Original Article

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Dentistry Section

The Comparative Efficacy of Different Files in The Removal of Different Sealers in Simulated Root Canal Retreatment- An In-vitro Study

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ABSTRACT

Introduction: Root canal treatment enjoys a high success rate all over the world and has saved billions of teeth from extraction. However, there are instances of failure, the main causes being insufficient cleaning and inadequate obturation. In such cases the most conservative treatment option would be non-surgical retreatment. It requires regaining access to the entire root canal system through removal of the original root canal filling thus permitting further cleaning and re- obturation. Removal of gutta-percha and sealer becomes a critical step to gain access to the root canal system, remove necrotic tissue debris, bacteria and infected dentin.

Aim: To compare and evaluate the efficacy of manual hand Hedstrom files and two rotary retreatment file systems ProTaper Universal retreatment files and Mtwo^{R} (retreatment) files in the removal of root canal filling material during root canal retreatment and the influence of the type of sealers zinc oxide eugenol and AH plus on the presence of remaining debris in the reinstrumented canals in the apical, middle and coronal third.

Materials and Methods: Sixty single rooted human premolar teeth were divided into 3 Groups of 20 teeth each Group I (20 Teeth): prepared using hand K Files, Group II (20 Teeth): prepared using ProTaper rotary system and Group III (20 Teeth): prepared using Mtwo rotary system. In groups- IA, IIA, IIIA: (10 teeth each) Obturation was done using Zinc Oxide Eugenol sealer and gutta percha. In groups- IB, IIB, IIIB: (10 teeth each) obturation was done with AH Plus sealer and gutta percha. All the teeth were subjected to retreatment. Groups IA and IB with Hedstrom files, Groups IIA and IIB with ProTaper retreatment files and for Groups IIIA and IIIB with Mtwo retreatment Files. The roots were longitudinally split and were observed under a stereomicroscope for remaining amount of filling material on the canal walls. Statistical analysis was done using One–way ANOVA (Analysis of variance) test and Tukey HSD Test.

Results: Mtwo^{R} files showed statistically significant difference in the removal of filling material in the apical third and ProTaper R in the coronal and apical thirds. Better cleaning efficacy was seen in canals obturated with zinc oxide eugenol sealer. Mtwo^{R} files showed better removal of filling material than ProTaper R followed by Hedstrom files, even though there was no statistically significant difference.

Conclusion: None of the instrument group showed complete removal of the filling material. It was easier to remove zinc oxide eugenol sealer than AH plus sealer.

Keywords: Hedstrom files, Mtwo^{R} files, Obturation, ProTaper

INTRODUCTION

Maximum removal of gutta percha and sealer followed by re-instrumentation is very crucial for successful re-treatment. As the bacteria or fungi surviving and thriving under the gutta percha and sealer have to be removed [1-3]. Gutta percha can be removed using K or H files along with chemical solvents. Alternatively, it can also be removed from the coronal portion using gates glidden drills or heated pluggers followed by the use of ultrasonics, lasers or Ni Ti rotary files for the remaining part of the canal [4,5]. Pro-Taper instruments (Dentsply-Maillefer Ballaigues, Switzerland) have a convex triangular cross-sectional design with different shafts. A new NiTi rotary system, ProTaper Universal Tulsa (Dentsply Tulsa, Tulsa,) is introduced. This new system is integrated with 3 ProTaper retreatment files, D1, D2, D3. The 3 ProTaper Universal System retreatment files (PTUS) are designed to facilitate the removal of filling material. Each file has different lengths, tapers, and apical tip diameters. Mtwo Retreatment Files consist of two instruments of 21mm length with active cutting tip: R1 (size 15, 0.05 taper) and R2 (size 25, 0.05 taper). They have S- shaped cross-section but a shorter pitch length to enhance the advancement of the file into the filling material. They are used at a speed of 250-350rpm and a torque of 120gcm. These instruments are characterized by two cutting edges, which cut dentine effectively [6]. Thus, the purpose of this in vitro study was to evaluate and compare the efficacy of two rotary retreatment file systems: ProTaper universal retreatment files, mtwo retreatment files and hand files (Hedstrom Files) in the removal of root canal filling material during root canal retreatment and the influence of the type of sealers zinc oxide eugenol and AH plus on the presence of debris of filling material in re-instrumented canals in single rooted mandibular premolars.

MATERIALS AND METHODS

This in vitro study was carried out over a period of 6 months in the Department of Restorative Dentistry, College of Dental Sciences, Jazan, Saudi Arabia. 60 single rooted human premolar teeth extracted for orthodontic reasons were collected. Inclusion criteria: single rooted teeth having patent and almost straight canals without bi/ trifurcation were included. Exclusion criteria: To minimize the variables associated with the study, teeth with white spot lesions, caries, restorations, erosions and cracks were excluded from the study. The collected teeth were disinfected and stored as per OSHA (Occupational Safety and Health Associated Hazards) regulations. Specimen preparation-soft tissue and calculus were mechanically removed from the root surface of 60 selected specimens. The teeth were verified radiographically for having patent and almost straight canal. The selected teeth were stored in the containers containing normal isotonic saline at room temperature and were used within one month of extraction.

Canal preparation-Group I (20 Teeth): The root canal space was prepared using hand K Files in a step back sequence to an apical size of 20 number file size at 1mm from canal terminus or apical foramen, resulting in a 5% canal taper.

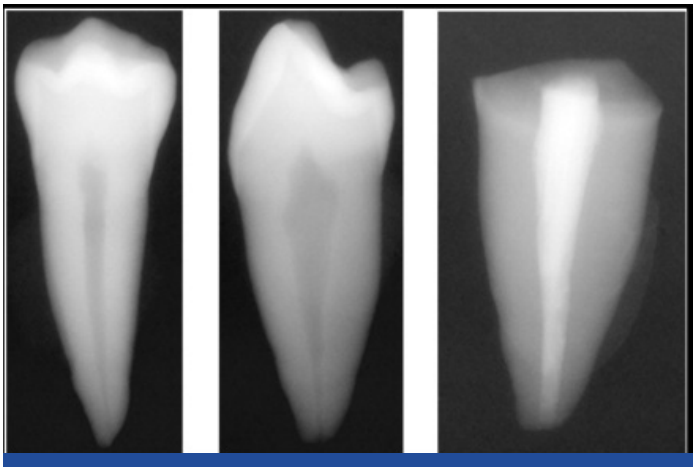
Group II (20 Teeth): The root canal space was prepared using ProTaper rotary system in crown down sequence to an apical size of 20 [Table/Fig-1], 1mm from canal terminus, resulting in a 7% taper.

Group III (20 Teeth): The root canal space was prepared with M two rotary system using simultaneous shaping technique to an apical size of 20, 1mm from canal terminus resulting in a 6% taper. The crowns of all the teeth were sectioned at the cement enamel junction using a water cooled diamond disc, so that length of all roots was 15mm. Decoronation was carried out to ensure standardization of specimens by eliminating some variables, such as anatomy of the dental crown and access to root canals thereby allowing more reliable comparison between the proposed retreatment techniques.

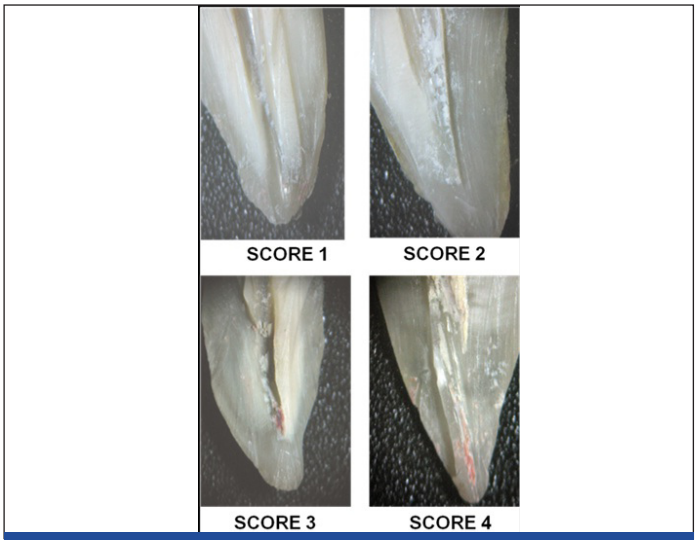
The root canals were irrigated in between each file with 3% sodium hypochlorite and saline alternatively. The smear layer was removed using EDTA followed by sodium hypochlorite.

Upon completion of instrumentation as per the standard procedure, the canal was flushed with saline as the final irrigant and dried using absorbent paper points. Groups IA, IIA, IIIA: (10 teeth each) obturation was done using zinc oxide eugenol sealer and gutta-percha using lateral condensation obturation technique. Groups IB, IIB, IIIB: (10 teeth each) obturation was done using AH plus sealer and gutta-percha points (ISO no. 15-30; 2% taper) (Dentsply Maillefer) using lateral condensation obturation technique. The access cavities were restored using Glass Ionomer Cement (GC Asia). All the teeth were stored at 37°C in artificial saliva for 30 days for the complete setting of the sealer. Retreatment technique: The coronal filling was removed to gain access to the root canal. The root canals were irrigated in between each file with 3% sodium hypochlorite and saline alternatively during canal re-preparation. Groups IA, IB: Gutta-percha and sealer were removed using hedstrom files. Size 30 K File was the final file used to the working length so that apical diameter of each root canal was 0.30 mm. Group IIA, IIB: ProTaper Retreatment Files D1, D2 and D3 were used in the coronal, middle and apical thirds. 30 size F3 File was the final file used to the working length so that apical diameter of each root canal was 0.30 mm and the taper of canal was 9%. Group IIIA, IIIB: Mtwo retreatment files: The canals were instrumented using Mtwo^{R} files, R 15/0.05 and R 25/0.05 with simultaneous shaping technique followed by a final file size of 30/0.06. ProTaper Retreatment files (500-750 rpm) and Mtwo retreatment files (300 rpm) were driven with anthogyr 16:1 gear reduction hand piece. As the gutta percha was sufficiently plasticized by the rotary files, gates glidden drills or ultrasonic tips were not used. Retreatment was deemed complete when the last file reached the working length, there was no filling material covering the instrument, and the canal walls were smooth and free of visible debris. Each instrument was discarded after use in 5 canals, and all the samples were prepared by a single operator.

[Table/Fig-1]: Samples selected and sample preparation.



[Table/Fig-2]: Radiographs showing almost straight, patent canal & obturation.



[Table/Fig-3]: Stereomicroscopic images of the apical third of the samples with scoring criteria.

Specimen evaluation: All the teeth were grooved buccolingually with a diamond disk and split longitudinally. Both halves of the root canal were photographed with (Canon IXUS 105) under a stereomicroscope at 4X magnification [Table/Fig-2,3]. The photographs of the samples were captured as jpeg images. Somma et al., criteria was used to score the amount of residual filling material. None to slight presence 0%–25% of residual debris covering the dentinal surface, presence of 25% to 50% of residual debris on the surface, presence 50%–75% of residual debris, the entire or almost the entire surface (75%–100%) covered with residual debris [7].

STATISTICAL ANALYSIS

Statistical analysis of the data was done using One–way Anova (Analysis of variance) test and Tukey HSD Test. SPSS (Statistical Package for Social Science) software version 15 was used. Level of significance was set at $p = 0.05$. A p-value <0.05 was considered to be statistically significant. A p-value <0.005 was considered to be statistically highly significant.

RESULTS

The data obtained was statistically analysed using Tukey's HSD test. The mean, standard deviation and p-values comparing the amount of remaining debris on the canal walls between the 3 groups. When hand H files, ProTaper R and Mtwo R files were compared with-in each group based on the sealer used during obturation, statistically significant results were obtained (i.e.,) p-value <0.05. Samples obturated with znc oxide eugenol sealer during obturation showed cleaner canal walls than AH plus sealer irrespective of the file system used for their retreatment. But when means of all the groups were compared, Mtwo R files showed

GROUPS		N	Mean	Std. Deviation	t	p-value
GROUP I	GROUP I A	10	1.5750	0.40531	2.12200	0.048 sig.
	GROUP I B	10	1.9417	0.36652		
GROUP II	GROUP II A	10	1.4583	0.30744	2.84500	0.011 sig.
	GROUP II B	10	1.8667	0.33380		
GROUP III	GROUP III A	10	1.2000	0.29187	2.82600	0.011 sig.
	GROUP III B	10	1.6083	0.35147		

[Table/Fig-4]: Tukey's HSD Test was applied to compare the mean amount of debris remaining among 3 groups.

GROUPS	N	Mean	Std. Deviation	p-value
GROUP I A	10	1.5750	0.40531	0.05 sig.
GROUP II A	10	1.4583	0.30744	
GROUP III A	10	1.2000	0.29187	
GROUP I B	10	1.9417	0.36652	0.102
GROUP II B	10	1.8667	0.33380	
GROUP III B	10	1.6083	0.35147	

[Table/Fig-5]: Tukey's HSD Test was applied to compare the Mean amount of debris remaining in 3 groups based on the sealer used in obturation.

better cleaning efficacy in the zinc oxide eugenol sealer group than other groups. [Table/Fig-4,5] shows the Mean, Standard Deviation and p-value to compare the mean amount of debris remaining in three groups based on the sealer used in obturation. When AH Plus was used as a sealer during obturation no statistically significant difference was found between the various instrument groups. When zinc oxide eugenol was used as a sealer, cleaner canal walls were obtained. Mtwo^{R} files showed better cleaning efficiency than ProTaper R files and Hand H files.

DISCUSSION

A study was undertaken at the University of Washington School of Dentistry to evaluate endodontically treated teeth to determine their rate of success shows that nearly 95% of all endodontically treated teeth were successful. Worldwide studies show that a lower success rate is associated with overfilled canals, teeth with preexisting periradicular lesions, and teeth not properly restored after root canal therapy [8-12]. According to another study, the major factors associated with endodontic failures are the persistence of bacterial infection in the canal space and/or the periradicular area and the presence of preoperative periradicular rarefaction [13,14]. Other factors contributing to endodontic failure include complex root canal anatomy, positive cultures, residual necrotic pulp tissue, broken instruments, root canal overfilling, mechanical perforations, root fracture, coronal leakage, presence of periradicular lesions and periodontal disease. Non surgical endodontic retreatment is the initial treatment of choice for the management of endodontic failures and preferred to surgical treatment due to the pain and discomfort involved in surgical procedures [15-17]. Non surgical endodontic retreatment requires regaining of access to the entire root canal system, complete removal of pre-existent obturating material which is critical in order to uncover remnants of necrotic tissue or bacteria that may be responsible for periapical infection and failure of root canal treatment [18-20]. The various obturation materials are pastes and cements, semisolid materials, and solid materials. Retreatment has been addressed frequently with respect to techniques of removing the various filling materials from root canal [21].

Gutta-percha in combination with a sealer is the most frequently used obturating material. The different types of root canal sealers are zinc oxide eugenol based, glass ionomer based, resin and silicone based sealers. Techniques described for gutta-percha removal include the use of heat, hand instruments, solvents, automated rotary instruments, ultrasonics, lasers and more recently NiTi rotary instruments [22-26]. NiTi rotary files have advantage in root canal preparation due to their unique physical properties. NiTi files have three times more elastic flexibility than stainless steel files due to its very low modulus of elasticity and superior resistance to torsional fracture. They are advantageous in instrumentation of canals with challenging shapes. In order to improve working safety, shorten preparation time and create a continuously tapered, conical flare of preparations, advanced instrument designs with non-cutting tips, radial lands, different cross-sections, superior resistance to torsional fracture and varying tapers have been developed. NiTi instruments maintain canal shape without zipping and ledge formation compared to hand instrumentation. NiTi rotary instrumentation plasticizes the Gutta-Percha (GP) through frictional heat, softened Gutta-Percha (GP) is less resistant and easier to be penetrated and removed [27].

Therefore, the use of rotary NiTi instruments and combined use of different technique in root canal retreatment may decrease patient and operator fatigue. Hence, the study was done to compare and evaluate the efficacy of manual hand Hedstrom files and two rotary retreatment file systems ProTaper Universal retreatment files and Mtwo^{R} (retreatment) files in the removal of root canal filling material (gutta-percha) during root canal retreatment and the influence of the type of sealers zinc oxide eugenol and AH plus on the presence of filling debris in the reinstrumented canals. In the present study, all retreatment techniques left remaining filling material on the canal walls. This confirms the previous result reported by numerous investigators such as Margo LM [27-30].

In this study Mtwo^{R} files have shown better cleaning efficacy than ProTaper R and hand H files when whole canal wall was evaluated during re-instrumentation. When the means were compared, the cleaning efficacy of Mtwo^{R} files was better followed by ProTaper R and then hand H files in each third of the tooth. This was in accordance to the results by Giuliani et al., In contrast to this Hammad et al., and Unal et al., showed that H and K files have better efficacy than ProTaper R rotary files [31-34]. In the present study when comparison was made based on the sealer used during obturation, teeth obturated with zinc oxide eugenol sealer had cleaner canal walls than AH plus sealer when whole canal was evaluated. When a comparison was made in each third of the tooth, statistically significant results were obtained in the apical third of the canal more debris was found in the canals obturated with AH plus sealer which is in accordance with the results obtained by Kosti et al., [35]. Sealer properties related to the ease of removal are adhesion to dentine and gutta-percha, degree of penetration into the dentinal tubules, film thickness, dimensional change, as well as solubility. AH plus is more dense and compact compared to zinc oxide eugenol sealer. AH plus sealer is a resin based sealer, has better adhesion to dentinal walls, penetrates 10-80 μm into the dentinal tubules and is difficult to remove during re-instrumentation.

LIMITATIONS

This is an in-vitro study, thus the result of this study cannot be directly applied to clinical situations. This study was done using straight root canals and therefore, the conclusion of this study cannot be directly applied to the teeth with curved root canals. Also, the tapers of the canal preparation were different which could affect the outcome of the study. Therefore, more studies are required to evaluate the efficacy, maintenance of original root canal morphology and safety of rotary NiTi instruments during the retreatment of teeth with complicated root canal anatomy in clinical conditions.

CONCLUSION

The following conclusions were drawn from the study. Samples obturated with zinc oxide eugenol sealer during obturation showed cleaner canal walls than AH plus sealer irrespective of the file system used for their retreatment. When the effectiveness of the various retreatment file systems was compared; maximum cleanliness of canal walls was found with Mtwo^{R} files followed by ProTaper R and least with hand H files. None of the instrument groups showed complete removal of the filling material.

REFERENCES

[1] Bhat SV, Suvarna DN, Shetty KHK. Comparison of efficiency of gutta percha removal in retreatment using protaper retreatment files, RaCe instruments with and without 'H' files - An ex vivo evaluation. *J Endod.* 2010;35-45

[2] Saad AY, Al-Hadlaq SM, Al-Katheeri NH. Efficacy of two rotary NiTi instruments in the removal of gutta-percha during root canal retreatment. *J Endod*. 2007;33(1):38-41.

[3] Alves FRF, Ribeiro TO, Moreno JO, and Lopes HP. Comparison of the efficacy of the nickel titanium rotary systems with or without the retreatment instruments in the removal of gutta percha in the apical third, *BMC Oral Health*. 2014;14(102):1-5.

[4] Dhillon JS, Bhagat A, Chhabra G. Efficacy of two rotary instruments for gutta percha removal during root canal retreatment. *Bangladesh Journal of Dental Research and Education*. 2014;04(02):56-60.

[5] Ali SM, Pradeep PS, Paul S, Jhons DN, Ganesh Prasad B. Comparative evaluation of efficiency and time of gutta percha removal using hedstrom files, protaper retreatment and rendo files - an ex vivo study. *Journal of Evidence based Medicine and Healthcare.* 2015;2(49):8484-87.

[6] Marfisi K, Mercade M, Plotino G, Duran Sindreu F, Bueno R, Roig M. Efficacy of three different rotatry files to remove gutta-percha and resilon from root canals. *Int Endod J.* 2010;43:1022-28.

[7] 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;34:466–69.

[8] Sjogren U, Hagglund B, Sundqvist G, Wing K. Factors affecting the long-term results of endodontic treatment. *J Endod.* 1990;16(10):498-504.

[9] Mikkonen M, Kullaa-Mikkonen A, Kotilainen R. Clinical and radiologic re-examination of apicoectomized teeth. *Oral Surg*.1983;55:302-06.

[10] Petersson K, Petersson A, Olsson B, Hakansson J, Wennberg Al. Technical quality of root fillings in an adult Swedish population. *Endodont Dent Traumatol*. 1986;2(3):99-102.

[11] Matsumoto T, Nagai T, Ida K, Iro M, Kawai Y, Horiba N, et al. Factors affecting successful prognosis of root canal treatment. *J Endod*. 1987;13(5):239-42

[12] Swartz DB, Skidmore AE, Griffin JA. Twenty years of endodontic success and failure. *J Endod*. 1983;9:198

[13] Lin LM, Skribner JE, Gaengler P. Factors associated with endodontic treatment failures. *J Endod*. 1992;18:625–27.

[14] Ingle J, James, Simon HJ, Machtou P, Bogaerts P. Outcome of endodontic treatment and re-treatment. Endodontics Fifth Edition 2002, BC Decker Inc Hamilton • *London Chapter* 13, 747-768.

[15] Imura N, Kato AS, Hata GI, Uemura M, Toda T, Weine F. A comparison of the relative efficacies of four hand and rotary instrumentation techniques during endodontic retreatment. *Int Endod J.* 2000;33(4):361-66.

[16] Roggendor MJ, Lenger M, Ebert J, Fillery E, Frankenberger R, Friedman S. Micro-CT evaluation of residual materials in canals filled with activ GP or guttaflow following removal with NiTi instruments. *Int Endod J*. 2010;43:200-09.

[17] De Carvalho Maciel AC, Zaccaro Scelza MF. Efficacy of automated versus hand instrumentation during root canal retreatment: an ex vivo study. *Int Endod J*. 2006;39:779-84.

[18] Kvist T, Reit C. Postoperative discomfort associated with surgical and nonsurgical endodontic retreatment. *Endod Dent Traumatol*. 2000;16:71–74.

[19] Sae-Lim V, Rajamanickam I, Lim BK, Lee HL. Effectiveness of profile 0.04 taper rotary instruments in endodontic retreatment. *J Endod*. 2000;26(2):100.

[20] 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.

[21] Pirani C, Pelliccioni GA, Marchionni S, Montebugnoli L, Piana G, Prati C. Effectiveness of three different retreatment techniques in canals filled with compacted gutta-percha or thermafil: a scanning electron microscope study. *J Endod.* 2009;35:1433-40.

[22] Mandel E, Friedman S. Endodontic Retreatment: A rational approach to root canal reinstrumentation. *J Endod*. 1992;11:565-69.

[23] Betti LV, Bramante CM, Quantec SC. Rotary instruments versus hand files for gutta-percha removal in root canal retreatment. *Int Endod J.* 2001;34:5l4-19.

[24] Cunha RS, De Martin AS, Barros PP, da Silva FM, Jacinto RC, da Silveira Bueno CE. In vitro evaluation of the cleansing working time and analysis of the amount of gutta-percha or resilon remnants in the root canal walls after instrumentation for endodontic retreatment. *J Endod.* 2007;33:1426-28.

[25] Hassanloo A, Watson P, Finer Y, Friedman S. Retreatment efficacy of the epiphany soft resin obturation system. *Int Endod J.* 2007;40:633-43.

[26] Horvath SD, Altenburger MJ, Naumann M, Wolkewitz M, Schirrmeister JF. Cleanliness of dentinal tubules following gutta-percha removal with and without solvents: a scanning electron microscopic study. *Int Endod J*. 2009;42:1032-38.

[27] Hayakawa T, Tomita F, Okiji T. The influence of the the diameter and the taper of root canals on the removal efficiency of plastic plus is thermafil carriers solution: using the files ProTaper retreatment. *J Endod*. 2010;36(10):1676-78.

[28] Takahashi C, Cunha R, De Martin A, Fontana CE, Silveira C, da Silveira Bueno C. In Vitro evaluation of the effectiveness of ProTaper universal rotary retreatment system for gutta-percha removal with or without a solvent. *J Endod*. 2009;35(11):1580-83.

[29] Margo LM, Munhoz M, Caroline S. Efficay of ProTaper retreatment system in root canals filled with gutta-percha and two endodontic sealers. *J Endod*. 2008;34:1223-25.

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

[31] Hulsmann M, Stotz S. Efficacy, cleaning ability and safety of different devices for gutta-percha removal in root canal retreatment. *Int Endod J*. 1997;30:227-33.

[32] Mohammad H, Alison Q, Nick S. Three dimensional evaluation of effectiveness of hand and rotary instrumentation for retreatment of canals filled with different materials. *J Endod*. 2008;34(11):1370-73.

[33] Celik Unai G, Ureyen Kaya B, Tac AG, Kececi 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.

[34] Giuliani. Efficacy of ProTaper universal retreatment files in removing filling materials during root canal retreatment. *J Endod*. 2008;34:1381–84.

[35] Kosti E, Lambrianidis T, Economides N, Neofitou C. Ex vivo study of the efficacy of H-files and rotary Ni-Ti instruments to remove gutta-percha and four types of sealer. *Int Endod J*. 2006;39:48-54.

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