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Efficacy of different techniques used for root canal retreatment

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ABSTRACT

Aim: This study compared the efficacy of gutta percha and sealer removal during retreatment using Protaper universal retreatment rotary files, D-Race rotary files and hand files with Gates Glidden.
Methods: Thirty six extracted single rooted teeth were selected for the current study. The canals were prepared using a modified crown-down technique then filled using the lateral compaction technique. Specimens were randomly divided into 3 equal groups each consisted of twelve specimens. Group one used manual files, group 2 used D-Race system while group 3 used Protaper retreatment system. Samples were split longitudinally and examined under the stereomicroscope.
Results: No significant differences among the Protaper and the D-RaCe groups in the mean values of root canal filling remnants, whereas the hand files and Gates Glidden group differed significantly.
Conclusion: D-Race and Protaper retreatment files removed gutta percha and sealer more efficiently than hand files and Gates Glidden.

1. Introduction

Success of endodontic therapy relies on proper disinfection of the root canal system followed by three dimensional obturation. Inability to achieve this goal will result in persistence of infection leading to failure of the treatment [1]. Non surgical retreatment is one of the best approaches in management of endodontic failures with a success rate of 74–98% [2]. In order to achieve complete disinfection during retreatment, root canal filling material should be removed efficiently [3]. Various obturation materials have been introduced recently, however gutta percha in combination with root canal sealer is still the most commonly used material [4]. Different methods are available for root canal filling removal including hand files, heat, ultrasonics, rotary instruments, laser and adjunctive use of solvent [5,6]. The use of manual instrumentation for gutta percha removal is time consuming [7]. Therefore, various rotary nickel titanium retreatment systems have been introduced in the market over the last decade. ProTaper universal retreatment files are characterized by progressively increasing tapers, a convex triangular cross section and a modified guiding tip. They consist of three instruments (D1, D2, D3) with various tapers and diameters at the tip (size 30, 0.09 taper, size 25, 0.08 taper, size 20, 0.07 taper). D1 file has an active tip that aids in facilitating penetration of subsequent files. The non-active tips of D2 and D3 reduce the incidence of ledging, perforation and stripping during removal of filling materials [8]. D-Race system for retreatment consists of 2 nickel titanium files DR1 and DR2 (size 30, 0.10 taper, size 25, 0.04 taper). DR1 has an active tip that can be used to penetrate root canal filling in the coronal and straight part of the canal, while DR2 is used to reach the full working length [9]. The aim of this study was to evaluate the effectiveness of the rotary systems Protaper universal retreatment files and D-Race during the removal of filling material in comparison with manual files. (see Tables 1–6, Figs. 1–9)

2. Materials and methods

2.1. Specimen preparation

Thirty six extracted single rooted teeth with single patent canals were selected for the current study. All specimens were collected, scaled for removal of attached tissue remnants and stored in 50% NaOCl solution at room temperature till the time of the experiment.

Access cavities were opened utilizing appropriate size round bur and diamond stone for each specific specimen mounted to a high speed hand piece and under copious water coolant.

Root canal length was determined with a size 10 K-file (Dentsply, Maillefer) introduced passively into the canal until its tip was just

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Table 1
Comparison between the values of apical, coronal and middle in hand files group.

	Apical (n = 28)	Coronal (n = 79)	Middle (n = 21)	χ^2 value	p value
Mean ± SD	1.393 ± 0.228	1.352 ± 0.491	1.414 ± 0.459	6.108	0.047*
p value vs apical	–	0.015*	0.233		
p value vs coronal	–	–	0.365		

χ^2 = Chi square of Kruskal Wallis test - $p > 0.05$ = not significant -*$p < 0.05$ = significant.

Table 2
Comparison between values of apical, coronal and middle in protaper group.

	Apical (n = 22)	Coronal (n = 8)	Middle (n = 11)	χ^2 value	p value
Mean ± SD	1.604 ± 0.754	1.242 ± 0.180	1.527 ± 0.499	4.702	0.095

χ^2 = Chi square of Kruskal Wallis test. - $p > 0.05$ = not significant.

Table 3
Comparison between the values of apical, coronal and middle in D-race group.

	Apical (n = 22)	Coronal (n = 10)	Middle (n = 11)	χ^2 value	p value
Mean ± SD	2.274 ± 0.754	1.146 ± 0.162	1.127 ± 0.499	26.820	0.001*
p value vs apical	–	0.001*	0.001*		
p value vs coronal	–	–	0.342		

χ^2 = Chi square of Kruskal Wallis test - $p > 0.05$ = not significant- *$p < 0.05$ = significant.

Table 4
Comparison between the values of apical GP remnants in the three studied groups.

	Hand files (n = 28)	Protaper (n = 22)	D-Race (n = 22)	χ^2 value	p value
Mean ± SD	1.393 ± 0.228	1.604 ± 0.754	2.274 ± 0.754	37.226	0.001*
p value vs hand	–	0.440	0.001*		
p value vs protaper	–	–	0.001*		

χ^2 = Chi square of Kruskal Wallis test. $p > 0.05$ = not significant. *$p < 0.05$ = significant.

Table 5
Comparison between the values of coronal GP remnants in the three studied groups.

	Hand files (n = 79)	Protaper (n = 8)	D-Race (n = 10)	χ^2 value	p value
Mean ± SD	1.352 ± 0.491	1.242 ± 0.180	1.146 ± 0.162	7.056	0.029*
p value vs hand	–	0.428	0.010*		
p value vs protaper	–	–	0.155		

χ^2 = Chi square of Kruskal Wallis test. $p > 0.05$ = not significant. *$p < 0.05$ = significant.

Table 6
Comparison between the values of middle third GP remnants in the 3 studied groups.

	Hand files (n = 21)	Protaper (n = 11)	D-Race (n = 11)	χ^2 value	p value
Mean ± SD	1.414 ± 0.459	1.527 ± 0.499	1.127 ± 0.499	6.919	0.031*
p value vs hand	–	0.351	0.028*		
p value vs protaper	–	–	0.023*		

χ^2 = Chi square of Kruskal Wallis test. $p > 0.05$ = not significant. *$p < 0.05$ = significant.

visible at the major apical foramen and the working length was calculated by subtracting 1 mm from this measurement.

The canals were prepared using a modified crown-down technique advocated by (Morgan & Montgomery 1984) [10].

The coronal third of the canal was flared with Gates–Glidden drills sizes 3 and 2, and the canal was then instrumented with K-type files (Dentsply Maillefer) to the predetermined working length till an apical size #40.

A total of 25 mL of 2.5% NaOCl was delivered throughout instrumentation with a 30-gauge needle between each two successive file sizes.

Once instrumentation was completed, passive ultrasonic irrigation was performed in all teeth using a CPR-6 Ultrasonic Tip (Obtura Spartan Endodontics, Algonquin, IL, USA) with a 2.5% NaOCl solution for 1 min followed by irrigation with 5 mL of a 17% EDTA aqueous solution for 3 min; and the final irrigation was performed with 5 mL of 2.5% NaOCl.

The EndoFill root canal sealer (Dentsply/Tulsa; Tulsa, Okla.), a zinc oxide–eugenol-based sealer, the sealer consisted of powder and liquid and it was mixed according to the manufacturer's instructions until it reached a homogenous thick consistency.

The canals were filled using the lateral compaction technique (Walton & Torabinejad 1996) [11]. Before filling, the canal was dried using paper points (Dentsply/Tulsa; Tulsa, Okla). A size 40 gutta-percha

Fig. 1. Sample prepared for image analysis.

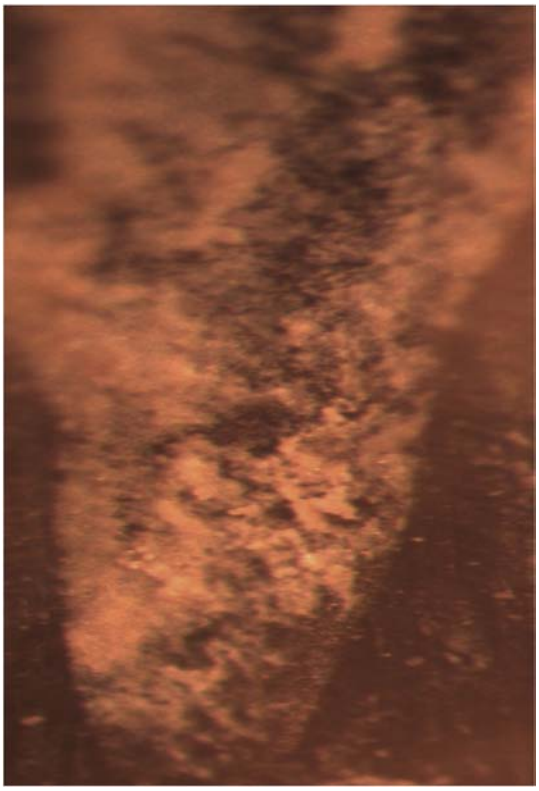

Fig. 2. Area of specific dimension selected.

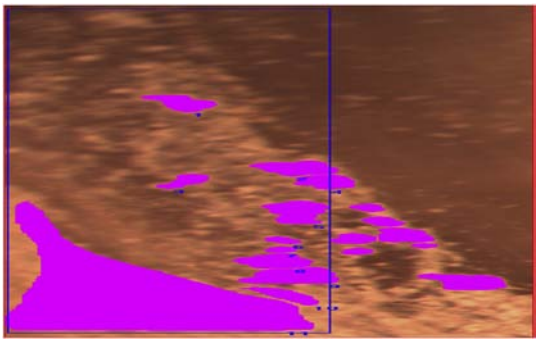

Fig. 3. Areas covered by root canal filling remnants were selected to calculate the percentage compared to the total surface area.

master cone (Dentsply/Tulsa; Tulsa, Okla) was selected and customized.

Afterwards, a sealer-coated master cone was placed up to the working length. Medium-fine accessory cones were laterally compacted

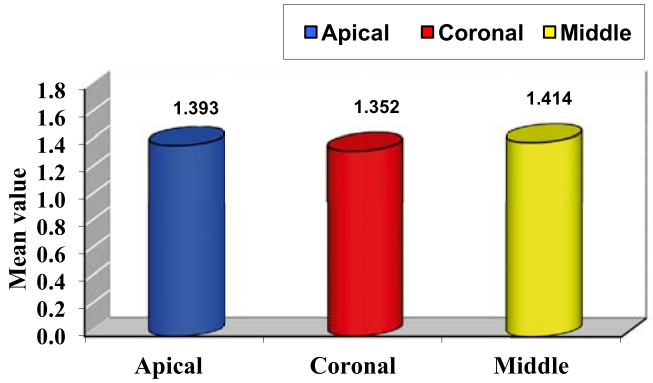

Fig. 4. Mean values of GP remnants in the apical, coronal and middle in hand files group.

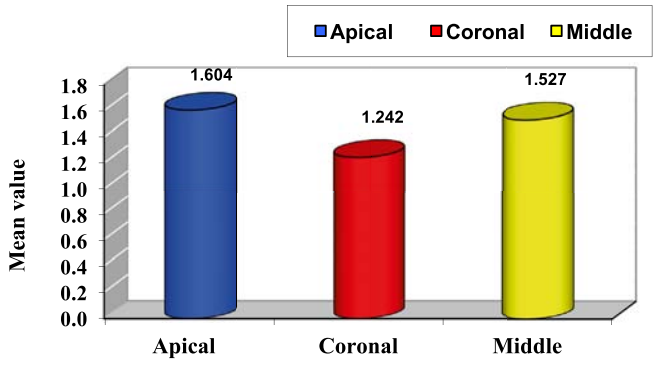

Fig. 5. Mean values of GP remnants in the apical, coronal and middle in Protaper group.

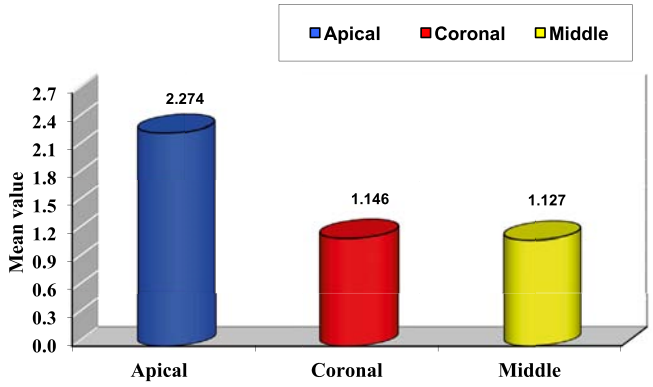

Fig. 6. Mean values of GP remnants in the apical, coronal and middle in D-race group.

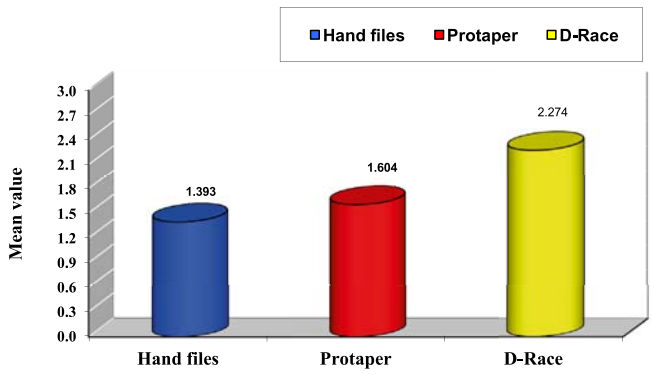

Fig. 7. Mean values of the apical GP remnants in the three studied groups.

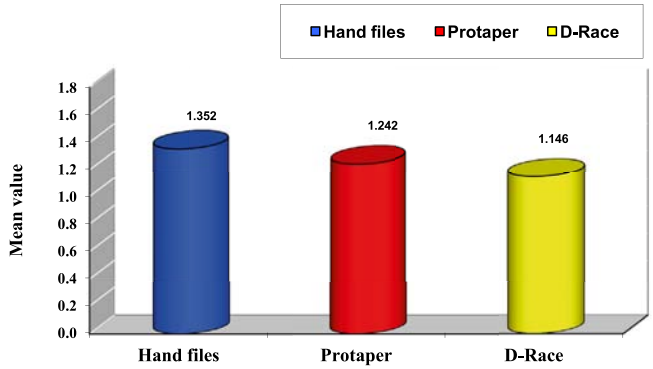

Fig. 8. Mean values of coronal GP remnants in the three studied groups.

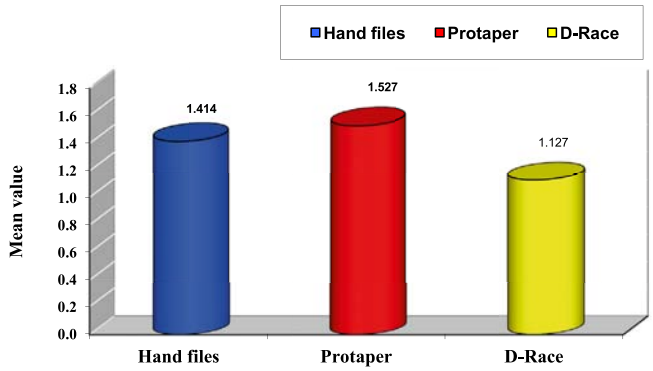

Fig. 9. Mean values of middle third GP remnants in the three studied groups.

until they could not be introduced deeper than 2 mm into the root canal.

A heated plugger was used to cut the gutta-percha at the entrance of the canal. Each tooth was radiographed in buccolingual and mesiodistal directions to ensure consistency of the root filling procedure. If there were any radiographic voids in the gutta-percha, the sample was discarded and replaced to standardize the number of specimens. The canal access was restored with Cavit-G (3M Espe, Seefeld, Germany), and the teeth were stored under 100% humidity at 37 °C for 30 days to allow the sealer to set completely.

2.2. Grouping

Specimens were randomly divided into 3 equal groups each consisted of twelve specimens. After complete setting of the root canal sealer, removal of the root canal filling from each one of the three experimental groups (desobturation) was attempted employing three different techniques respectively as follows:

2.3. Group I

The root canals were re-instrumented to the original working length with K-files up to size 45. Gates–Glidden burs sizes 2 and 3 were also used in the middle third of the canals at a depth of 6 mm. After reaching the working length with a size 45 file, file sizes 50, 55, 60, 70 and 80 were used in a step-back motion until file size 50 reached a point 0.5 mm short of the working length to complete the preparation. Files were discarded at the first sign of physical damage.

2.4. Group II

The X-smart plus endodontic motor (Dentsply/Tulsa; Tulsa, Okla) alongside the D-Race system (FKG Dentaire) were used. The slowest speed dictated by the manufactrurer (600 RPM) was employed and the torque was adjusted at 1.5 Ncm. The first instrument, DR1, is used in the first millimetres of the coronal and straight part of the canal. Once access was cleared with the DR1, the second instrument, DR2, was used to reach the working length.

2.5. Group III

The X-smart plus endodontic motor alongside the ProTaper retreatment kit (Dentsply/Tulsa; Tulsa, Okla) were utilized to remove the root canal filling.

The lowest speed (500–700 RPM) that will effectively engage and remove obturation material from the canal was selected.

Without engaging dentin, the spinning ProTaper D1 file (30/09) was gently pressed into the gutta percha to create friction, generate a heat wave, and remove the gutta percha filling out of the canal. The D1 file was frequently removed, inspected for remnants of obturation material on the blades and cleaned from debris using sterile gauze wet with alcohol. The D1 file was used until it fit passively between the dentinal walls and gutta percha was removed from the coronal one-third of the canal.

The ProTaper D2 file (25/08) was then employed in the same manner until it fit passively between the dentinal walls and gutta percha was removed from the middle third of the canal.

Finally the ProTaper D3 file (20/07) was then inserted and lightly pressed into the more deeply positioned material to remove obturation material out of the apical one-third of the canal.

The root canals in all groups were re-instrumented until the canal walls became smooth, and there was no evidence of filling material on the instrument.

A total volume of 25 mL of 2.5% NaOCl was delivered from a 30-gauge (tip size 25) needle during re-instrumentation. Passive ultrasonic irrigation was again performed in all teeth with a 2.5% NaOCl solution for 1 min followed by irrigation with 5 mL of a 17% EDTA aqueous solution.

Final irrigation was performed with 5 mL of a 2.5% NaOCl solution. After irrigation, the canals were dried with paper points.

To eliminate inter-operator variation, the same operator carried out all intracanal procedures.

Samples were coded then split longitudinally and examined under the stereomicroscope; images were then taken and the external contour of each section and areas with filling material were outlined.

The total canal area and filling material remnants were quantified in each specimen. The ratio of remaining filling material to root canal periphery was computed and expressed in square pixels.

Results were expressed as mean ± SD. Test of normality, Kolmogorov-Smirnov test, was used to measure the distribution of data. Accordingly, comparison between different variables in the three groups was performed using of Kruskal Wallis ANOVA test followed by Mann-Whitney test if significant results were recorded. Statistical analysis was performed using SPSS computer program (version 19 windows). P value ≤ 0.05 was considered significant.

3. Results

Root canal filling remnants were observed on samples from all three experimental groups in all of the coronal, middle and apical regions. Within each one of the experimental groups; comparisons were made between the amounts (expressed as percentage) on each of the coronal, middle and apical thirds. Corornal, middle and apical regions of all three groups were also compared. The apical region showed the highest amount of root canal filling remnants in all of the three groups tested. Yet the D-RaCe showed the highest value followed by the ProTaper and finally the hand files that showed the least amount of apical root canal filling remnants. Coronally, the D-Race showed the lowest mean values followed by the Protaper and finally the hand files group.

Comparing the root canal filling remnants in the middle third in all

three groups showed that the lowest mean value was shown by the D-RaCe followed by hand files and finally the ProTaper group.

Statistically there was no significant differences among the Protaper and the D-RaCe groups in the mean values of root canal filling remnants, whereas the hand files group differed significantly ($p < 0.05$ = significant.)

4. Discussion

Rotary instruments have been found to be very useful instruments in root canal retreatment [12,13]

The present study aimed to explore whether endodontic retreatment kits recently introduced to the market are able to remove filling material from root canals more effectively than other methods or not.

The use of vertical split roots to obtain images to investigate the root canal walls was advocated by different authors [14]. This method necessities the use of straight roots and relatively wide canals. Therefore single rooted premolars were selected for the current study and hence to facilitate standardization of the experiment, together with the use of the stereo microscope to evaluate the presence of filling material remnants [15], a method that has been shown to be more effective for investigating the remaining root canal filling material compared with the radiographic techniques [16].

Results revealed the efficacy of all three techniques in removal of the root canal filling materials.

Schirrmeister et al. showed that RaCe rotary instruments were more efficient than FlexMaster and Hedström files for gutta-percha removal. However, they found that ProTaper rotary instrument was not significantly different from FlexMaster, Hedström files [17]. They suggested that the greater ability of RaCe instruments in retreatment is due to the smooth surface of the instrument caused by the special chemical surface treatment and the resultant decrease in gutta-percha adherence to the flutes which increased the cutting ability.

The ProTaper retreatment kit contains three flexible instruments (D1, D2 and D3), of which the tapers and diameters are 0.09/0.30 mm, 0.08/0.25 mm, and 0.07/0.20 mm, respectively. Another study suggested that the convex triangular cross section of D series instruments reduces their contact with the canal walls [18]. This might be the main reason for more filling remnants found in ProTaper group coronally in the present study.

In the current study no solvent was used was able to measure the effect of the instrument used solely on the cleanliness of the root canals. In a recent study [18] solvent application resulted in more gutta-percha remnants on canal walls and dentinal tubules. Moreover; the International Agency for Research of Cancer has classified chloroform based gutta percha solvents as group 2B of carcinogens which indicates inadequate evidence of carcinogenicity in humans, but sufficient evidence of carcinogenicity in experimental animals. The antibacterial property achieved by the solvent can be replaced by flushing agents and hand/rotary instruments designed for this purpose.

5. Conclusion

The amount of gutta percha and sealer remaining after retreatment with D-Race and Protaper retreatment files was not significantly different but showed better efficiency than hand files and Gates Glidden.

References

[1] Kvist T, Reit C. The perceived benefit of endodontic retreatment. Int Endod J 2002;35:359–65. Hülsmann M, Drebenstedt S, Holscher C. Shaping and filling root canals during root canal re-treatment. Endod Topics. 2011;19:74-124.
[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;33:38–41.
[3] Hülsmann M, Bluhm V. Efficacy, cleaning ability and safety of different rotary NiTi instruments in root canal retreatment. Int Endod J 2004;37:468–76.
[4] Stabholz A, Friedman S. Endodontic retreatment - case selection and technique. Part 2: treatment planning for retreatment. J Endod 1988;14:607–14.
[5] Schirrmeister JF, Wrbas KT, Schneider FH, Altenburger MJ, Hellig E. Effectiveness of a hand file and three nickel-titanium rotary instruments for removing gutta-percha in curved root canals during retreatment. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;101:542–7.
[6] Sae-Lim V, Rajamanickam I, Lim BK, Lee HL. Effectiveness of Profile .04 taper rotary instruments in endodontic retreatment. J Endod 2000;26:100–4.
[7] 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;33:361–6.
[8] Fariniuk LF, Azevedo MAD, Carneiro E, Westphalen VPD, Piasecki L, Da Silva UX. Efficacy of protaper instruments during endodontic retreatment. IJDR 2017;28:400–5.
[9] Akhavan H, Azdadi YK, Azimi S, Dadresanfar B, Ahmadi A. Comparing the efficacy of Mtwo and D-Race retreatment systems in removing residual gutta percha and sealer in the root canal. Int Endod J 2012;7:122–6.
[10] Morgan LF, Montgomery S. An evaluation of the crown down pressureless technique. JOE 1984;10:491–8.
[11] Walton RE, Torabinejad M. Principles and practice of endodontics. second ed. Philadelphia, PA: Saunders; 1996. p. 234–59.
[12] Masiero AV, Barletta FB. Effectiveness of different techniques for removing gutta-percha during retreatment. Int Endod J 2005;38:2–7. 10.
[13] Schirrmeister JF, Wrbas 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. 11.
[14] Bramante CM, Betti LV. Efficacy of Quantec rotary instruments for gutta-percha removal. Int Endod J 2000;33:463–7.
[15] 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. Int Endod J 2012;45:927–32.
[16] Mello Jr. JE, Cunha RS, Bueno CES, Zuolo ML. Retreatment efficacy of gutta-percha removal using microultrasonics: part I - an ex vivo study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;108:59–62.
[17] 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] Schirrmeister JF, Wrbas 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.