Original Research Article

A Comparative Study to Evaluate the Effectiveness of FKG Dentaire and Protaper Retreatment Systems in Removal of Root Canal Obturation Materials

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Abstract

Background: Defective endodontic treatment is one of the most common causes of failure among dental patients. When conventional root canal treatment fails, endodontic retreatment is the most conservative method of choice. Therefore, the main goal of retreatment is to regain access to the apical foramen by complete removal of the root canal filling material.

Aim and objectives: The aim of this study was to compare of the efficiency of newly introduced FKG Dentaire against ProTaper rotary retreatment files and conventional Gates Glidden + H hand files during root canal retreatment.

Materials and methods: 36 extracted human maxillary anterior teeth with one single straight root canal were collected for the study. Teeth were prepared and obturated with gutta-percha points and AH 26 (silver-free) sealer and then divided randomly into 3 groups. (Group 1): the gutta-percha was removed using Gates Glidden and H hand files. (Group 2): the gutta-percha was removed using ProTaper universal retreatment. (Group 3): the gutta-percha was removed using Retreatment FKG Dentaire. The working time was recorded for each group and the sample was evaluated under the electron-scanning microscope.

Results: There was significant difference in the total time required for retreatment group showed the least working time. However, under the electron scan microscope, it had been shown that the debris percentage for both FKG (47.5%) and Pro-taper (48%) were found to be significantly less than that observed with H-files group (63%).

Conclusion: Teeth retreated using the FKG Dentaire and Protaper, have nearly similar remnant filling material was observed. However, the time required to remove gutta-percha + AH Plus was significantly less in FKG than that required for the ProTaper and H-files. The mean difference is significant at the 0.05 level.

Key words

Re-treatment, Protaper, FKG, SEM.

Introduction

Defective endodontic treatment is one of the most common causes of failure among dental patients. When conventional root canal treatment fails, endodontic retreatment is the most conservative method of choice. The main goal of retreatment is to regain access to the apical foramen by complete removal of the root canal filling material. Biomaterial-centered biofilm form in root canal obturating material in failed endodontic cases [1] and necrotic tissue and bacteria, covered by obturating material, may cause periapical inflammation [2]. Therefore, in retreatment we should remove the obturating material as much as we can to reduce the number of microorganisms within the canal. Removal of obturating material can be done through several methods such as ultrasonic technique, chemical methods, and heat pluggers [3–5]. Nickel-titanium rotary instruments have also been used [6, 7]. There is limited information about the removal root canal filling materials for retreatment purpose and some studies have investigated the effectiveness of the new ProTaper universal retreatment instruments in the removal of obturating material during endodontic retreatment. However, no study evaluates the efficiency of FKG retreatment systems. Therefore, the aim of this study was to compare he efficacy of Retreatment FKG Dentaire files in the removal of root canal fillings obturated with gutta-percha and AH 26 sealer. The XP-endo® Finisher R has a core diameter larger (ISO 30) than the XP-endo® Finisher (ISO 25), making it slightly stiffer and also more efficient in removing root fillings materials adhering to the canal walls. It can then contact and scrape the dentine surface and/or the root filling material without changing the original shape of the canal. This universal instrument should be used following any retreatment case of diameter ISO 30 or more. It equalizes a size of Ø ISO 30 and Taper 0%, lengths; 21 mm, 25 mm and it works with Optimal speed of 1'000 rpm (minimum 800 rpm) and under a torque of 1 Ncm.

Materials and methods

Sample preparation

A total of thirty-six (36) extracted human maxillary anterior teeth with one single straight root canal of approximately similar lengths and diameters were collected for the study. Soft tissue and calculus were mechanically removed from the root surfaces. Teeth were prepared using Protaper Universal rotary files (Dentsply Maillefer, Ballaigues, Switzerland) until reaching size size X3: 30/0.06 taper and with the aid of X-Smart rotary contra-angle motor (Dentsply, Sirona, Canada) with a speed of 300 rpm and under a torque of 2Ncm. Finally, all the teeth were obturated with gutta-percha points size F3 of the same system and according to manufacturer instructions using AH26 silver-free sealer (Dentsply Maillefer, Ballaigues, Switzerland). Teeth were radiographed in bucco-lingual and mesio-distal direction to confirm the adequacy of root fillings. Two weeks later, and after de-coronation of the teeth, the samples were divided into 3 groups: Concerning Group 1, gutta-percha was removed using Gates Glidden

(SybronEndo, West Collins, Orange, CA, USA) and H hand files (DiaDent, Burnaby, BC, Canada) in conjunction with chloroform (Merck, Darmstadt, Germany). While in Group 2, the gutta-percha was removed using ProTaper universal retreatment system (Dentsply Maillefer, Ballaigues, Switzerland) and chloroform. Finally, in Group 3, gutta-percha was removed using Retreatment FKG Dentaire system (La Chaux-de-Fonds, Switzerland), also with the aid of chloroform.

Methods of Evaluation

The following time periods were also calculated during the process of retreatment for all the specimens;

Time to reach the working length (T1)

The time elapsed from entering the canal with the first instrument until reaching the working length was measured.

Time for reshaping (T2)

The time elapsed after reaching the working length until no obturation material was seen covering the instruments was measured, including the time required for instrument changes and irrigation protocols.

Total time for retreatment (Tt)

The time elapsed from entering the canal with the first instrument until no obturation material was seen covering the instruments was measured (T1 + T2).

Procedural errors

The numbers and types of fractured and deformed instruments were recorded.

Sample analysis

After removal of the obturation materials, the roots were split vertically into two halves using diamond burs and the cleanliness of canal walls was examined by scanning electron microscopy.

After vacuum drying, the specimens were sputter coated with gold palladium under a 10-mA current (**Figure – 1**). Micrographs at magnifications of 50 ¥ and 200 ¥ were then taken under a scanning electron microscope at 25 kV for the three groups. The residual obturation material and debris at the coronal, middle and apical thirds of each canal were evaluated (**Figure - 2, 3, 4).**

Figure - 1: A photograph showing the gold palladium coated specimens after vacuum drying.

Statistical analysis

Statistical analysis was performed using the IBM statistical analysis (2019) Software programmer. Intergroup comparison was performed using one-way Anova analysis tests (**Table – 1**). The level of significance was set at P at 0.05. Data were analyzed using statistical package for social sciences (SPSS). A descriptive statistic will calculate the efficiency of FKG and Protaper re-treatment kits (**Table – 2**).

Results

Mean working time for each group: (**Figure – 5**)

- Mean working time for FKG Group = 1:155 min
- Mean working time for Protaper Group = 6:9 min
- Mean working time for H files and GG Group = 11:418 min

Debris amount for each group: (**Figure – 6**)

- Debris amount in FKG Group = 47.5%
- Debris amount in Protaper Group = 48%
- Debris amount in H-files Group = 63%

Discussion

In the presence of an endodontic failure, a non-surgical approach to the root canal system is preferable to a surgical procedure. The literature indicates retreatment success percentages of 40–100% [8]. The variability of the outcome of endodontic retreatment is related to various factors: the patient's age and types of teeth treated [9], the presence of variations in the natural course of the root canals, the possibility of removing the coronal restorations to access the pulp chamber, the techniques used to remove the existing filling materials and the possibility of repairing pathologic or iatrogenic defects [10]. Complete removal of filling material is an important factor in root canal retreatment because it allows for chemo-mechanical re-instrumentation and re-disinfection of the root canal system [11]. Nowadays, complete removal of filling materials has not been demonstrated to ensure success of root canal retreatment, and that remaining material will cause the retreatment to fail. However, removal of as much filling material as possible from inadequately prepared and filled root canal systems would appear to be essential to uncover remaining necrotic tissue or bacteria that may be responsible for periapical inflammation and persistent disease [12]. Several rotary systems associated with different technique have been used to remove filling material during retreatment [13-15]. Therefore, flexible machine-powered rotating instruments made of Nickel-Titanium (NiTi) that exhibit continuous rotary and reciprocal motion have been developed over the last decade [16, 17]. Moreover, several techniques have been introduced to measure residual filling material in the root canal. In some previous studies, two-dimensional images were used to compare the ability of multiple instruments to clean gutta-percha and sealer from root canals [18, 19]. In the current study, the cleanliness of the root canal was measured with the aid scanning electron microscope.

Table - 1: Showing the "one-way Anova test" of the specimens.

	Sum of squares	df	Mean square	F	Sig.
Between groups	34.356	2	17.178	5.044	.016
Within groups	71.514	21	3.405		
Total	105.780	23			

Table - 2: Showing the mean difference for the three groups.

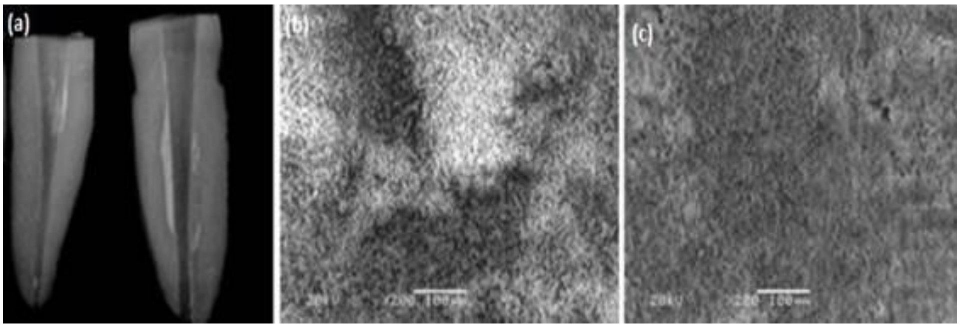
(I) Groups	(J) Groups	Mean difference (I-J)	St. Error	Sig.	Lower Bound	Upper Bound
Group 1	Group 2	-2.60425	.92269	.010	-4.5231-	-.6854
	Group 3	-.13800-	.92269	.883	-2.0568-	1.7808
Group 2	Group 1	2.60425	.92269	.010	.6854	4.5231
	Group 3	2.46625	.92269	.014	.5474	4.3851
Group 3	Group 1	.13800	.92269	.883	-1.7808	2.0568
	Group 2	-2.46625-	.92269	.014	-4.3851-	-.5474-

*Significant at the 0.05 level

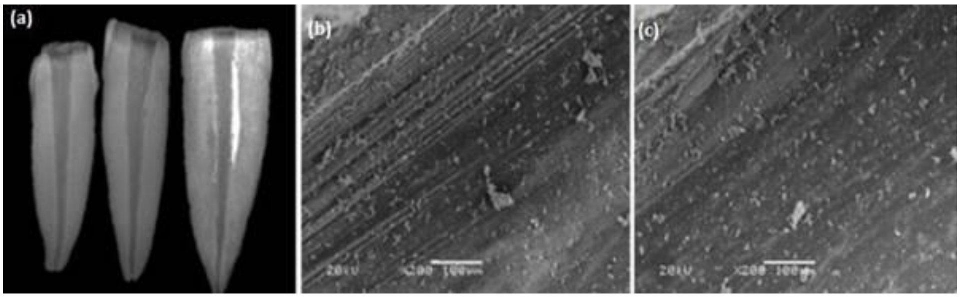
Scanning Electron Microscopy

Scanning electron microscopy (SEM) images of surfaces have great resolution and depth of field, with a three-dimensional quality that offers a visual perspective familiar to most users. SEM images are widely used, and much has been written about the technique. The comments here are primarily oriented toward SEM as a surface analysis tool. SEM functions by focusing and restoring a relatively high-energy electron beam (typically, 5–100 keV) on a specimen that is under vacuum. Low-energy secondary electrons (1–20 eV) are emitted from each spot where the focused electron beam makes an impact. The intensity of the secondary electron emission is a function of the atomic composition of the sample and the geometry of the features under observation. The image of the surface is spatially reconstructed on a phosphor screen (or CCD detector) from the intensity of the secondary electron emission at each point. Because of the shallow penetration depth of low-energy electrons produced by the primary electron beam, only the secondary electrons generated near the surface can escape and be detected. Consequently, SEM is a surface analysis method [20]. SEM is widely used to investigate the microstructure and chemistry of a range of materials. The main components of the SEM include a source of electrons, electromagnetic lenses to focus electrons, electron detectors, sample chambers, computers, and displays to view the images. Electrons, produced at the top of the column, are accelerated downwards where they passed through a combination of lenses and apertures to produce a fine beam of electrons. The electron beam hits the surface of the sample mounted on a movable stage under vacuum. The sample surface is scanned by moving the electron-beam coils. This beam scanning enables information about a defined area of the sample. The interaction of the electron beam with the sample generates a number of signals, which can then be detected by appropriate detectors [21].

<u>Figure - 2</u>: A photomicrograph by SEM of (a) X25 and (b, c) X200 showing specimens of group 1 that were retreated by Gates Glidden and H hand files.



<u>Figure - 3</u>: A photomicrograph by SEM of (a) X25 and (b, c) X200 showing specimens of group 2 that were retreated by ProTaper retreatment system.



<u>Figure - 4</u>: A photomicrograph by SEM of (a) X25 and (b, c) X200 showing specimens of group 3 that were retreated by FKG retreatment system.

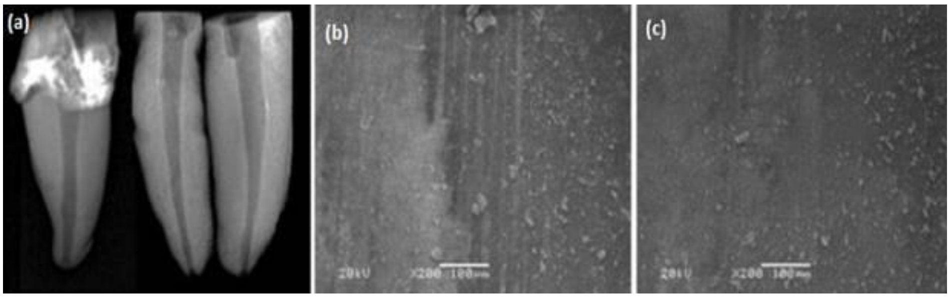


Figure - 5: A graph showing working time per minutes for each group.

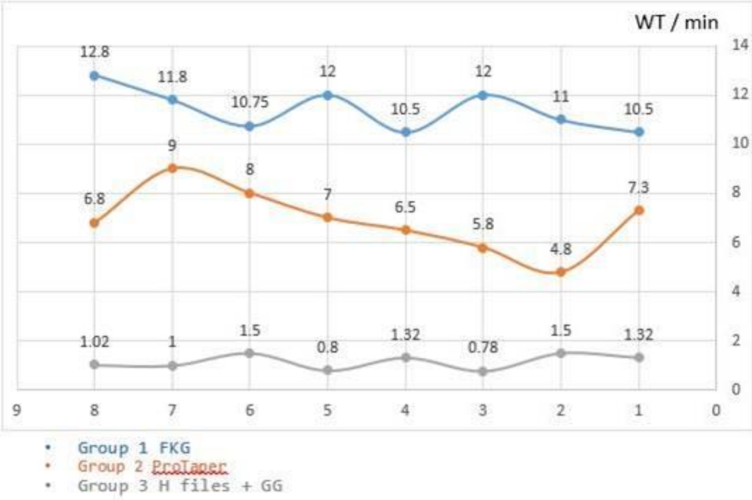
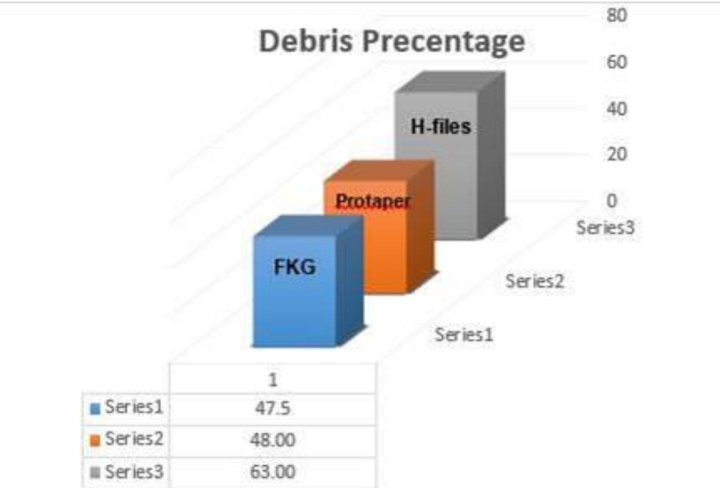


Figure - 6: A graph showing amount of remaining debris for each group.



The evaluation of debris and the presence of smear layer require high magnification levels that are achievable only by SEM. Thus, the standard technique for evaluating post-operative root canal cleanliness is by imaging the root canal walls with SEM. [22]. Numerous studies have investigated the cleanliness of un-instrumented areas of the root canal under SEM, using longitudinal sections of extracted teeth [23]. According to L.S. Gu, J.-Q Ling, X. Wei, X.-Y. Huang [24], performed a study to evaluate the efficacy of the ProTaper Universal rotary retreatment system for gutta-percha (GP) removal from root canals. He concluded that, all techniques left GP/sealer remnants on root canal walls. The ProTaper Universal rotary re-treatment system removed GG more efficiently than traditional techniques in maxillary anterior teeth.

In the present study, ProTaper and FKG retreatment instruments, which have been developed for root canal retreatment, were used, and their effectiveness was evaluated.

In the current study, ProTaper and FKG were used for removal of filling material. There was significant difference in the total time required for retreatment. FKG group was found to be significantly less (mean 1.5 min) than those of teeth prepared with Pro-taper (mean 7 min) and H-files (mean 11 min). However, under the electron scan microscope, it has been shown that the debris percentage for both FKG (47.5%) and Pro-taper (48%) were found to be significantly less than that observed with H-files group (63%). The current findings indicate that it is impossible to clean the root canal by 100% with all of these instruments, as our result showed some remnant filling material on the root canal walls in all groups. Both of ProTaper, FKG were used for instrumentation were effective, safe and fast in terms of removal of obturation material during retreatment.

This study was performed on teeth with straight root canals. Therefore, our final decision cannot be generalized to teeth with curved root canals. Further investigation is necessary to evaluate the efficacy and safety of rotary FKG dentaire during retreatment of teeth with more complicated root canal anatomy.

Conclusion

In the current study, teeth retreated using the FKG dentaire and Protaper, have nearly similar remnant filling material was observed. While teeth prepared with H-files instruments contained significantly more remaining filling material than those prepared with ProTaper and FKG.

The time required to remove gutta-percha and AH Plus sealer was significantly less in FKG than that required for the ProTaper and H-files. Moreover, the total required time needed for retreatment time of the teeth prepared with FKG was significantly reduced compared to that of those prepared with ProTaper and H-files. The mean difference is significant at the 0.05 level.

References

1. S. A. Frank, A. G. Barbour. Within-host dynamics of antigenic variation. Infection, Genetics and Evolution, 2006; 6(2): 141–46.
2. N. Roˆc ̧as, I. Y. Jung, C. Y. Lee, J. F. Siqueira Jr. Polymerase chain reaction identification of microorganisms in previously root-filled teeth in a south Korean population. Journal of Endodontics, 2004; 30(7): 504–08.
3. L. R. Wilcox. Endodontic retreatment: ultrasonics and chloroform as the final step in reinstrumentation. Journal of Endodontics, 1989; 15(3): 125–28.
4. M. H¨ulsmann, V. Bluhm. Efficacy, cleaning ability and safety of different rotary NiTi instruments in root canal retreatment. International Endodontic Journal, 2004; 37(7): 468–76.
5. E. Ezzie, A. Fleury, E. Solomon, R. Spears, J. He. Efficacy of retreatment techniques for a resin-based root canal obturation material. Journal of Endodontics, 2006; 32(4): 341–44.
6. O. Zmener, C. H. Pameijer, G. Banegas. Retreatment efficacy of hand versus automated instrumentation in ovalshaped root canals: an ex vivo study. International Endodontic Journal, 2006; 39(7): 521–26.
7. J. Ring, P. E. Murray, K. N. Mamerow, B. I. Moldauer, F. Garcia-Godoy. Endodontics: removing root canal obturation materials a comparison of rotary file systems and re-treatment agents. Journal of the American Dental Association, 2009; 14(6): 680–88.
8. Paik S, Sechrist C, Torabinejad M. Levels of evidence for the outcome of endodontic retreatment. J Endod., 2004; 30: 745–50.
9. 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: 361–66.
10. Farzaneh M, Abitbol S, Friedman S. Treatment outcome in endodontics: the Toronto study. Phases I and II: Orthograde retreatment. J Endod., 2004; 30: 627–33.
11. Barrieshi-Nusair KM. Gutta-percha retreatment: effectiveness of nickel titanium rotary instruments versus

stainless steel hand files. J Endod., 2002; 28: 454–56.

12. Schirrmeister JF, Wrbas KT, Meyer KM, Altenburger MJ, Hellwig E. Efficacy of different rotary instruments forgutta-percha removal in root canal retreatment. J Endod., 2006; 5: 469–72.
13. 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.
14. Betti LV, Bramante CM, de Moraes IG, Bernardineli N, Garcia RB. Efficacy of Profile .04 taper series 29 in removing filling materials during root canal retreatment – an in vitro study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod., 2009; 108: 46–50.
15. Ünal GC, Kaya BU, Taç 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.
16. Kocak MM, Kocak S, Turker SA, Saglam BC. Cleaning efficacy of reciprocal and rotary systems in the removal of root canal filling material. J Conserv Dent., 2016; 19(2): 184-88.
17. de Souza PF, Oliveira Goncalves LC, Franco Marques AA, Sponchiado Junior EC, Roberti Garcia L da F, de Carvalho FMA. Root canal retreatment using reciprocating and continuous rotary nickel-titanium instruments. Eur J Dent., 2015; 9(2): 234-39.
18. Taşdemir 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(3): 191-96.
19. Aripin H. The Comparison of Cleanliness Apical Thirds Root Canal Walls in Retreatment Using Rotary NiTi Instrument and Combination of Gates-Glidden Drills and Hedstrom Files. Tesis Universitas Indonesia, 2012; (April).
20. Buddy D. Ratner. Biomaterials Science, Third Edition, Elsevier, 2013.
21. Ashok K. Singh. Engineered Nanoparticles, First edition, Elsevier, 2016.
22. Fariniuk LF, Baratto-Filho F, da Cruz-Filho AM, de Sousa-Neto MD. Histologic analysis of the cleaning capacity of mechanical endodontic instruments activated by the ENDOflash system. J Endod., 2003; 29: 651-53.
23. Peters OA, Barbakow F. Effects of irrigation on debris and smear layer on canal walls prepared by two rotary techniques: A scanning electron microscopic study. J Endod., 2000; 26: 6-10.
24. Gu LS, Ling JQ, Wei X, Huang XY. Efficacy of ProTaper Universal rotary retreatment system for gutta-percha removal from root canals. International Endodontic Journal, 2008 Apr; 41(4): 288-95.