Comparative evaluation of retreatment techniques by using different file systems from oval-shaped canals

Rucheet Purba, Snehal S. Sonarkar, Rajesh Podar, Shishir Singh, Shashank Babel, Gaurav Kulkarni

Private Practitioner, Bengaluru, Karnataka, 1Department of Conservative Dentistry and Endodontics, VSPM Dental College and Research Centre, Nagpur, 2Department of Conservative Dentistry and Endodontics, Terna Dental College, Navimumbai, Maharashtra, India

Abstract

Introduction: Endodontic failure resolves after complete removal of obturating material followed by disinfection, cleaning, shaping and three-dimensional obturation.

Materials and Methods: Seventy single-rooted mandibular premolars, with single oval-shaped root canal were included. They were decoronated at a length of 16 mm from the apex. Shaping and cleaning were performed, and obturation was done using the warm lateral compaction technique. The teeth were divided into seven groups according to retreatment procedures (Hand files; ProTaper Universal retreatment files; MTwo® Retreatment system; R-Endo® Retreatment system; ProTaper Universal retreatment files with solvent and ultrasonics; MTwo® R with solvent, and ultrasonics and R-Endo® with solvent and ultrasonics). The data were obtained and subjected to the statistical analysis.

Results: All instrumentation techniques left obturating material with least in Group 6 and maximum Group 5. The mean time taken for complete retreatment procedure was minimum in Group 2 and maximum with Group 1.

Conclusion: MTwo® R with solvent and ultrasonics, R-Endo®, and R-Endo® with solvent and ultrasonics were effective in gutta-percha removal from coronal third, middle third, and apical third, respectively. Significance: Nonsurgical endodontic retreatment using rotary files helps in gaining access to infected teeth. During retreatment procedure, this helps disinfectant to reach in critical areas of the root canal system, thereby decreasing the microbial load, leading to achieve healthy periradicular tissues.

Keywords: Obturation; retreatment; retreatment files; solvent

INTRODUCTION

Endodontic failure is described as condition wherein clinically the treated tooth is symptomatic, and periapical lesion that appears subsequent to endodontic treatment radiographically. These failures occur due to the factors such as access related, missed canals, access cavity perforations, instrumentation related, ledge formation, separated instruments, foreign objects, and obturation related due to coronal leakage. Thus, to eliminate failure and to achieve successful outcome, endodontic retreatment could be performed either by nonsurgical endodontic retreatment (NSERT) or through periradicular surgery. Currently, failure rate is about 14%–16% after initial root canal treatment. This NSERT is an attempt to re-establish healthy periradical tissues. It requires regaining access to the root canal system by removing the obturating material followed by three dimensional cleaning, shaping, disinfection and obturation. Complete removal of obturating material exposes the necrotic tissue remnant that may be responsible for the persistent disease. Removal of gutta-percha and root canal sealer would help in maximizing the ability to disinfect the root canal system.

Address for correspondence:
Dr. Snehal S. Sonarkar, Department of Conservative Dentistry and Endodontics, VSPM Dental College and Research Centre, Digdoh Hills, Hingna, Nagpur, Maharashtra, India.
E-mail: snehalsonarkar@gmail.com

Date of submission: 21.04.2020
Review completed: 26.06.2020
Date of acceptance: 21.07.2020
Published: 10.10.2020

Access this article online

Quick Response Code:  
Website: www.jcd.org.in  
DOI: 10.4103/JCD.JCD_167_20

How to cite this article: Purba R, Sonarkar SS, Podar R, Singh S, Babel S, Kulkarni G. Comparative evaluation of retreatment techniques by using different file systems from oval-shaped canals. J Conserv Dent 2020;23:91-6.
The different methods used for the removal of obturating material are chemical (chloroform, xylene, eucalyptol, orange oil, tetrachloroethylene, methoxyflurane, cinnamon oil, halothane, isoflurane, anise oil, almond oil, and turpentine oil), mechanical (hand and rotary endodontic files), physical (ultrasonic, heat, and laser), and finally, combination techniques (heat and endodontic files, endodontic files and chemicals, Paper points, and chemicals). There are various studies reporting efficacy, cleaning ability, and safety of rotary nickel-titanium (NiTi) instruments. The most commonly used NiTi retreatment systems are ProTaper universal retreatment files, R-Endo® files, and MTwo® R files.

ProTaper retreatment files have three different lengths, unique tapers, and diameters to sequentially remove obturating materials. These files are D1 (cutting tip, size 30, 9% taper) used for coronal third, D2 (noncutting tip, size 25, 8% taper) used in middle third, and D3 (noncutting tip, size 20, 7% taper) used for apical third. MTWO® retreatment files consist of R15/0.05 (tip size 15, 5% taper) and R25/0.05 (cutting tip, size 25, 5% taper). R-Endo system has a noncutting having tip sizes and taper as R1 (25/08) used in coronal third, R2 (25/06) used in middle third and R3 (25/04) aids in obturating material removal from the apical third.

Orange oil is an excellent solvent constituting dlimonene, which is responsible for good solubility. It was found that orange oil does not have any deleterious effect xylol, chloroform on gutta-percha. Orange oil is an excellent solvent comprising limonene, which is responsible for good solubility. It was found that orange oil does not have any deleterious effect on xylol, chloroform on gutta-percha.

Various researches have been done on different file systems, with or without the aid of solvent and ultrasonics in obturating material removal in circular canals. This in vitro experimental study aims to evaluate and compare the efficacy and time taken for complete removal of obturating material by using ProTaper universal retreatment, R-Endo®, and MTWO® Retreatment techniques. The null hypothesis was that these retreatment techniques were unable to remove obturating material in oval-shaped canals.

**MATERIALS AND METHODS**

**Selection of teeth**
Seventy single-rooted mandibular premolars, with single oval-shaped root canal were included. The oval-shaped canals were defined as having a maximum diameter of up to two times greater than minimum diameter of the canal. Oval shape was determined when buccolingual to mesiodistal dimensions ratio is about 1.3:1. The teeth with more than one canal, curved canal, immature apices, root caries, and calcifications were excluded. The teeth were cleaned, autoclaved, and stored in 0.2% thymol. They were decoronated at cemento-enamel junction perpendicular to the long axis of the root such that root length was 16 mm.

**Teeth preparation**
Access cavity preparation was done, and working length was determined by introducing size 10 K-file till it extruded from the apex. The length was measured, and working length was set 1 mm short of measured length. The glide path was established and ProTaper (Dentsply Maillefer, Ballaigues, Switzerland) files were used for cleaning and shaping. Each file was lubricated with Glyde (Dentsply Maillefer, Ballaigues, Switzerland) before introduction in the canal. During preparation, between each file, 2 ml of 5%NaOCl was used as irrigant. The canals were prepared till F2. After complete instrumentation, all specimens were irrigated with 5 ml of 17% liquid ethylenediaminetetraacetic acid followed by 5 ml of saline solution and were dried with corresponding paper points (Dentsply Maillefer, Ballaigues, Switzerland). The canals were obturated with F2 gutta-percha and AH plus sealer (Dentsply Maillefer, Ballaigues, Switzerland) with warm lateral compaction technique. The quality of obturation was deemed adequate when no voids were seen on mesio-distal and bucco-lingual digital radiographs. The teeth were sealed with temporary filling material (Cavit, Detrey, Dentsply) and stored in humidifier at 37°C for 2 weeks.

**Retreatment technique**
The teeth were randomly assigned into seven experimental groups (n = 10). For rotary file system, X-Smart motor was used at 500 rpm speed and 2 Ncm torque. The solvent was not used for Groups 2, 3, and 4.

**Group 1 Hand files**
Two ml of Wonder orange solvent (Pulpdent, USA) was placed in the coronal portions of canal. The smaller Hedstrom files (Mani Inc., Japan) sizes 15 and 20 were used for the removal of obturating material. Once the working length was reached, sizes 25 and 30 K-files were used till they came out clean.

**Group 2 ProTaper Universal retreatment files**
Obturating material was removed using the crown down method. These files were used in brushing action with lateral pressing movements. The D3 file was taken till working length.

**Group 3 MTWO® Retreatment system**
The obturating materials were removed initially using sizes 1–3 Gates Glidden drills coronally. The canals were instrumented using R2 in a brushing action with lateral pressing movement. The files were progressed till working length by applying slight apical pressure. The blades of file and debris on file were inspected frequently.
Group 4 R-Endo® Retreatment system
This file system was used in gentle in and out motion on the canal walls. The R1 and R2 files were used to one-third and two-thirds of the estimated working length, respectively. The R3 was used till the working length for the removal of obturating material.

Group 5 ProTaper Universal retreatment files with solvent and ultrasonics
In addition to the sequence followed for Group 2, 2 ml of Wonder orange solvent was placed in canal and activated using ultrasonics (25 K-file attached to an EMS scaler on a medium power setting 25KHz).

Group 6 MTwo® R with solvent and ultrasonics
The sequence followed was same for Group 3. The use of solvent and ultrasonics was similar to Group 5.

Group 7 R-Endo® with solvent and ultrasonics
The sequence followed was same for Group 4. The use of solvent and ultrasonics was similar to Group 5.

Digital radiographs were taken in both buccolingual and mesio-distal direction. If the digital radiographs revealed remaining gutta-percha, the root canals were reinstrumented.10

Time recorded
Time was recorded with stop watch (in minutes) till the working length was reached (T1). The time taken to change the instrument was excluded. The time required to achieve satisfactory gutta-percha removal was recorded as T2. Total time for retreatment was the sum of T1 and T2.11 All procedures were accomplished by a single-operator eliminate bias.

Sample analysis
Two longitudinal grooves were placed on the outer surface of roots. The teeth were split into two half with a chisel and mallet. Each half was further divided into three parts: coronal, middle, and apical third. Samples were evaluated at ×20 magnification. No attempt was made to distinguish between residual sealer and gutta-percha. The amount of residual filling material was scored according to Ezzie et al.’s criteria [Table 1].12

The presence of material on root canal walls was evaluated individually by three examiners. They were blinded to the methods of retreatment used for each tooth, and scoring was done.

Statistical analysis
Mean values for debris score were tabulated [Table 2] and analyzed using the statistical analysis software MedCalc (MedCalc software for windows, Version 12.7.5, Ostend, Belgium). The result was evaluated using the ANOVA and post hoc Bonferroni test. The P value was considered statistically significant if <0.05. The result stated that all instrumentation techniques left obturating material with no statistically significant difference. However, in Group 6, least obturating material was seen, and maximum was seen in Group 5 [Table 2]. Post hoc Bonferroni test showed remnants in the coronal, middle, and apical third for each group [Table 3] The mean time taken for complete retreatment procedure was found minimum in Group 2 and maximum in Group 1 [Table 4]. The efficacy of groups in terms of mean time taken to complete procedure was ProTaper > R-Endo > ProTaper + ultrasonics > R-Endo + ultrasonics > MTwoR + ultrasonics > H-file [Tables 4 and 5].

DISCUSSION
Single-rooted mandibular first and second premolars were taken as it showed 27% prevalence of oval-shaped canal anatomy.13 Mandibular premolars have an average root length of 14 mm. The teeth were decoronated at 16 mm length from apex, retaining 2 mm of coronal structure for coronal seal. Orange oil solvent was used as it yields the larger number of dentinal tubules free of obturating materials as compared to other solvents.14 Ultrasonics were used as an adjunct in dislodging the remnants of obturating material using the electromagnetic energy.

In the current study, the amount of remaining filling material was evaluated by longitudinal cleavage, and quantitative analysis was done under stereomicroscope with 20X magnification.8,15,16 Debris scores were analyzed according to Ezzie et al.’s criteria.12 This method was chosen because of its simplicity.17,18 Other method of scoring has been given by Hulsmann and Bluhm in 2004 were gutta-percha, and sealer was measured in millimeter, and scoring was done on a scale of 1–7.11

In the present study, no significant difference was found between different techniques of gutta-percha removal. Similar results were found when rotary, reciprocating, and adaptive motion systems were used for the evaluation of gutta-percha removal.19

In this study, ProTaper retreatment file left highest debris. These findings were in accordance with other study,

Table 1: Scoring Criteria according to Ezzie et al.

| Score | Criteria |
|-------|----------|
| 1     | No to slight presence (0%-25%) of obturation debris on the dentinal surface |
| 2     | Some presence (25%-50%) of obturation debris on the dentinal surface |
| 3     | Moderate presence (50%-75%) of the obturation debris on the dentinal surface |
| 4     | Heavy presence (>75%) of obturation debris on the dentinal surface |

Purba, et al.: Evaluation of retreatment techniques
Recently, a study concluded that when chloroform was used as the solvent with MTwo® file performed better as it has a small core diameter and better chip removal capacity with increased chip space that can result in great cutting ability. However, contrast findings were found in other study, wherein ProTaper left significantly lesser gutta-percha and sealer than MTwo®. 

In the current study, debris was present on the canal wall with lower score with group 6 when solvent and ultrasonics were used. The better performance of MTwo® file is attributed to the design of instrument. It has S-shaped cross-section, an increasing pitch length in the apical-coronal direction, cutting tip, and with positive rake angle. It does not require crown-down instrumentation sequence. Further, these files have sharp blades that help the file to cut through canal and reach the apical end-point while by passing the obturating material. These findings were in accordance with other study, wherein MTwo® file performed better as it has a small core diameter and better chip removal capacity with increased chip space that can result in great cutting ability. However, contrast findings were found in other study, wherein ProTaper left significantly lesser gutta-percha and sealer than MTwo®. 

In this study, ProTaper retreatment file removed gutta-percha fastest when compared to other rotary systems due to their specific flute design. The file not only cut gutta-percha but also the superficial layer of dentin during the root filling removal. Other features are progressive tapers of D1, D2, and D3 files which make it possible to shape specific sections of a root canal with one file. The flute design and rotary motion cut the large amount of gutta-percha around the instrument and direct it toward the orifices. These findings wherein contrast with other study where significant difference was found with ProTaper over RaCe, K3, and H Files in the removal of obturating material.

Earlier studies reported that R-Endo® retreatment files and H-files have similar effectiveness in removing filling material in straight root canals and in curved canals. Similar findings were seen in the current study. However, other studies concluded that R-Endo® retreatment files were less effective in removing filling material from root canal walls than manual instruments. This might be due to the fact that K-filices were used in combination with H-files for gutta-percha removal which seemed to be advantageous.

In this study, NiTi rotary files took less retreatment time than hand files. This could be attributed to the gutta-percha plasticization resulting from instrument rotation which results in softened gutta-percha that is less resistant, easy
Failure of NiTi instrument was not observed in the present study. This can be attributed to the fact that, each instrument was discarded after retreatting five canals thus reducing substantially the possibility of instrument separation.[10] Furthermore, the null hypothesis was rejected as all groups were effective in removing obturating material. The result of this study would be biased since one of the groups had ProTaper retreatment files. It is known that D1, D2, and D3 are the same as F3, F2, and F1 but with different lengths and in sequence. One of the limitations of this study would be the use of stereomicroscope for the evaluation of obturating material remnants.

These findings were in accordance with other study, wherein MTwo® file performed better as it has a small core diameter and better chip removal capacity with increased chip space that can result in great cutting ability.[21,22]

CONCLUSION

Within the limitations, it can be concluded that none of the retreatment techniques completely cleaned the oval-shaped canals. MTwo® R files with solvent and ultrasonics were most effective in gutta-percha removal from coronal third, R-Endo® was effective in middle third and R-Endo® with solvent and ultrasonics was effective in the apical thirds. Further, ProTaper Universal retreatment files took the minimum time for gutta-percha removal. Thus, for the success of NSERT complete removal of previous endodontic material is required for the elimination of endodontic microflora from the root canal system. More studies should be carried out using other endodontics file system to evaluate the efficacy in oval-shaped canals.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Lovdahl PE. Endodontic retreatment. Dent Clin North Am 1992;36:473-90.
2. Torabinejad M, Coral R, Handysides R, Shabahang S. Outcomes of nonsurgical retreatment and endodontic surgery: A systematic review. J Endod 2009;35:930-7.
3. Stabholz A, Friedman S. Endodontic retreatment–case selection and technique. Part 2: Treatment planning for retreatment. J Endod 1988;14:607-14.
Puria, et al.: Evaluation of retreatment techniques

4. Good ML, McCnammon A. An removal of gutta-percha and root canal sealer: A literature review and an audit comparing current practice in dental schools. Dent Update 2012;39:703-8.

5. Pécora JD, Spanó JC, Barbini EL. In vitro study on the softening of gutta-percha cones in endodontic retreatment. Braz Dent J 1993;4:43-7.

6. Jou YT, Karabacak B, Levin J, Liu D. Endodontic working width: Current concepts and techniques. Dent Clin North Am 2004;48:323-35.

7. Zmener O, Pameijer CH, Banegas G. Effectiveness in cleaning oval-shaped root canals using Anatomic Endodontic Technology, ProFile and manual instrumentation: A scanning electron microscopic study. Int Endod J 2005;38:356-63.

8. Giuliani V, Cocchetti R, Pagavino G. Efficacy of ProTaper universal retreatment files in removing filling materials during root canal retreatment. J Endod 2008;34:1381-4.

9. Schirmeister JF, Wirbas KT, Meyer KM, Altenburger MJ, Hellwig E. Efficacy of different rotary instruments for gutta-percha removal in root canal retreatment. J Endod 2006;32:469-72.

10. Troian CH, Só MV, Figueiredo JA, Oliveira EP. Deformation and fracture of Radie and K3 endodontic instruments according to the number of uses. Int Endod J 2008;39:616-25.

11. Hültmann M, Bluhm V. Efficacy, cleaning ability and safety of different rotary NiTi instruments in root canal retreatment. Int Endod J 2004;37:468-76.

12. Ezzie E, Fleury A, Solomon E, Spears R and He J. Efficacy of retreatment techniques for resin based root canal obturating material. J Endod 2006;32:341-4.

13. Wu MK, R'oris A, Barkis D, Wesselink PR. Prevalence and extent of long oval canals in the apical third. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;89:739-43.

14. Zaccaro Scelza MF, Lima Oliveira LR, Carvalho FB, Côrte-Real Faria S. In vitro evaluation of macropage viability after incubation in orange oil, eucalyptol, and chloroform. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;102:e24-7.

15. Tazdemir T, Er K, Yildirim T, Celik D. Efficacy of three rotary NiTi instruments in removing gutta-percha from root canals. Int Endod J 2008;41:191-6.

16. Só MV, Saran C, Magro ML, Vier-Pelisser FV, Munhoz M. Efficacy of ProTaper retreatment system in root canals filled with gutta-percha and two endodontic sealers. J Endod 2008;34:1223-5.

17. Somma F, Cammarota G, Plotino G, Grande NM, Pameijer CH. The effectiveness of manual and mechanical instrumentation for the retreatment of three different root canal filling materials. J Endod 2008;34:466-9.

18. Martfai K, Mercade M, Plotino G, Duran-Sindreu F, Bueno R, Roig M. Efficacy of three different rotary files to remove gutta-percha and Resilon from root canals. Int Endod J 2010;43:1022-8.

19. Crozeta BM, Silva-Sousa YT, Leoni GB, Mazz-Chaves JF, Fantinato T, Baratell-Filho F et al. Micro-Computed Tomography Study of Filling Material Removal from Oval-shaped Canals by Using Rotary, Reciprocating, and Adaptive Motion Systems. J Endod 2016;42:793-7.

20. Chandrasekar, Ebenezar AV, Kumar M, Sivakumar A. A comparative evaluation of gutta percha removal and extrusion of apical debris by rotary and hand files. J Clin Diagn Res 2014;8:ZC110-ZC114. doi:10.7860/JCDR/2014/10203.5199.

21. Schäfer E, Oitzinger M. Cutting efficiency of five different types of rotary nickel-titanium instruments. J Endod 2008;34:198-200.

22. Vatapur M. Efficacy of two rotary systems in removing gutta-percha and sealer from the root canal walls. Iran Endod J 2011;6:69-73.

23. Bhagavaldas MC, Diwan A, Kusumvali S, Pasha S, Devale M, Chava DC. Efficacy of two rotary retreatment systems in removing Gutta-percha, and sealer during endodontic retreatment with or without solvent: A comparative in vitro study. J Conserv Dent 2017;20:12-6.

24. Horvath SD, Altenburger MJ, Naumann M, Wolkowitz M, Schirmeister JF. Cleanliness of dentinal tubules following gutta-percha removal with and without solvents: A scanning electron microscopic study. Int Endod J 2009;42:1032-8.

25. Fenoul G, Meless GD, Pérez F. The efficacy of R-Endo rotary NiTi and stainless-steel hand instruments to remove gutta-percha and Resilon. Int Endod J 2010;43:135-41.

26. Gergi R, Sabbagh C. Effectiveness of two nickel-titanium rotary instruments and a hand file for removing gutta-percha in severely curved root canals during retreatment: An ex vivo study. Int Endod J 2007;40:532-7.

27. Unal GC, Kaya BU, Taq AG, Keçeci AD. A comparison of the efficacy of conventional and new retreatment instruments to remove gutta-percha in curved root canals: An ex vivo study. Int Endod J 2009;42:344-50.

28. Bramante CM, Betti LV. Efficacy of Quantec rotary instruments for gutta-percha removal. Int Endod J 2000;33:463-7.

29. Barrieshi-Nusair KM. Gutta-percha retreatment: Effectiveness of nickletitanium rotary instruments versus stainless steel hand files. J Endod 2002;28:454-6.

30. Ferreira JJ, Rhodes JS, Ford TR. The efficacy of gutta-percha removal using ProFiles. Int Endod J 2001;34:267-74.

31. Gu LS, Ling JQ, Wei X, Huang XY. Efficacy of ProTaper Universal rotary retreatment system for gutta-percha removal from root canals. Int Endod J 2008;41:288-95.