Dammaschke T, Schafer E. Shaping ability and cleaning effectiveness of two

single-file systems in severely curved root canals of extracted teeth: Reciproc and WaveOne versus Mtwo and ProTaper. *Int Endod J* 2012; 45: 449–461.