

Comparative evaluation of the effectiveness of Hero Shaper Rotary endodontic file and D-Race Retreatment file system in removing Root Canal obturation material: A Cone Beam Computed Tomography Study

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Abstract:

Background: Non-surgical retreatment is considered as the primary treatment option in teeth with post-treatment disease. This involves coronal disassembly including removal of the contents of the previously treated root canals, mainly Gutta percha. Although several techniques such as heat and chemicals have been recommended for this purpose, rotary instruments are currently the most popular means for removal of obturation material. Specific instruments for this, termed Retreatment files, have been marketed, but a vast majority of clinicians rely on conventional rotary files for retreatment cases also. The present study was designed to evaluate and compare the effectiveness of Hero Shaper treatment file and D-Race retreatment file system in removal of root canal obturation material, using Cone Beam Computed Tomography

Materials and Methods: 90 two rooted permanent maxillary 1st premolars were decoronated to standardize root length. Following cleaning and shaping with Hero Shaper rotary file up to 25/4%, obturation was performed with Total Fill BC sealer and gutta-percha. All specimens were randomly divided into Group1 [Hero Shaper (n=45)] and Group2 [D-Race (n=45)]. Retreatment was accomplished using Hero Shaper rotary files of size 25/4% in a forward reciprocating motion in the specimens of Group1. Group2 specimens were retreated using D-Race retreatment file system. Gutta percha solvent was used for both groups. Cone Beam Computed Tomography (CBCT) and volumetric analysis were performed before and after the retreatment procedures.

Results: Data was analyzed using the statistical package SPSS 26.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p < 0.05$. Two tailed Independent T test was used to check the between group analysis. The mean volume of remaining obturation material was lesser in the D-Race retreatment file Group compared to Hero Shaper treatment file group, and this difference was statistically significant ($p < 0.05$).

Conclusion: D-Race retreatment file system showed superior performance than Hero shaper treatment file in removal of obturation material from the root canal system; However complete removal of obturation material was not seen with either system.

Key-words:

Retreatment, Hero Shaper, D-Race, Retreatment file, CBCT

Date of Submission: 02-07-2024

Date of Acceptance: 13-07-2024

I. Introduction:

Endodontic therapy helps retain the tooth that is affected by caries, trauma, non-carious lesions and other pulpal pathology. Studies reveal a high success rate of endodontic therapy, between 85 and 95%, even in the face of all the challenges combating infection in the root canal system.^{1,2,3}

Despite the high success rates and predictability of endodontic therapy, failures can nevertheless happen due to persistent infections or recontamination of the root canal system after endodontic intervention.⁴ Post treatment disease can affect endodontically treated cases in a few instances and non-surgical retreatment procedures may need be performed in order to manage the infection. Non-surgical retreatment when performed successfully, helps in regaining the health of periapical and periradicular tissues.⁵

The different approaches to removing root-filling materials for the purpose of non surgical retreatment, include heated instruments, manual instruments with or without chemical solvents, Gates-Glidden drills, rotary instruments and reciprocation systems.⁶

Hero Shaper (Micro Mega, France) is a second- generation nickel-titanium rotary instrumentation system. These files have 3 sharp helical cross-sections which prevent screw-in effect on the root canal walls, while

contributing to its efficacy.⁷ Although recommended extensively for canal cleaning and shaping, there is limited literature on the ability of Hero shaper system in removing obturation material.

D-Race is a retreatment file system that consists of two files DR1 & DR2, with low degree of taper and apical preparation size among other comparable systems.⁸ The present study evaluated the efficiency of both these file systems in removal of root canal obturation material, while also preserving maximal root dentin.

II. Materials And Methods:

Study design: In vitro experimental study

Study location: The specimen preparation was done in the Department of Conservative Dentistry & Endodontics, Malabar Dental College and Research Centre. Cone beam computed tomography was carried out in the Department of Oral Medicine and Radiology, Malabar Dental College and Research Centre.

Study Duration: October 2022 to December 2022

Sample size: Ninety human maxillary premolars extracted for Orthodontic purpose and untraceable to the contributors were selected and used for the study.

Sample size calculation: Sample size estimation was done using G*Power version 3.1.9.2 with the help of values for standard deviation obtained from published literature. The effect size was 0.7684 and the sample size so as to achieve 95% power and 0.05 α error, was estimated to be 45 per group, making a total of 90.

Subjects & selection method: The study was conducted following approval from the Institution Ethical Committee (Ref. No: IEC/04/CONS-B/MDC/2020). Periapical radiographs were taken to assess the samples to conform to the following criteria.

Inclusion criteria:

Caries free maxillary premolars with two roots and two root canals

Exclusion criteria:

Teeth with immature root apices, irregular anatomy, calcified canals, fracture or craze lines and thin curved roots

Procedure methodology

Specimens were decoronated with a diamond disc at the cemento-enamel junction under copious water cooling, perpendicular to the long axis of the root, maintaining a uniform remaining root length of 14 ± 2 mm from the apex. Working length was determined by inserting an ISO #10K file (Mani Inc, Togichi Japan) until it was just visible at the apical foramen and then reducing the length by 1 mm. Cleaning and shaping was performed with Hero Shaper rotary file (Micro Mega, France) up to #25/04 size as per standard protocol. Irrigation was done with 1ml of 5.25% Sodium hypochlorite during and between each instrument. The removal of debris and smear layer was performed with 5 ml 7% Maleic acid (NICE, Nice chemicals, India) followed by 1 ml 5.25% Sodium hypochlorite. 2 ml distilled water was used as the final flush and in between the above irrigants. After drying with paper points the root canals were coated with Total fill BC sealer (Calcium silicate based bioceramic sealer; FKG Dentaire, Switzerland) using Lentulospiral (Mani Inc, Togichi, Japan). The master cone was inserted 2mm short of the working length. The coronal part of the gutta-percha was cut using obturation pen (Denjoy iFill GP Obturation system, China) until 3–4 mm of gutta-percha remained at the apical one-third, and vertical compaction was done with hand plugger. After this, the coronal two-third was back-filled with warm gutta-percha using Obturation gun (Denjoy iFill GP Obturation system, China).⁹ All root canal treated specimens were kept at 37°C and 100% humidity for 2 weeks in an incubator to simulate in vivo conditions. After this, the specimens were randomly divided into 2 groups.

Group 1:(n=45) Canals to be retreated with Hero Shaper treatment file

Group 2:(n=45) Canals to be retreated with D-Race rotary retreatment file

The specimens of Group 1 were retreated using Carvene Gutta Percha Solvent (Prevest DentPro, USA) and Hero shaper treatment file of size #25/04. The files were used in a torque-controlled cordless endodontic motor (E Connect Pro, Orikam, India) at a speed of 300 rpm and a torque of 2.5 N cm.⁶ Instrumentation was done until apical patency was obtained and the working length was re-established using a 10K file (Mani Inc, Togichi, Japan).

Group 2 specimens were retreated using the same solvent and D-Race rotary retreatment file system. The D-Race retreatment file system include two files DR1 and DR2. The coronal third of the root filling was removed using the DR1 instrument (size 30, 0.10taper) operated at 1000rpm. The DR2 instrument (size 25, 0.04 taper) was used with light apical pressure at 800rpm until the working Length was reached.¹⁰

CBCT images of the specimens were obtained (ProMax 3D ProFace, Planmeca, Finland) with exposure parameters set at 90 Kv, 8Ma and 0.04s. Volumetric evaluation of the amount of obturation material remaining in each canal was estimated using a Romexis software (Planmeca, Helsinki, Finland).

Statistical analysis

Two tailed Independent T test was used to check the between group analysis. Data was analyzed using the statistical package SPSS 26.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p < 0.05$.

III. Result

The mean volume of remaining filling material in Group 1 (Hero shaper) was 0.054 ± 0.005 whereas in Group 2 (D-Race) it was recorded as 0.007 ± 0.003 . This difference was found to be statistically significant. ($p = 0.0001^*$ HERO SHAPER > D-RACE).

Table no 1 : Comparison of remaining obturating material

	GROUP	MEAN VOLUME
VOLUMETRIC ANALYSIS	HERO SHAPER	0.054±0.005
	D-RACE	0.007±0.003
P VALUE (INDEPENDENT T TEST)		0.0001*

* $P < 0.05$ is statistically significant

IV. Discussion

A successful root canal retreatment requires the removal of all existing filling material.¹¹ Any residual obturation material left behind can act as a source of contamination leading to periapical inflammation and delayed healing.¹² Therefore the amount of residual filling material is said to have a direct impact on the long term prognosis of a tooth that is undergoing root canal retreatment.¹³ As literature suggests, NiTi systems are found to be more efficient and safe in removal of the root canal filling material.^{14,15}

Thermoplasticized obturation techniques are found to create better adaptation of gutta percha to root canal walls, improved degree of homogeneity and provide optimum coronal and apical seal when compared to cold lateral condensation.^{16,17} It follows that canals obturated using this method would be most difficult to retreat. Total fill BC sealer is a recently introduced bioceramic sealer that has excellent antibacterial activity, better sealing ability and bond strength as compared to other sealers. It also has good flow, low shrinkage and is insoluble.¹⁸ Therefore Total fill BC sealer was used in the present study along with thermoplasticized obturation to ensure a hermetic seal during obturation.

Hero shaper system is designed with adapted pitch to reduce screw-in effect thereby reducing the chance of extrusion of filling material. The positive rake angle and stiff inner core design of this file ensures sufficient cutting efficiency and less chance of breakage which are both essential during retreatment.¹⁹

D-Race retreatment system comprises of two files of varying length and taper. DR-1 is indicated for use in the coronal third of the root canal. It has a tip size of ISO 30 and a taper of 10% which also has a cutting tip for easy penetration into the root canal filling material. DR-2 has a tip size of 25 and 4% taper and is used for cleaning of the apical 2/3rd.²⁰ Karamifar et al in 2017, Kontogiannis et al in 2019, and Hassan et al in 2022 reported the superior efficacy of D-Race system over other popular retreatment systems.^{21,22,23}

The mean volume of remaining filling material in Group 1 (Hero shaper) was 0.054 ± 0.005 whereas in Group 2 (D-Race) it was recorded as 0.007 ± 0.003 , which was a statistically significant difference. This may be attributed to tip's triangular cross section, high cutting ability, alternating cutting edges, and bullet-shaped design of D-Race system.²⁴ This result supports the report by Rodig et al that the residual filling material was comparatively lesser when using D-Race system as compared to Pro Taper Universal Retreatment files and Hedstrom files.²⁵ Another reason for superior performance for this system might be that the cutting tip and larger taper of the initial file softened the coronal part of the remaining GP by friction over a large surface area, making it easier for the DR2 file to engage and penetrate through the remaining filling material, easier than Hero shaper file.

The general tendency to use regular rotary files for retreatment may be attributed primarily to the concern for root dentin preservation. Most of the retreatment file systems have a larger tip size and/or taper, such as the Protaper Universal Retreatment file system, Mtwo Retreatment file system and R-Endo Retreatment file system.^{26,27,28} Retreatment procedures when carried out using larger instruments are said to decrease the amount of residual filling material.²⁹ However, this can lead to over preparation and decrease in the amount of remaining dentin thickness thus leading to chances of vertical root fracture.³⁰ The D-Race file system used in our study ensured a small, as also, practical apical preparation of size 25.

V. Conclusion

The results of the present study help us conclude that D-Race retreatment files are more efficient than Hero Shaper rotary files in removal of obturating material from canals. D-Race with its superior design features and ability to conserve tooth structure is a viable choice in cases of retreatment.

References

- [1]. Swartz DB, Skidmore AE, Griffin Jr JA. Twenty years of endodontic success and failure. *Journal of endodontics*. 1983 May 1;9(5):198-202.
- [2]. Sjögren UL, Hägglund B, Sundqvist G, Wing K. Factors affecting the long-term results of endodontic treatment. *Journal of endodontics*. 1990 Oct 1;16(10):498-504.
- [3]. Smith CS, Setchell DJ, Hartly FJ. Factors influencing the success of conventional root canal therapy—a five-year retrospective study. *International endodontic journal*. 1993 Nov;26(6):321-33.
- [4]. Salehrabi R, Rotstein I. Endodontic treatment outcomes in a large patient population in the USA: an epidemiological study. *Journal of endodontics*. 2004 Dec 1;30(12):846-50.
- [5]. Monguillhott Crozeta B, Damião de Sousa-Neto M, Bianchi Leoni G, Francisco Mazzi-Chaves J, Terezinha Corrêa Silva-Sousa Y, Baratto-Filho F. A micro-computed tomography assessment of the efficacy of rotary and reciprocating techniques for filling material removal in root canal retreatment. *Clinical oral investigations*. 2016 Nov;20(8):2235-40.
- [6]. Haridas K, Hariharan M, Singh P, Varughese A, Ravi AB, Varma KR. Effect of instrumentation techniques and kinematics on apical extrusion of debris: An in vitro study. *J Contemp Dent Pract*. 2019 Sep 1;20(9):1067-70.
- [7]. Kaptan F, Sert S, Kayahan B, Haznedaroğlu F, Tanalp J, Bayırlı G. Comparative evaluation of the preparation efficacies of HERO Shaper and Nitiflex root canal instruments in curved root canals. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2005 Nov 1;100(5):636-42.
- [8]. Cavenago BC, Ordinola-Zapata R, Duarte MA, del Carpio-Perochena AE, Villas-Bôas MH, Marciano MA, Bramante CM, Moraes IG. Efficacy of xylene and passive ultrasonic irrigation on remaining root filling material during retreatment of anatomically complex teeth. *International endodontic journal*. 2014 Nov;47(11):1078-83.
- [9]. Yulianda SS, Usman M, Margono A. Density comparison of root canal obturation at apical one-third between single cone and downpack-backfill techniques using polidimetylsiloxane sealer. In *Journal of Physics: Conference Series* 2017 Aug 1 (Vol. 884, No. 1, p. 012022). IOP Publishing.
- [10]. Rödiger T, Hausdörfer T, Konietschke F, Dullin C, Hahn W, Hülsmann M. Efficacy of D-RaCe and ProTaper Universal Retreatment NiTi instruments and hand files in removing gutta-percha from curved root canals—a micro-computed tomography study. *International endodontic journal*. 2012 Jun;45(6):580-9.
- [11]. Ng YL, Mann V, Gulabivala K. A prospective study of the factors affecting outcomes of nonsurgical root canal treatment: part 1: periapical health. *International endodontic journal*. 2011 Jul;44(7):583-609.
- [12]. Endo MS, Ferraz CC, Zaia AA, Almeida JF, Gomes BP. Quantitative and qualitative analysis of microorganisms in root-filled teeth with persistent infection: monitoring of the endodontic retreatment. *European journal of dentistry*. 2013 Jul;7(03):302-9.
- [13]. Yang X, Lan J, Ji M, Tsauo C, Gao Y, Zou L. Assessment of the Effectiveness of Supplementary Methods for Residual Filling Material Removal Using Micro-computed Tomography: A Systematic Review and Meta-analysis of In Vitro Studies. *European Endodontic Journal*. 2022 Oct 1;7(3):178-86.
- [14]. Bramante CM, Betti LV. Efficacy of Quantec rotary instruments for gutta-percha removal. *International Endodontic Journal*. 2000 Sep;33(5):463-7.
- [15]. Hülsmann M, Bluhm V. Efficacy, cleaning ability and safety of different rotary NiTi instruments in root canal retreatment. *International endodontic journal*. 2004 Jul;37(7):468-76.
- [16]. O'Sullivan SM, Hartwell GR. Obturation of a retained primary mandibular second molar using mineral trioxide aggregate: a case report. *Journal of endodontics*. 2001 Nov 1;27(11):703-5.
- [17]. Bapna, Rakhi & Makandar, Saleem & Dordi, Jehan & Bapna, Pradeep & Karobari, Mohmed. (2019). Evaluation of voids in thermoplastisized obturation using mta- fillapex sealer. *International Journal of Scientific Research*. 8. 75-76.
- [18]. Sandhu SV, Tiwari R, Bhullar RK, Bansal H, Bhandari R, Kakkar T, Bhusri R. Sterilization of extracted human teeth: A comparative analysis. *Journal of oral biology and craniofacial research*. 2012 Sep 1;2(3):170-5.
- [19]. Kaptan F, Sert S, Kayahan B, Haznedaroğlu F, Tanalp J, Bayırlı G. Comparative evaluation of the preparation efficacies of HERO Shaper and Nitiflex root canal instruments in curved root canals. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2005 Nov 1;100(5):636-42.
- [20]. Garg A, Nagpal A, Shetty S, Kumar S, Singh KK, Garg A. Comparison of time required by D-RaCe, R-Endo and Mtwo instruments for retreatment: an in vitro study. *Journal of clinical and diagnostic research: JCDR*. 2015 Feb;9(2):ZC47.
- [21]. Kontogiannis TG, Kerezoudis NP, Kozyrakis K, Farmakis ET. Removal ability of MTA-, bioceramic-, and resin-based sealers from obturated root canals, following XP-endo® Finisher R file: An ex vivo study. *Saudi Endodontic Journal*. 2019 Jan 1;9(1):8.
- [22]. Karamifar K, Mehra N, Pardis P, Saghir MA. Cleanliness of canal walls following gutta-percha removal with hand files, RaCe and Race plus XP-Endo finisher instruments: a photographic in vitro analysis. *Iranian endodontic journal*. 2017;12(2):242.
- [23]. Hassan E, Sharaan M, Ragab M. Cleaning Efficacy and Debris Extrusion using XP-Endo Finisher and XP-Endo Finisher R as Supplementary Files during Retreatment: An in Vitro Study. *European Endodontic Journal*. 2022;7(1):40.
- [24]. Grischke J, Müller-Heine A, Hülsmann M. The effect of four different irrigation systems in the removal of a root canal sealer. *Clinical oral investigations*. 2014 Sep;18(7):1845-51.
- [25]. Rödiger T, Hausdörfer T, Konietschke F, Dullin C, Hahn W, Hülsmann M. Efficacy of D-RaCe and ProTaper Universal Retreatment NiTi instruments and hand files in removing gutta-percha from curved root canals - a micro-computed tomography study. *Int Endod J*. 2012 Jun;45(6):580-9. doi: 10.1111/j.1365-2591.2012.02014.x. Epub 2012 Jan 20. PMID: 22264204.

- [26]. Fariniuk LF, Azevedo MA, Carneiro E, Westphalen VP, Piasecki L, da Silva Neto UX. Efficacy of protaper instruments during endodontic retreatment. *Indian Journal of Dental Research*. 2017 Jul 1;28(4):400-5.
- [27]. Marques da Silva B, Baratto-Filho F, Leonardi DP, Henrique Borges A, Volpato L, Branco Barletta F. Effectiveness of ProTaper, D-RaCe, and Mtwo retreatment files with and without supplementary instruments in the removal of root canal filling material. *International endodontic journal*. 2012 Oct;45(10):927-32.
- [28]. Garg A, Nagpal A, Shetty S, Kumar S, Singh KK, Garg A. Comparison of time required by D-RaCe, R-Endo and Mtwo instruments for retreatment: an in vitro study. *Journal of clinical and diagnostic research: JCDR*. 2015 Feb;9(2):ZC47.
- [29]. Hassanloo A, Watson P, Finer Y, Friedman S. Retreatment efficacy of the Epiphany soft resin obturation system. *International Endodontic Journal*. 2007 Aug;40(8):633-43.
- [30]. Hülsmann M, Drebenstedt S, Holscher C. Shaping and filling root canals during root canal re-treatment. *Endodontic Topics*. 2008 Sep;19(1):74-124.