RESEARCH ARTICLE

Comparative Evaluation of Debris Extruded Apically by Different File Systems during Retreatment of Root Canals with or without Use of Solvent

Vasundhara Shivanna[1], Karishma Dixit[2]

Abstract

Objectives: To evaluate the apical extrusion of debris during removal of the root canal filling material by H-files, ProTaper retreatment (PTR) files, and Mtwo retreatment (MtwoR) files with and without the use of a solvent.

Materials and methods: Ninety extracted human mandibular premolar teeth were used. All the teeth were prepared with ProTaper universal files (Dentsply Maillefer) up to size F3 and obturated using a F3 gutta-percha cone with an AH 26 sealer. After 1 week, the teeth were divided into three groups based on the retreatment file systems used. Each group was divided into subgroups I and II based on whether a solvent was used or not, group IA (H-file with solvent); group IB (H-file without solvent); group IIA (PTR with solvent); group IIB (PTR without solvent); group IIIA (MtwoR with solvent); group IIIB (Mtwo without solvent), and the retreatment procedure was carried out. The debris extruded was collected in Eppendorf tubes and the mean weight of debris extruded was measured. Data were analyzed using the *t* test and one-way ANOVA.

Results: The MtwoR files resulted in less debris extrusion followed by the PTR files and then the H-files with significant difference between all the groups. Irrespective of the file system used, the use of a solvent resulted in significantly less debris extrusion.

Conclusion: None of the file systems could avoid apical extrusion of debris during retreatment but the MtwoR files produced significantly less debris extrusion compared to the other two groups. The use of a solvent significantly reduced debris extrusion.

Clinical significance: Postoperative complications after endodontic retreatment vary with the type of file system used and also with the use of a solvent.

Keywords: Apical extrusion, Electronic weighing machine, Endodontic retreatment, H-files, MtwoR, ProTaper retreatment, Solvent.

CODS Journal of Dentistry (2018): 10.5005/jp-journals-10063-0036

Introduction

Endodontic treatment has a success rate of 62–96%.[1] Treatment failure may occur due to persistence of infection in missed or uninstrumented canals, dentinal tubules or the canal complexities, or due to iatrogenic errors or extraradicular infections.[2] Nonsurgical retreatment is the first approach for the management of an endodontically failed tooth.[3]

The aim of nonsurgical endodontic retreatment is to not only remove the root canal filling completely but also ensure effective decontamination of the root canal system so as to establish healthy periapical tissues.[4] During the retreatment procedure, filling materials, necrotic tissues, bacteria, or irrigants may be undesirably pushed into the periapical tissues. This can result in pain, swelling, and discomfort to the patient.[5] A greater amount of debris extrusion will result in greater reaction.[6] The apical extrusion of debris is affected by the number of instruments used, the instrumentation technique, instrument design, kinematics used, the irrigating solution and device, and the root canal morphology.[7]

Root canal fillings may be removed using hand files, rotary files, gates glidden drills, application of heat, and with or without the aid of solvents. Recently, Nd:YAG lasers have been used for retreatment. The ProTaper retreatment (PTR) and Mtwo retreatment (MtwoR) files have been specially designed for removing root canal fillings.[8] The ProTaper Universal retreatment files (Dentsply Maillefer) consist of three instruments (D1, D2, D3) for removing the filling material from the coronal, middle, and apical third of the canal. The MtwoR files (Vdw) consist of two instruments (R1 and R2) with cutting tips for effective removal of root canal fillings.[9]

[1,2]Department of Conservative Dentistry and Endodontics, College of Dental Sciences, Davangere, Karnataka, India

Corresponding Author: Karishma Dixit, Department of Conservative Dentistry and Endodontics, College of Dental Sciences, Davangere, Karnataka, India, Phone: +91 8880467448. e-mail: karishmadixit@gmail.com

How to cite this article: Shivanna V, Dixit K. Comparative Evaluation of Debris Extruded Apically by Different File Systems during Retreatment of Root Canals with or without Use of Solvent. CODS J Dent 2018;10(2):35–38.

Source of support: Nil

Conflict of interest: None

Till date, no study has compared the apical extrusion of debris caused by H-files, the PTR files, and the MtwoR files during endodontic retreatment with and without the use of a solvent.

Therefore, the aim of this *in vitro* study was to compare the amount of debris extruded apically by H-files, PTR files, and MtwoR files during endodontic retreatment with and without using a solvent (Figs 1 and 2).

Materials and Methods

Selection of Teeth

Ninety extracted human mandibular premolar teeth with single, straight, and oval canals were selected and stored in saline until use.

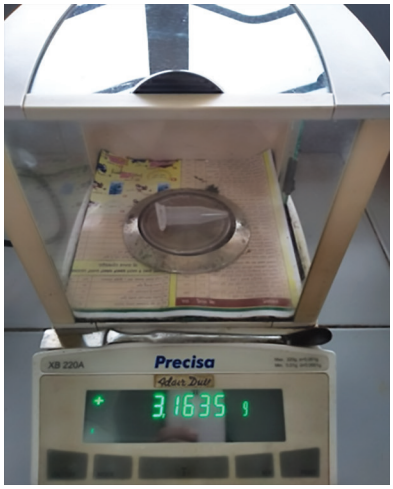

Fig. 1: Weighing of the Eppendorf tubes using an electronic weighing machine

Fig. 2: Tooth and Eppendorf tube assembly mounted on a glass vial

Exclusion Criteria

Teeth with calcifications, immature apices, and developmental disturbances were excluded.

Methodology

All the teeth were decoronated using a diamond disc mounted on a straight handpiece with water coolant to standardize the length to 15.0 mm. Patency was established with a #10 K-file. Working length (WL) was determined by subtracting 1.0 mm from the length at which a #15 K-file was visible at the apical foramen. With a #15 K-file in place, the external root surface of all the teeth was coated with two coats of nail varnish leaving apical 1.0 mm.

All the specimens were then prepared with the ProTaper Universal files (Dentsply Maillefer) in the sequence of S1, SX, S2, F1, F2, and F3. 2 mL of 2.5% NaOCl and normal saline were used for irrigation between each file. The root canal space was then dried with paper points and obturated with a F3 gutta-percha (GP) cone and an AH-26 sealer (Dentsply).

All the teeth were then stored in an incubator at 37°C for 7 days to allow complete setting of the sealer.

Debris Collection and Retreatment

For the debris collection during the retreatment procedure, Eppendorf tubes were used. A hole was cut on the stopper of the tube and the empty tube was then weighed using an electronic weighing machine to 10^{-4} g precision. For each tube, three consecutive measurements were taken and the mean value was recorded.

The Eppendorf tube were then mounted over a glass vial and a 27-gauge needle was placed over the stopper to equalize air pressure. The glass vials were covered with aluminum foil to avoid operator bias. The teeth were randomly divided into three groups based on the retreatment file system used and mounted over the Eppendorf tube and glass vial assembly. The groups were further subdivided based on whether a solvent was used

Group Ia: The retreatment procedure was carried out using the H-files 30, 25, 20 with use of a solvent till the WL was reached.

Group Ib: The retreatment procedure was carried out using H-files 30, 25, 20 without using a solvent till the WL was reached.

Group IIa: The retreatment procedure was carried out with the PTR files in the sequence of D1, D2, D3 at 500 rpm speed and 3 N cm torque with use of a solvent till the WL was reached.

Group IIb: The retreatment procedure was carried out with the PTR files in the sequence of D1, D2, D3 at 500 rpm speed and 3 N cm torque without using a solvent till the WL was reached.

Group IIIa: The retreatment procedure was performed using MtwoR files R1 and R2 in simultaneous technique at 300 rpm speed and 1.2 N cm torque with use of a solvent till the WL was reached.

Group IIIb: The retreatment procedure was performed using MtwoR files R1 and R2 in simultaneous technique at 300 rpm speed and 1.2 N cm torque without using a solvent till the WL was reached.

New set of files were used for each tooth. Distilled water was used for irrigation throughout the procedure. The retreatment procedure was deemed complete when no GP remnant was seen on the flutes of the file. After the retreatment procedure was completed, the tooth was removed from the Eppendorf tube and the debris adhered to the root apex of the tooth was washed off with distilled water into the tube. The Eppendorf tubes were then placed in an incubator at 70°C for 5 days to allow the moisture to evaporate.

The Eppendorf tubes containing the dry debris were weighed again using the same electronic weighing machine and the mean weight of three consecutive measurements was recorded.

Weight of apically extruded debris was calculated by the following formula:

Weight of the apically extruded debris = mean weight of the Eppendorf tube with dry debris − mean weight of the empty Eppendorf tube

Statistical Analysis

The mean weight of apically extruded debris was calculated for each group. Data were analyzed using the independent *t* test and one-way ANOVA at 95% confidence level ($p < 0.05$).

Results

The intragroup comparison of the mean weight of apically extruded debris is depicted in Table 1. The intergroup comparison of mean weight of apically extruded debris is depicted in Tables 2 and 3. It was found that irrespective of the file system used, significantly

Table 1: Intragroup comparison of mean weight of debris extruded during retreatment

Solvent group	*Nonsolvent group*	*Mean difference*	*p value*
Group IA	Group IB	−0.0003133	0.000*
Group IIA	Group IIB	−0.0003800	0.002*
Group IIIA	Group IIIB	−0.0004267	0.000*

*Significant difference at $p < 0.05$

Table 2: Mean weight of debris extruded during retreatment with a solvent

Groups	*N*	*Mean*	*Standard deviation*
Group IA	15	0.002153	0.0001506
Group IIA	15	0.001313	0.0002503
Group IIIA	15	0.001980	0.0002757

Table 3: Mean weight of debris extruded during retreatment without a solvent

Groups	*N*	*Mean*	*Standard deviation*
Group IB	15	0.001600	0.0003251
Group IIB	15	0.002467	0.0001718
Group IIIB	15	0.001747	0.0002063

more debris was extruded when no solvent was used for retreatment. Among the file systems, the MtwoR files extruded the least debris followed by the PTR files and then the H-files with significant difference between all the three.

Discussion

The aim of nonsurgical endodontic retreatment is to completely remove the existing filling materials and address the existing pathologies.[10] Apical extrusion of debris and filling materials during retreatment can result in postoperative pain, inflammation, and failure of healing. Compared to primary root canal therapy, the nonsurgical retreatment procedure leads to more extrusion apically.[11]

Several techniques have been advocated for the removal of root canal fillings. These include hand and rotary instruments with and without aid of solvents, ultrasonics, and lasers.[8] The hand H-files because of their positive rake angle remove the root filling material in chunks and pieces.[12] Rotary nickel-titanium (NiTi) instruments generate frictional heat that helps to plasticize the GP and ease its removal.[13]

In the present study, the MtwoR files caused significantly less debris extrusion compared to the PTR and H-files. This could be related to several factors: the active cutting tips of both the MtwoR files that actively engage and pull the GP coronally, the less number of file systems employed in the MtwoR files, and the "S"-shaped cross-section of the these files, which provides greater space for augering the debris coronally compared to the triangular cross-section of the PTR files.[14–16] The hand H-files resulted in maximum debris extrusion. This result is in accordance to previous studies, which state that rotary instruments position the debris between the blades and auger it coronally.[11] Also the hand files act as a piston in the tube, which results in greater extrusion of debris whereas the rotary instruments act as a screw conveyor that transports the debris coronally.[17]

It was found that the use of a solvent during the retreatment procedure resulted in less debris extrusion. This can be explained by the fact that the solvents result in a thin film of GP and sealer on the canal walls and thus a less extrusion through the apex.

Although decoronation of teeth does not mimic clinical situations, the specimens were decoronated to standardize the specimens by eliminating variables such as crown anatomy and root canal length.[4] In the present study, the single cone technique with an AH-26 sealer was used as the single GP cone with sealer cement results in a uniform core of the filling material. This prevents the failures observed in multiple cone techniques.[18]

Distilled water though not the preferred root canal irrigant was used during the retreatment procedure because the use of saline or sodium hypochlorite may have a positive effect on the weight of debris extruded.[19] No attempt was made to simulate the periapical tissues as the floral foam used may absorb the extruded irrigant and debris and interfere with the results.[7] The Myers and Montgomery model is the most widely accepted and commonly used system for assessing the apically extruded debris and was thus used in this study.[20]

Conclusion

Within the limitations of this *in vitro* study, it was found that none of the file systems could prevent apical extrusion of debris during the retreatment procedure. The rotary files because of their screwing action resulted in less debris extrusion than hand files. Among the rotary files, the MtwoR because of its cross-section, active tip, and fewer instrument system resulted in significantly less debris extrusion than the PTR files. Use of chemical solvents significantly reduced the apical extrusion of debris.

References

1. Oyama KO, Siqueira EL, Santos MD. In vitro study of effect of effect of solvent on root canal retreatment. Braz Dent J 2002;13(3):208–211. DOI: 10.1590/S0103-64402002000300014.
2. Torabinejad M, Handysides R, Shabahang S. Outcomes of non-surgical retreatment and endodontic surgery: a systematic review. J Endod 2009;35(7):930–937. DOI: 10.1016/j.joen.2009.04.023.
3. Marfisi K, Mercade M, Plotino G, et al. Efficacy of three different rotary files to remove gutta-percha and Resilon from root canals. Int Endo J 2010;43(11):1022–1028. DOI: 10.1111/j.1365-2591.2010.01758.x.
4. Turker SA, Uzunoglu E, Salgam BC. Evaluation of the amount of apically extruded debris during retreatment of root canals filled by different obturation techniques. Niger J Clin Pract 2015;18(6):802–806. DOI: 10.4103/1119-3077.158140.
5. Vikram M. Comparison of apically extruded debris retreatment procedure by two types of endodontic instruments. Int J Recent Surg Med Sci 2017;3(1):7–9.
6. Huang X, Ling J, Wei X, et al. Quantitative evaluation of debris extruded apically using Pro Taper universal Tulsa rotary system in endodontic retreatment. J Endod 2007;33(9):1102–1105. DOI: 10.1016/j.joen.2007.05.019.
7. Gungor. TJ. Apical extrusion of debris: a literature review on inherent occurrence during root canal treatment. Int Endod J 2014;47(3): 211–221. DOI: 10.1111/iej.12137.
8. Hwang JI, Chuang AH, Sidow SJ, et al. The effectiveness of endodontic solvents to remove endodontic sealers. Mil Med 2015;180(3):92–95. DOI: 10.7205/MILMED-D-14-00379.

9. Khedmat S, Azari A, Shamshiri AR, et al. Efficacy of ProTaper and Mtwo retreatment files in removal of gutta-percha and gutta flow from root canals. Iran Endod J 2016;11(3):184–187. DOI: 10.7508/iej.2016.03.007.
10. Ruddle CJ. Non-surgical retreatment. J Endod 2004;30(12):827–845. DOI: 10.1097/01.don.0000145033.15701.2d.
11. Kasam S, Mariswamy AB. Efficacy of different methods for removing root canal filling material in retreatment- an in-vitro study. J Clin Diagn Res 2016;10(6):ZC06–ZC10. DOI: 10.7860/JCDR/2016/17395.7904.
12. Hulsmann M, Stotz S. Efficacy, cleaning ability and safety of different devices for GP removal in root canal treatment. Int Endod J 1997;30(4):227–233. DOI: 10.1111/j.1365-2591.1997.tb00702.x.
13. Bernardes RA, Duarte MH, Vivan RR, et al. Comparison of three retreatment techniques with ultrasonic activation in flattened canals using micro-computed tomography and scanning electron microscopy. Int Endod J 2015;49(9):890–897. DOI: 10.1111/iej.12522.
14. Saberi S, Shahraki S, Ebrahimipour S. Apical extrusion of intracanal bacteria with single file and multifile rotary instrumentation systems. J int Soc prevent Communit Dent 2017;7(5):292–296. DOI: 10.4103/jispcd.JISPCD_199_17.
15. Cicek E, Kocak MM, Kocak S, et al. Comparison of the amount of apical debris extrusion associated with different retreatment systems and supplementary file application during retreatment process. J Conserv Dent 2016;19(4):351–354. DOI: 10.4103/0972-0707.186456.
16. Ehsani M, Farhang R, Harvandi A, et al. Comparison of apical extrusion of debris by using single file, full sequence rotary and reciprocating systems. J Dent (Tehran) 2016;13(6):394–399.
17. Kumar GP, Godavarthy DS, Yarlagadda M, et al. Apical extrusion of debris in mesiobuccal root maxillary molars with five rotary file systems. J Clin Diagn Res 2018;12(5):ZC05–ZC09. DOI: 10.7860/JCDR/2018/34261.11470.
18. Pereira AC, Nishiyama CK, Pinto LC. Single cone obturation technique: a literature review. RSBO 2012;9(4):442–447.
19. Uzunoglu E, Gorduysus M. Apical extrusion of debris and irrigant using novel preparation systems. J Contemp Dent Prac 2014;15(4):423–427. DOI: 10.5005/jp-journals-10024-1556.
20. Gkampesi S, Mylona Z, Zarra T, et al. Assessment of apical extrusion of debris during endodontic retreatment with 3 rotary nickel-titanium retreatment systems and hand files. Balk J Dent Med 2016;20:22–28. DOI: 10.1515/bjdm-2016-0003.