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Evaluation by means of diaphanization of root canal preparation in flattened canals

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Abstract

Objective: To evaluate, by diaphanization, the cleaning ability three different instruments on walls of flattened root canals.

Methods: Thirty lower incisors, which had their root canals filled with India ink after coronal access and determination of the working length, were selected. The samples were randomly divided into three groups, of 10 teeth each, according to the instrument used during preparation: Group 1– hand files instrumentation; Group 2– instrumentation with ProTaper Universal rotary files; Group 3 – instrumentation with iRace rotary files. After instrumentation, the teeth were diaphanized and evaluated for cleaning ability, by analyzing the amount of dentin walls in which Indian ink was not removed.

Results: When performing the Kruskal-Wallis test ($p>0.05$) there were not significant statistical differences between groups, as well as for the arithmetic average of the scores at cervical, middle and apical thirds.

Conclusion: None of the instruments used for root canal preparation of flattened root canals was able to perform a complete cleaning of the dentin walls.

Key words: Root canal preparation; Dental pulp cavity; Endodontics

Avaliação do preparo de canais radiculares achatados a partir da diafanização

Resumo

Objetivo: Avaliar a partir de diafanização a capacidade de limpeza das paredes de canais de raízes achatadas preparadas com 3 diferentes instrumentos.

Métodos: Foram seleciona dos 30 incisivos inferiores, preenchidos com corante após o acesso coronário e determinação do comprimento de trabalho. As amostras foram divididas aleatoriamente em 3 grupos, de 10 dentes cada, de acordo com o tipo de instrumento utilizado para o preparo: Grupo 1 – instrumentação manual; Grupo 2 – instrumentação rotatória com ProTaper Universal; Grupo 3 – instrumentação rotatória com iRace. Após a instrumentação, os dentes foram diafanizados e avaliados com relação à limpeza a partir da mensuração da quantidade de dentina removida das paredes.

Resultados: Não foram encontradas diferenças estatisticamente significantes entre os grupos a partir da análise dos escores com o teste de Kruskal-Wallis ($p>0.05$),

Conclusão: Nenhum dos instrumentos utilizados para o preparo de canais radiculares achatados foi capaz de promover a completa limpeza das paredes dentinárias.

Palavras-chave: Preparo do canal radicular; Cavidade pulpar; Endodontia

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Introduction

Endodontic therapy aims at providing an adequate biomechanical root canal preparation and its airtight sealing with an inert material, by means of root filling. To accomplish this goal, the root canal preparation stage is considered essential to the treatment success, once its purpose is the organic tissue removal, whether it is vital or necrotic, and the shaping in order to facilitate the filling materials introduction [1].

Root canal cleaning occurs through endodontic instruments mechanical action in addition to irrigating solutions and drugs physical-chemical properties, aiming at eliminating aggressors and irritants such as microorganisms, their products and pulp tissues remnants, degraded or not [2].

Chemo-mechanical root canal preparation is the stage that requires more time in endodontic treatment. Therefore, endodontists and dental material industries are concerned with the development of systems that allow better root canal shaping by means of an automated instrumentation, maintaining its original anatomy and facilitating the biomechanical preparation [3]. Manual instrumentation, on the other hand, enables a higher incidence of iatrogenic complications during preparation, such as canal transportation, ledges, perforations, dentin compression and presence of fractured instruments [4].

Currently, rotary systems are considered safe, non-deforming nor transporting the root canal, when correctly used and indicated. Automated preparation decreases stress both for the patient and the professional. However, rotary systems shaping is not always effective, especially in flattened root canals, since the instruments may not contact all root canal walls, which is why in such cases the use of concentrated chemical solutions is especially indicated [5]. Also, Plotino et al. [6] questioned whether the NiTi instruments flexibility allows a controlled and complete preparation of the most various anatomies found in root.

Root canal anatomical complexities difficult cleaning and disinfection, due to endodontic instruments non-adaptation to dentin walls. The preparation of curved and flattened root canals is more complex once the instrument suffers stresses and strains imposed by the procedure, which may ultimately influence root canal treatment outcome [7].

According to Wu et al. [8] flattened root canals buccal and lingual walls are areas of difficult access to instrumentation. Barbizam et al. [9] observed by optical microscopy analysis in flattened root canals that the instruments do not contact polar areas during instrumentation. Therefore, irrigation is of fundamental importance, and its association with instrumentation is necessary to promote cleaning and disinfection of root canal systems.

Given the importance of root canal cleaning and shaping for successful endodontic treatment, the present study aims to evaluate the presence of Indian ink in root canal walls after the diaphanization of extracted mandibular incisors, which had their root canals prepared by three different instruments: K-type hand files (Dentsply-Maillefer – Ballaigues, Switzerland), ProTaper Universal rotary files (Dentsply Maillefer Instruments S.A. – Ballaigues, Switzerland) e iRaCe rotary files (FKG Dentaire S.A. – La-Cheaux-de Fonds, Switzerland).

Methods

The present study was submitted and approved by the Ethics in Research Committee of the Dentistry Faculty, Federal University of Bahia (protocol number 278.766).

Human mandibular incisors, extracted by periodontal disease or extensive caries, and with complete formed apices, were selected for this study. The teeth were cleaned in order to remove any tissue debris, autoclaved and stored in saline until the moment of use.

Initially, periapical radiographs were taken both in buccolingual and mesiodistal directions for evaluations of possible calcifications in the pulp chamber and root canal, as well as the presence of more than one canal. Teeth that showed calcifications and more the one root canal were excluded from the study. Thus, 30 human mandibular incisors were selected.

The coronal access was performed with spherical diamond burs (KG Sorensen – Cotia, SP, Brazil) in high speed. The working length was visually determined by introducing a size 10 K-file (Dentsply Maillefer – Ballaigues, Switzerland) with a silicon stop into the root canal until its tip was observed at the apical foramen; 1 mm was reduced from that value.

Eventual remaining pulp was removed from the root canals through the insertion of a #15 Hedstroem (Dentsply Maillefer – Ballaigues, Switzerland) instrument to the WL with the aid of 1% sodium hypochlorite (Biodinâmica – Ibiporã, PR, Brazil). Thus, the initial diameter corresponding to a #15 file to the WL for all teeth was established. The canals were then washed with 3 mL of distilled water and dried with absorbent paper points (Dentsply – Petropolis,RJ, Brazil).

Root canals were filled in with Indian ink (Faber Castell – São Carlos, SP, Brazil), previously stored within anesthetics cartridges, which was inserted into the canals with the aid of a carpule syringe and an anesthesia needle (DFL – Rio de Janeiro, RJ, Brazil). The ink was inserted until the root canals and the pulp chamber were completely filled in and it passed through the apical foramen.

After 48 hours, time required for ink drying, the teeth were randomly divided into three groups of 10 teeth each, according to the instrumentation technique: Group 1: K-type hand files instrumentation; Group 2: ProTaper Universal rotary files instrumentation; Group 3: iRace rotary files instrumentation.

In Group 1, shaping was performed by serial technique followed by Passive Step-back technique. Sizes 15, 20, 25 e 30 K-type hand files were used at WL for creating the apical matrix. After its creation, the Passive Step-back technique was performed with four more instruments. In Group 2, teeth were prepared by ProTaper Universal Rotary

technique, using the following operatory sequence: S1, S2, F1, F2 and F3 at WL.

In Group 3, instrumentation was performed by iRaCe Rotary, using the following operatory sequence: R1 (15.06), R2 (25.04) and R3 (30.04) at WL.

In Groups 2 and 3 an X-Smart electric engine was operated (Dentsply Maillefer – Ballaigues, Switzerland) with 250 rpm e 400 rpm speed, respectively, and torque suggested by each file manufacturer. A 0.30 mm apical diameter was standardized for all groups.

During instrumentation, 1 ml of 1% sodium hypochlorite was used, in association with Endo-PTC (Compounding Pharmacy), as each instrument was replaced. By the time the preparation was finished, the smear layer was removed with the aid of 0.1 ml of 17% EDTA (Iodontosul – Porto Alegre, RS, Brazil), agitated with the aid of an instrument for 1 minute and removed with 1 ml of 1% sodium hypochlorite. The final rinse of the root canal was performed with 0.5 ml of a detergent solution (Iodontosul – Porto Alegre, RS, Brazil).

After instrumentation root canals were dried with size 30 absorbent paper points (Dentsply – Petrópolis, RJ, Brazil).

For the diaphanization process, teeth were individually stored within glass recipients and decalcified with muriatic (Muriax – Salvador, BA, Brazil) during approximately 72 hours, until a needle trespassing through the root could be observed. Once verified decalcification, teeth were washed in running water for 4 hours, and then submitted to dehydration phase with ethyl alcohol in its various concentrations: 80% (for 12 hours), 90% (for 2 hours) e 100% (for 3 hours). After drying, the samples were placed in methyl salicylate to achieve transparency.

The diaphanized teeth were evaluated by using the light box and a SONY DSC-HX1 camera (Sony Brasil – São Paulo, SP, Brazil) at an 8X increase. The presence of Indian Ink at dentin walls of each third of the root canal was evaluated according to the following score:

0 – absence of ink on dentin walls;
1 – presence of ink on one wall;
2 – presence of ink on two walls;
3 – presence of ink on three walls;
4 – presence of ink on four walls.

The arithmetic average of the scores was statistically analyzed by Kruskal Wallis test with a 5% significance level using the BioEstat 5.0 software.

Results

The root canal cleaning was analyzed by observing the ink removal from dentin walls in each third by means of scores, and the lower the score, the better the cleaning of the root canal (Figures 1-3).

Figure 4 shows the scores frequency for each third of the evaluated groups.

The averages of the scores obtained in each root canal third are shown in Table 1. During instrumentation there were no files fractures.

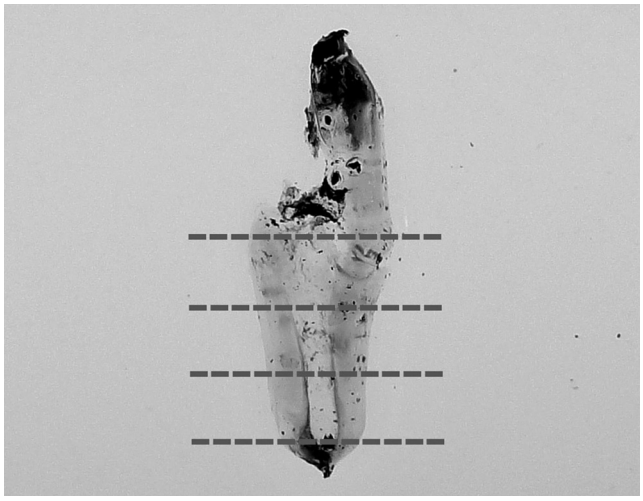

Figure 1. Group 1 (hand files) tooth, with scores 0 in the cervical third, 1 in the middle and apical thirds.

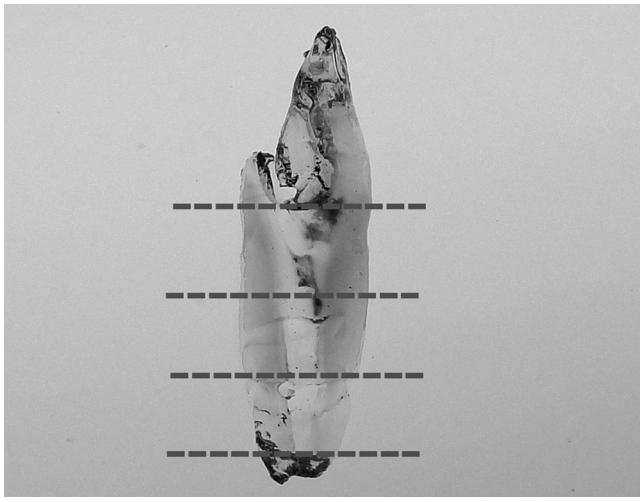

Figure 2. Group 2 (ProTaper Universal) tooth, with score 0 in the three thirds.

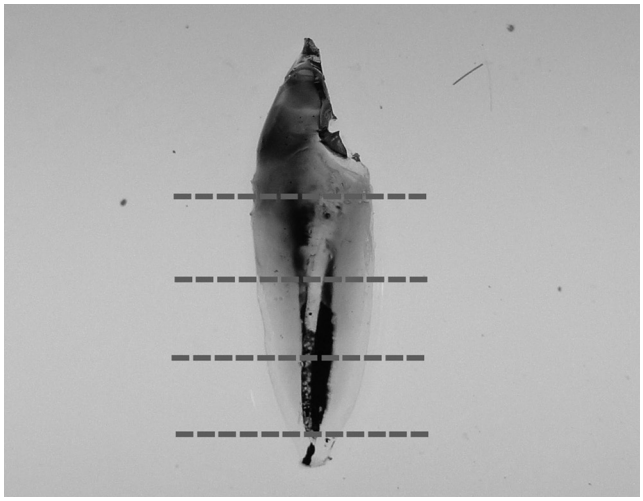

Figure 3. Group 3 (iRace) tooth, with score 2 in the cervical third and 4 in middle and apical thirds.

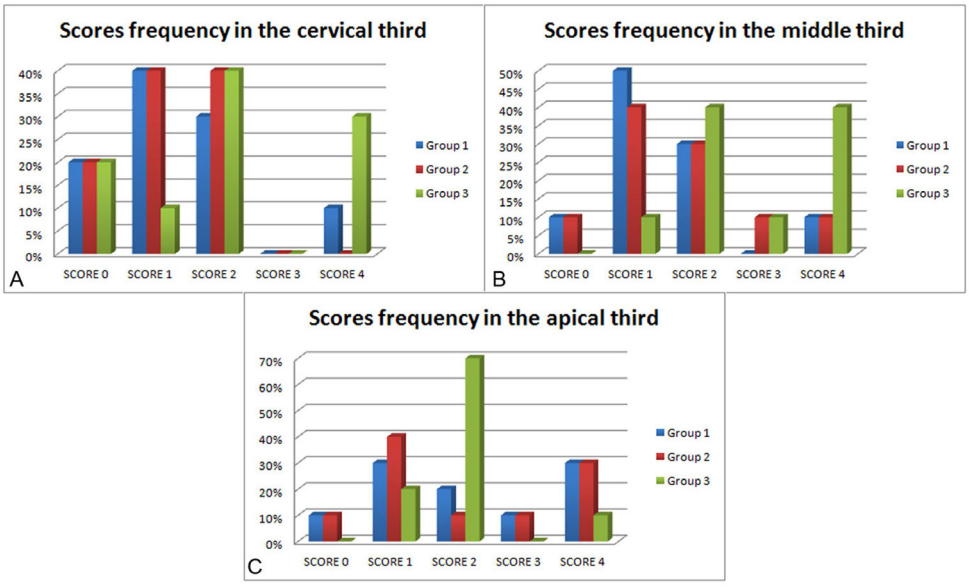

Figure 4. Scores frequency of the 3 groups in cervical (A), middle (B) and apical (C) thirds.

Table 1. Scores averages for each root canal third of the evaluated groups.

Group	Cervical	Middle	Apical
Group 1 (Hand files)	1,4	1,5	2,2
Group 2 (ProTaper Universal)	1,2	1,7	2,1
Group 3 (iRaCe)	2,1	2,8	2,0

In general, Group 2, in which ProTaper Universal System instrumentation was performed, resulted in cleaner walls, followed by Group 1 (hand files instrumentation) and Group 3 (iRaCe system). However, there was no statistical difference among the groups as to the average of the scores in the cervical, middle and apical thirds (Kruskal Wallis $p>0.05$).

Discussion

The root canal preparation aims to achieve an adequate cleaning and disinfection of the canal system, as well as at obtaining a uniform and continuous conical shape, maintaining the foramen's original spatial position. Nevertheless, anatomical diversity, such as those found in flattened canals, may hinder therapy, often leading to failure [10, 11].

Flattened or oval canals studies use the mesial root of molars [12,13] or mandibular incisors [4,7,14,15]. Extracted mandibular incisors were used in this study by having a pronounced flattening on the mesiodistal direction, which can generate a second lingual canal. As well as, the occurrence of severely flattened canals, with elongated cross-section, being the biggest diameter on the bucco-lingual direction [10]. Mandibular incisors with more the one root canal were excluded and only the ones with mesiodistal flattening were used.

To evaluate the instrumentation techniques according to their cleaning ability, the present study used the methodology that makes use of dentin walls coloring, similar to Grecca et al. [16] and Sipert et al. [12] studies. It is important to mention that the dye (Indian Ink) used is water insoluble, which made the instrumentation technique the only responsible for the dye removal.

The results analysis showed that Group 2 (ProTaper Universal) achieved a better cleaning in the cervical third, although this difference was not statistically significant when compared to the other groups. This result corroborates to Martini et al. [17] study, which tested four root canal preparation systems and where the ProTaper system presented the best results. These findings are probably because they are nickel-titanium rotary instruments with extreme flexibility e multiple tapers, eliminating dentin more efficiently.

Regarding to the other groups, Group 1 (hand file instrumentation) achieved better cleaning in the middle third, while Group 3 (iRaCe) showed better cleaning in the apical third, although this difference has no statistical significance. A better cleaning was expected from the rotary techniques, once these systems present superior tapers compared to ISO hand instruments, providing a suitable enlargement of the cervical and middle thirds, and thus facilitating the preparation of the apical third [18]. The brushing motion is the one suggested for rotary files use, in which the instrument is guided against the canal lateral walls and pulled in coronal direction [19]. In the present study, even though brushing motion was used in Groups 2 and 3, the presence of dye was still observed in dentin walls.

In Group 1 (hand file instrumentation), linear motion was applied to the files, and even so, dye was observed

in dentin walls, similarly to Wu et al. [20] study. These authors compared two hand file instrumentation techniques in mandibular incisors and observed that both balanced-force and circumferential movements left large areas of the root canal without instrumentation.

Barato-Filho et al. [21] evaluated the canal preparation in human mandibular central incisors using ProTaper system, and as a result, a better preparation was achieved by using F1, F2 and F3 instruments in apical preparation in aid with 2.5% sodium hypochlorite. This paper results show that, even when using instruments with greater taper then the ISO standard (Group 2 – F2 30/09; Group 3 – 30/04) in the apical third, there dye was still present on the root canal walls.

The apical third is considered a critical area regarding to cleaning, shaping and filling [22]. This fact could be noticed in our study, where the higher scores (a high number of walls with dye) were found in the apical third (Table 1).

Grecca et al. [7] evaluated rotary, hand file and ultrasonic instrumentation techniques in flattened canals. After statistical analysis, the authors concluded that there was no significant difference among groups and that none of them have completely removed the dyed areas. This is in agreement with the results obtained in our study.

However, Schirrmeister et al. [23], while comparing ProTaper system with four other instruments for the preparation of simulated root canals, found that the iRaCe system (by using the following files sequence: 40/10; 35/08; 30/06; 25/04 crown down direction, and 25/02; 30/02 at WL) presented the best canal preparation. This was not observed in our study, which showed no statistical difference among the used techniques.

According to Grecca [16], the more complex the root canal anatomy is, a greater number of instruments should be used, being the larger tapers in the cervical and middle thirds and the minor in the apical third. The iRaCe system manufacturer recommends using only 3 instruments (15/06; 25/04; 30/04), which may have influenced the negative results presented by this system.

In general, literature shows that there is still no technique that prepares root canals with mesio-distal flattening in their entirety. The circular preparations provided by instrumentation, whether rotary or manual, do not cover all root canal walls, once they promote a preparation that corresponds to the instrument cross-section, which may lead to therapy failure. [24]. That can be proved by the present study results, where no technique was able to promote the complete cleanliness of the dentin walls.

The challenge in promoting an adequate cleaning to the flattened root canals has already been reported in the scientific literature, as debris were found after biomechanical preparation, especially in isthmuses and polar areas [14, 23-25]. According to the present study, more than 76.4% of the walls that remained untouched after preparation were buccal or lingual walls, demonstrating the challenge of the instrumentation of these areas in flattened canals.

It could be observed that, despite technological advances related to root canal preparation, the anatomical complexity is still one of the limiting factors that should be considered while choosing the instrumentation protocol. According to the literature and the results found in the present study, the search for techniques and instruments that provide a better cleaning of the flattened root canal system is necessary, once none of the evaluated techniques has successfully cleaned the dentin walls.

Conclusion

There was no statistical difference ($p>0.05$) among the preparation techniques used, as for the ability of removing Indian Ink in the cervical, middle and apical thirds. According to the methodology , none of the techniques used in the flattened root canals during biomechanical preparation was capable of accomplishing a complete cleaning of the dentin walls, although, on average, ProTaper Universal instruments have shown a greater number of clean walls, followed by hand files and iRace.

References

1. Sydney GB, Batista A, Deonizio MD. Radicular access. Robrac 2008; 17:1-12.
2. Hulsmann M, Heckendorff M, Lennon A. Chelatings agents in root cannal treatment: mode of action and indications for their use. Int Endod. J 2003; 36:810-30.
3. Semaan FS, Fagundes FS, Haragushiku G, Leonardi DP, Baratto-Filho F. Mechanized endodontic: the evolution of continuous rotary systems: [review]. RSBO. 2009;6:297-309.
4. Gonçalves SB, Brosco VH, Bramante CM. Comparative analysis of rotatory (GT) and manual root canal preparation and association of both techniques in instrumentation of flattened root canals. J Appl Oral Sci. 2003;11:35-9.
5. Baratto-Filho F, Vanni JR, Maia SMAS, Sousa-Neto MD, Leonardi DP. Shaping ability of ProTaper instruments in flattened root canals. Perspect Oral Sci. 2009;1:25-9.
6. Plotino G, Grande NM, Melo CM, Bahia MG, Testarelli L, Gambarini G. Cyclic fatigue of NiTi rotary instruments in a simulated apical abrupt curvature. Int Endod J. 2010;43:226-30.
7. Grecca FS, Garcia RB, Bramante CM, de Moraes IG, Bernardineli N. A quantitative analysis of rotary, ultrasonic and manual techniques to treat proximally flattened root canals. J Appl Oral Sci. 2007;89-93.
8. Wu MK, R'oris A, Barkis D; Wesselink PR. Prevalence and extend of long oval canals in the apical third. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2000;89:739-43.
9. Barbizam JVB, Fariniuk LF, Marchesan MA, Pecora JD, Sousa-Neto MD. Effectiveness of Manual and Rotary Instrumentation Techniques for Cleaning Flattened Root Canals. J Endod. 2001;28:365-66.
10. Pires LB, Albergaria SJ, Fagundes Tomazinho FS, Tomazinho LF. Radiographic evaluation of apical deviation of curved root canals after the use of manual and rotary instrumentation. RSBO. 2009;6:279-85.
11. Rasquin LC, Carvalho FB, Lima RKP. In vitro evaluation of root canal preparation using oscillatory and Rotary systems in flattened root canals. J. appl Oral Sci. 2007;15:65-9.
12. Sipert CR, Hussne RP, Nishiyama CK. Comparison of the cleaning efficacy of the FKG Race system and hand instrument in molar root canal. J Appl Oral Sci. 2006;14:6-9.
13. Gonçalves LCO, Junior ECS, Frota MF, Marques AAF, Garcia LFR. Morphometrical analysis of cleaning capacity of a hybrid instrumentation in mesial flattened root canals. Aust Endod J. 2011;37:99-104.
14. Interliche R; Marchesan MA, Silva SRC, Pécora JD, Silva-Sousa YTC, Sousa-Neto MD. Influence of Hero Apical instruments on cleaning ovoid-shaped root canals. Braz Oral Res. 2011;25:314-8.
15. Sasaki EW, Versiani MA, Perez DE, Sousa-Neto MD, Silva-Sousa YT, Silva RG. Ex vivo analysis of the debris remaining in flattened root canals of vital and nonvital teeth after biomechanical preparation with Ni-Ti rotary instruments. Braz Dent J. 2006;17:233-6.
16. Grecca FS. Avaliação da eficácia dos métodos de instumentação rotatória (sitema K3 e Protaper), ultra-som e manual na remoção de corante

aderido às paredes de canais radiculares com achatamento proximal. Estudo "in vitro". (Dissertação de doutorado) Bauru (SP): Faculdade de Odontologia de Bauru 2003.

17. Martini GR, Vanni JR, Bona AD, Lazaretti D. A. The influence of different methods of cervical magnifying in the attainment of the lenght of work in first mesio-vestibular canals tests of superior molar. RSBO. 2007;4:7-11.
18. Pécora JD, Capelli A. Técnica mecanizada para preparo dos canais radiculares- Protaper Plus. [article online]. School of Dentistry of Ribeirão Preto, University of São Paulo. 2004. [Accessed on 2013 April 27]. Available at http://www.forp.usp.br/restauradora/rotatorios/protaper_plus/protaper_plus.pdf
19. Lopes HP, Souza LC, Vieira VTL, Silveira AMV, Vieira MVB, Elias CN. Fratura dos instrumentos endodônticos. Recomendações clínicas. Rev Bras Odontol. 2011;68:152-6.
20. Wu MK, Sluis VLWM, Wesselink PR. The capability of two hand instrumentation techniques to remove the inner layer of dentine in oval canals. Int Endod J. 2003;36:218-24.
21. Baratto-Filho F, Leonardi DP, Zielak JC, Vanni JR, Sayão-Maia SMA, Sousa-Neto MD. Influence of protaper finishing files and sodium hypochlorite on cleaning and shaping of mandibular central incisors – A histological analysis. J Appl Oral Sci. 2009;17:229-33.
22. Ritt AS, Buco J, Wagner MH, Rosa RA, Vier-Pelisser FV, Só MVR. Effectiveness evaluation of manual x rotary instrumentation during endodontic retreatment in root canals filled with gutta-percha and calcium hydroxide based-sealer. RFO. 2012;17:55-9.
23. Schirrmeister JF, Wrbas KT, Schneider FH, Altenburger MJ, Hellwig 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.
24. Williamson AE, Sandor AJ, Justman BC. A comparision of three nickel titanium rotary systems. EndoSequence, ProTaper universal, and ProFile GT, for canal-cleaning ability. J Endod. 2009;35:107-9.
25. Taha NA, Ozawa T, Messer HH. Comparision of three techniques for preparing oval-shaped root canals. J Endod. 2010;36:532-5.