

EFFICACY OF PROTAPER RETREATMENT FILES AND ENDOSTAR RE IN REMOVING TOTALFILL AND ADSEAL

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ABSTRACT

Background: Although root canal therapy has a high degree of success, it doesn't always lead to the desired response, and failure may occur.

Aim of the work: Our study was conducted to evaluate the efficiency of ProTaper Retreatment files (PTUR) and Endostar Re retreatment (ERE) system in removal of different root canal filling materials (TotalFill bioceramic sealer and ADseal resin sealer) regarding remaining obturating material on canal walls.

Materials and Methods: The total number of samples was 60 freshly extracted single rooted canines and were randomly divided into two main groups (I and II) (20 each) according to the type of material used in obturation. Group I: obturated with gutta-percha and total fill sealer, Group II: obturated with gutta-percha and ADseal sealer. Each One of them was categorized into two subgroups: subgroup A and B based on the system use (10 each), Subgroup A: using PTUR and Subgroup B: using ERE. The residual obturating material was evaluated using the digital microscope.

Results: ERE has higher efficiency in removal of obturating material than PTUR system with statistically significant difference. Bioceramic sealer had a significantly higher remaining filling material than resin sealer

Conclusion: Under the circumstances of this study, it can be concluded that : PTUR was fast in retreatment but removed less filling material. ERE was efficient in root canal retreatment. TotalFill sealer was hard to be removed.

KEYWORDS: Different Rotary Ni-Ti Instruments, bioceramic sealer , Root Canal Retreatment.

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INTRODUCTION

Failure might occur in case of persistence of bacteria in the root canal system as a consequence of insufficient cleaning, inadequate obturation, or when there is coronal leakage⁽¹⁾. If root canal therapy fails, treatment options include conventional retreatment (orthograde filling), apical surgery, or extraction. Whenever possible, the conventional retreatment is preferred as it is the most conservative method. Although conservative retreatment may pose a significant challenge to clinicians making it stressful and time consuming procedure, especially in curved canals⁽²⁾.

The main goal of retreatment is to regain access to the apical foramen by removing the root canal filling material completely. Remnants may shield and protect persistent bacteria involved in post-treatment disease maintaining inflammatory process and symptoms⁽³⁾. Removal as much as possible of obturation material allows chemico-mechanical re-instrumentation and re-disinfection of the root canal system⁽⁴⁾. However, none of the techniques evaluated to date could completely remove remnants of gutta-percha and/or sealer from the root canal.

Several techniques for the removal of the root canal filling have been tested, such as manual, rotary and reciprocating instruments and LASER irradiation⁽⁵⁾. Rotary Ni-Ti systems had been introduced for retreatment as ProTaper Universal Retreatment files, MTwo Retreatment files, R-ENDO, D-Race and Endostar RE. Endostar RE (Poldent Co. Ltd) was a newly introduced rotary retreatment files used to efficiently remove old fillings from the canal during root canal retreatment with two different cross sections square cross section with four with 4 cutting edges and good elasticity and s-shaped cross sections with great cutting ability, a non-cutting apex and very good elasticity.

Difficulty in removal of different types of sealers is of great concern as recently introduced bioceramic sealers which are bioactive materials,

biocompatible and can interact with surrounding dentinal tissue forming hydroxyapatite like crystal which are good for adhesion however their removal from the root canal is questionable^(6,7).

Several studies have evaluated the efficacy of different engine-driven nickel-titanium (Ni-Ti) file systems in the removal of root canal filling materials, whereby these systems promised reduced working time^(2,8,9,10). Against this background, this study is aiming to further investigate the applicability of Ni-Ti rotary instruments in the removal of root canal filling material.

Therefore, this study aimed to evaluate the efficiency of PTUR and ERE in the removal of TotalFill and ADseal regarding determination of the amount of remaining obturation material on dentinal walls.

MATERIALS AND METHODS

Manual files #10 Mani (DENTSPLY, Maillefer, Ballaigues, Suisse) were used for patency and tooth length determination, mpro files, sodium hypochlorite 2.5%, 17% ethylene-diamine-tetra-acetic acid (EDTA) solution and plastic syringe with 27-gauge needle for canal preparation and cleaning, Paper points size 50, gutta-percha size 50, Spreader size 35, Flame, condenser, epoxy resin sealer (Ad seal) from Metabiomed for obturation. ProTaper universal retreatment system (DENTSPLY, Maillefer which includes 3 files (D1, D2, D3) (30/9, 25/8, 20/7) respectively, Endostar RE retreatment system (Poldent Co. Ltd, which include 3 files (file 1,2,3) respectively). fissure surgical bur and wheel stone for tooth separation and decoronation, diamond disc and chisel for root splitting, stereomicroscope with digital camera for evaluation of remaining obturating material were also used in the study.

Sample selection: Forty extracted single rooted canines were selected. Teeth were decoronated at 15 mm by low speed diamond disc then access was

done by round bur in a high-speed hand pieces. The working length (WL) was established 1 mm short of that length. All samples were prepared and instrumented using the crown down technique by mpro file system. Apical patency was checked using a size #15 K-file then apical stop was checked by k-file #20, and the canals were irrigated with 2ml of 2.5% sodium hypochlorite (NaOCl) using a 27-gauge needle and a plastic syringe.

Samples grouping: after root canal preparation, the samples were classified into two main groups (I and II) on the basis of the type of obturation material (20 each): Group I: Gutta-percha and TotalFill sealer were used in obturation, Group II: Gutta-percha and ADseal sealer were used in obturation. Each group was classified into two subgroups: subgroup A and B(n=10) on the basis of the system used for clearing away the obturation material: Subgroup A: retreatment was done using PTUR. Subgroup B: retreatment was done using ERE.

Obturation of samples: root canals were dried by paper points size #50 until complete dryness, in group I: all root canals of group I were obturated by lateral compaction technique. Root canals were filled with gutta-percha size #50/.02 and TotalFill. In lateral compaction obturation, canal patency and master cone fitting was checked. TotalFill sealer, as it is a pre-mixed bioceramic obturation material, was injected in the canal and injection tip was inserted not more than the coronal third (5 mm), master cone was inserted in the canal and moved gently to coat the canal wall then a spreader size#35 and auxiliary gutta-percha size#30/.02 were used to complete obturation.

In group II: all root canals of group II were obturated by lateral compaction technique. Root canals were filled with gutta-percha size #50/.02 and ADSEAL. In lateral compaction obturation, canal patency and master cone fitting was checked, ADseal sealer was mixed on mixing bad and was inserted in the canal by the master cone then spreader

size#35 and auxiliary gutta-percha size#30/.02 were used to complete obturation.

After lateral condensation was completed, all canal orifices were sealed by temporary filling and stored in an incubator at 37°C in 100% humidity for two weeks to allow complete setting.

Retreatment of samples: Subgroup A: PTUR files were used in root canal filling removal on the basis of manufacturer's guidance. PTUR (D1, D2 and D3) were used till reaching the full length. Then finally we used Mani H file size #50 to remove the obturation material from apical 1/3 (15 mm).

Subgroup B: ERE files were used for root canal filling removal on the basis of manufacturer's guidance. ERE (files 1,2,3 and 4) were used till reaching the full length. Then finally use Mani H file size #50 to remove the obturation material from apical 1/3 (15 mm).

Evaluation: all samples were splitted longitudinally using chisel into mesial and distal halves. The half of the root that had the largest area of remaining obturation material was selected⁽¹¹⁾ for scanning using stereomicroscope and analyzed at coronal, middle and apical portions, using a fixed magnification of x50. Images were captured using a digital camera fitted on the microscope, and then transferred to desktop and saved as JPEG format. Image J software⁽¹²⁾ was used to analyze the obtained images by measuring the percentage of area covered by remaining obturation material with no attempt to distinguish between residual filling material and sealer⁽¹³⁾.

RESULTS

Numerical data were presented as mean and standard deviation (SD) values. They were explored for normality by checking the data distribution and using Shapiro-Wilk test. Data showed parametric distribution so independent t-test was used for intergroup comparisons and repeated measures

ANOVA followed by Bonferroni post hoc test was used for intragroup comparisons. The significance level was set at $p \leq 0.05$. Statistical analysis was performed with R statistical analysis software version 4.1.2 for Windows^[14]

Regarding over all remaining filling material: Bioceramic sealer (53.99±12.87) had a significantly higher value than resin sealer (40.19±12.11). ProTaper (48.84±12.24) had a significantly higher value than Endostar (42.15±15.09) ($p=0.035$).

Regarding effect of sealers within other variables

PTUR in the coronal sections TotalFill (40.96±4.49) had a none significantly higher value than ADseal (37.63±10.34) in the middle sections, TotalFill (61.52±4.22) had a none significantly higher value ADseal (53.07±10.88) in the Apical sections, TotalFill (59.36±11.06) had a significantly higher value than ADseal (46.27±9.29) ($p=0.042$).

ERE in the coronal sections, TotalFill (38.25±1.30) had a significantly higher value than ADseal (27.93±7.70) ($p=0.007$). in the middle

sections, TotalFill (62.46±4.82) had a significantly higher value than Adseal (31.09±8.44) ($p<0.001$). in the apical sections, TotalFill (61.42±15.10) had a none significantly higher value than Adseal (45.12±3.07). (table 1-figure 1)

Regarding effect of files within other variables

ADseal: in the coronal sections, PTUR (37.63±10.34) had a none significantly higher value than ERE (27.93±7.70). in the Middle sections, PTUR (53.07±10.88) had a significantly higher value than ERE (31.09±8.44) ($p<0.001$). in the apical sections, PTUR (46.27±9.29) had a none significantly higher value than ERE (45.12±3.07).

TotalFill : In the coronal sections, PTUR (40.96±4.49) had a none significantly higher value than ERE (38.25±1.30). in the Middle sections ERE (62.46±4.82) had a none significantly higher value than PTUR (61.52±4.22). in the apical sections, ERE (61.42±15.10) had a none significantly higher value than PTUR (59.36±11.06)(table 2-figure 2)

TABLE (1) Mean, Standard deviation (SD) values of remaining filling material (%) for different types of sealers within other variables

File type	Root section	Remaining filling material (%) (mean ± SD)		p-value
		ADseal	TotalFill	
ProTaper	Coronal	37.63±10.34	40.96±4.49	0.515ns
	Middle	53.07±10.88	61.52±4.22	0.130ns
	Apical	46.27±9.29	59.36±11.06	0.042*
Endostar	Coronal	27.93±7.70	38.25±1.30	0.007*
	Middle	31.09±8.44	62.46±4.82	<0.001*
	Apical	45.12±3.07	61.42±15.10	0.072ns

*; significant ($p \leq 0.05$) ns; non-significant ($p>0.05$)

TABLE (2) Mean, Standard deviation (SD) values of remaining filling material (%) for different file types within other variables

Sealer	Root section	Remaining filling material (%) (mean ± SD)		p-value
		ProTaper	Endostar	
Resin sealer	Coronal	37.63±10.34	27.93±7.70	0.052ns
	Middle	53.07±10.88	31.09±8.44	<0.001*
	Apical	46.27±9.29	45.12±3.07	0.744ns
Bioceramic sealer	Coronal	40.96±4.49	38.25±1.30	0.231ns
	Middle	61.52±4.22	62.46±4.82	0.750ns
	Apical	59.36±11.06	61.42±15.10	0.811ns

*; significant ($p \leq 0.05$) ns; non-significant ($p>0.05$)

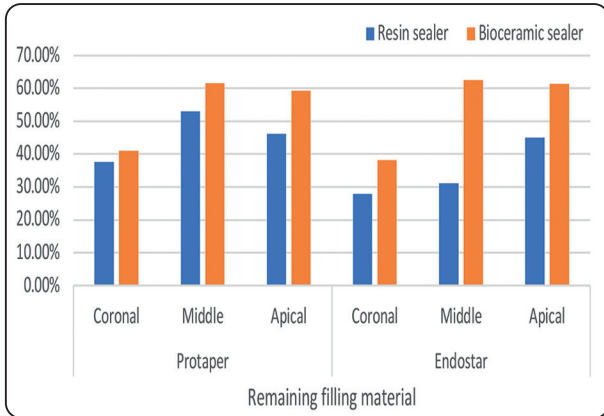


Fig. (1): Bar chart showing average remaining filling material (%) for different types of sealers within other variables

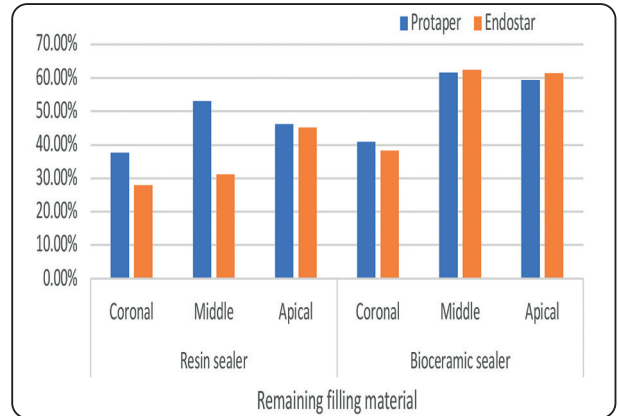


Fig. (2) Bar chart showing average remaining filling material (%) for different file types within other variables

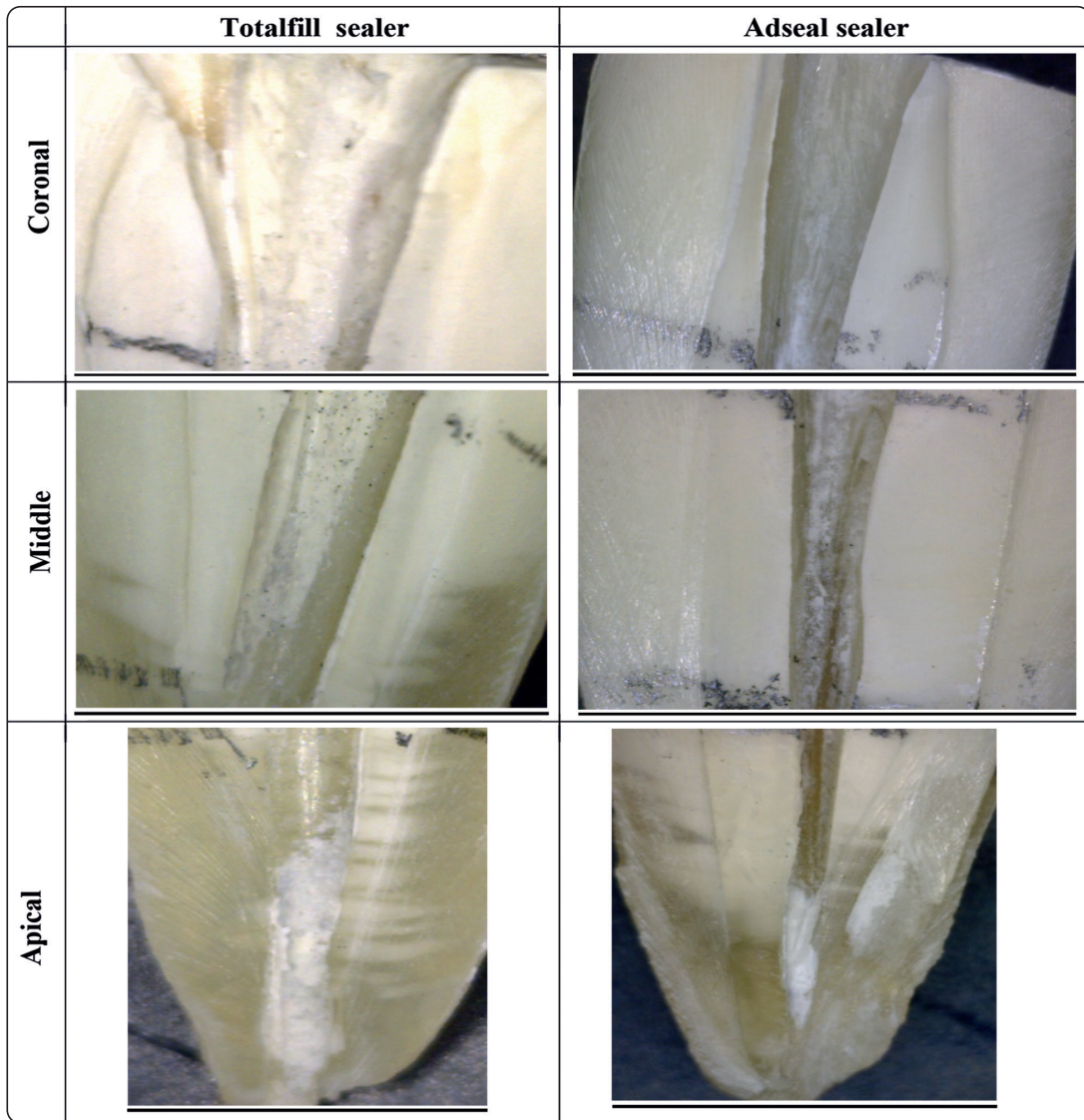


Fig. (3): Digital micrograph showing remaining filling material while using PTUR as retreatment files

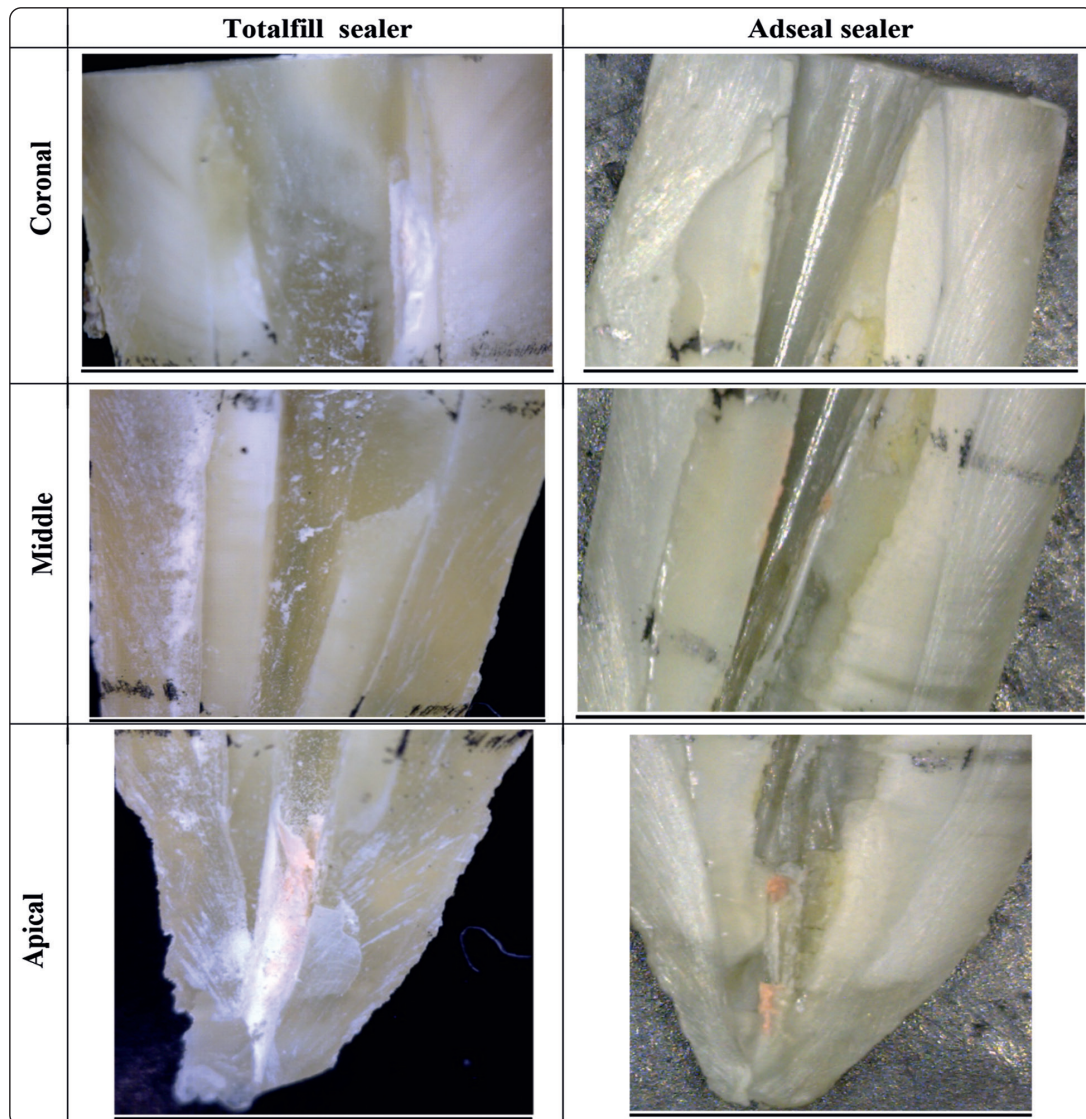


Fig. (4): Digital micrograph showing remaining filling material while using ERE as retreatment files

DISCUSSION

Endodontic treatment is fairly predictable in nature with reported success rates up to 86– 98%. Nonsurgical endodontic retreatment of previously obturated root canals is the initial treatment of choice for the management of endodontic failures. Necrotic tissue or bacteria, covered by remaining gutta-percha or sealer, might be responsible for periapical inflammation or pain. Thus, the maximum quantity of obturation material should be removed to allow chemo-mechanical re-instrumentation and re-disinfection of the root canal system ⁽⁹⁾. In

the current study, the retreatment procedure was considered complete when there was no evident filling material on the last retreatment instrument used. However, all the canals had remnants of the filling material on the canal walls, as shown in other studies ⁽¹⁵⁾. Our results indicate that the absence of filling material on the instruments is not a valid criterion for demonstrating complete removal of filling material from the canal walls, as found in the results of a study by Schirrmeister and others ⁽¹⁰⁾. Due to limited availability of micro-CT scan, in the current study the amount of remaining

filling material was evaluated by longitudinal cleavage followed by quantitative analysis. Three different aspects of the tooth were evaluated: the coronal, middle, and apical thirds in one half of a split root specimen. Root sections were imaged by stereomicroscope followed by analysis using ImageJ software⁽¹⁶⁾. It was reported that this method was effective in determining the amount of filling residue and minimized subjectivity in the scoring method based on a scale⁽¹⁷⁾.

Regarding removal of gutta-percha it is supposed that there are some features that impact the removal of gutta-percha such as Taper, cross section and Metallurgy either it is austenite or martensite. The taper can be either progressive or uniform taper. In this study there were two files one with progressive taper which was PTUR and one with uniform Taper which was ERE. regarding cross section there was one file which was PTUR system which was convex triangle and one with two different cross sections (square for two files and S for third file) which was ERE. Regarding metallurgy there was one austenitic file which was PTUR system, and one martensitic file which was ERE.

ADSEAL is one of epoxy resin-based sealers widely used in Egypt and its properties are comparable to AH plus but more economic. Epoxy resin-based sealer is characterized by its excellent physicochemical properties like resorption resistance, lower toxicity, adhesive properties and dimensional stability^(18,19), despite not showing bioactive potential^(20,21).

TotalFill is one of hydrophilic calcium-silicate based root canal sealers, which instantly attracted the dental community, because it is premixed, injectable, hydrophilic, and bioactive root-filling materials. Overall, the body of evidence made available over the last few years has shown that such hydrophilic calcium-silicate root canal sealers are biocompatible and bioactive, features mostly attributed to the presence of calcium phosphate in their composition.⁽⁶⁾

Root canal preparation was done with Mpro rotary endodontic files. After complete preparation with m-pro files, the preparation continues by hand files up to file #50/0.02 to complete apical preparation⁽²²⁾. After obturation access cavity was sealed with temporary filling and kept in incubator with 100% humidity and 37°C to allow complete setting of the sealer for 2 weeks a protocol based on that of Oliveira and colleagues⁽²³⁾ as sealer reach its max physical properties within 7 to 10 days. In contrast the study carried by Tasdmeir and colleagues the obturation material was allowed to set for six weeks. In clinical practice, many months or years typically pass before a tooth requires retreatment. As time elapses, the setting, chemical and physical characteristics of the obturation materials and sealers may change slightly according to environmental conditions⁽²⁴⁾.

For retreatment, some modification was done to treatment sequence that further canal re-preparation accomplished after the final retreatment file. H file size #50/0.02 was used after removal of gutta-percha by the retreatment kit of each system. The introduction of shaping file is to completely remove the gutta-percha from apical area because the retreatment files will only remove gutta-percha from the coronal and middle third of the canal, but the apical area will remain untouched. The final file in retreatment kits was #20/0.07/#30/0.06 and canal was prepared by 50#2% so the last apical 5 mm will remain untouched^(8,25,13).

In the current study, the amount of remaining filling material was evaluated by longitudinal cleavage followed by quantitative analysis. The sectioning of roots was performed carefully so as not to dislodge the gutta-percha from the canal walls. After the roots were separated longitudinally, evaluation of remaining filling material was performed by calculating the percentage of debris in the canal. Three different aspects of the tooth were evaluated: the coronal, middle, and apical thirds

in one half of a split root specimen. Root section were imaged by digital microscope followed by analysis using ImageJ software⁽¹⁶⁾. ImageJ software for analysis of digital micrographs is somewhat a subjective method for evaluation of remaining filling debris. It was reported that this method was effective in determining the amount of filling residue and minimized subjectivity in the scoring method based on a scale⁽²⁶⁾.

Under the conditions of the present study, it was impossible to remove root canal filling material completely in the root canals regardless of retreatment method using PTUR system or ERE system in full agreement with other studies where neither of techniques used in retreatment was able to completely remove root canal filling material.

The results of the current study showed that a greater amount of root canal filling material was observed in PTUR group in comparison to ERE with significant difference. This could be attributed to the greater files size and taper of ERE (#30/0.06) than PTUR (#20/0.07) and the s shape cross section of ERE which give us great cutting ability. These results were in full agreement with other studies which found M-two retreatment files which share the same s shape cross section design of ERE, left less remaining filling material than PTUR files⁽²⁷⁾. However, there was conflict with other studies that found ProTaper more efficient than MTwo, this could be attributed to the use of solvent in these studies⁽²⁸⁾.

Regarding type of root filling material, the results of current study revealed that a greater amount of root canal filling material was observed in TF-BCS group in comparison to AD-RBS with significant difference. This could be attributed to the greater bonding of bioceramic sealer by its ability to form hydroxyapatite like crystals. These results were in full agreement with other studies which indicate that after the removal of root canal sealer from the root canal, MTA Fillapex⁽²⁹⁾,

iRoot SP⁽²⁹⁾ or EndoSequence BC Sealer were demonstrated to leave more remnants compared to the conventional root canal sealer^(30,31, 32)

Regarding percentage of remaining root filling material in different root sections the results of current study showed that the least percentage of obturation material was found in the coronal third than in middle and apical third, with significant difference. This could be attributed to the volume of the irrigation used as in coronal part more volume used and act as reservoir.

CONCLUSION

Under the circumstances of this study, it can be concluded that:

1. Endostar-RE retreatment system was efficient in removal of root canal filling material.
2. Canal level affected the amount of remaining root canal filling material.
3. Retrieval of TotalFill BC sealer in root canal filling was difficult.

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