

COMPARISON OF EFFICIENCY AND EFFECTIVENESS OF FIBER POST REMOVAL IN MULTI-ROOTED TEETH USING FOUR DIFFERENT TECHNIQUES

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ABSTRACT

Aim: To compare the speed (efficiency) and effectiveness of 4 different fiber post removal techniques.

Materials and Methods: Fiber posts (GC Corporation, Japan) were cemented using Gradia Core (GC Corporation, Japan) into 36 maxillary first molar teeth, after endodontic therapy and post space preparation were completed. The teeth were divided into four groups according to technique of post removal: group A; Largo reamers (Dentsply Maillefer, Switzerland), group B; Roane Gates Glidden drills (Miltex GmbH, Rietheim-Weilheim, Germany), group C; Needle bur #859 314 010 (Komet, Brasseler, Germany) group D; Thermafil Post Space Bur # 5 length 25(Dentsply Maillefer, Switzerland). Samples were then divided between three general practitioners for post removal. Speed (efficiency) and effectiveness according to a 6 degrees scale were recorded. Data were collected and statistically analyzed.

Results: There was no significant difference degrading the efficiency to remove fiber post using either techniques (p value: 0.47). Group A scored the shortest mean removal time (9.5 min) while group B scored the longest mean removal time (14.4 min). Regarding effectiveness no significant difference was found between or among groups either techniques (p value: 0.14). Group D scored the best mean scores (2.4) while group A and B scored the least mean scores (3.9). Regarding Score 6 (off-axis drilling), only group C recorded 2, and group D: 1.

Conclusions: none of the techniques used was significantly effective or efficient in removing fiber post.

INTRODUCTION

Controversies always surround endodontically treated teeth (ETT). Several classic studies have proposed that the dentin in ETT is different than

dentin in teeth with “vital” pulps ⁽¹⁻³⁾. It was thought that the dentin in ETT was more brittle because of water loss ⁽¹⁾ and loss of collagen cross-linking ⁽³⁾. However, more recent studies ^(4,5) dispute

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this finding. In 1991, Huang et al.⁽⁴⁾ compared the physical and mechanical properties of dentin specimens from teeth with and without endodontic treatment at different levels of hydration. They concluded that neither dehydration nor endodontic treatment caused degradation of the physical or mechanical properties of dentin. Sedgley and Messer⁽⁵⁾ compared the biomechanical properties of dentin from ETT to vital teeth. The properties were comparable. These and other studies support the interpretation that it is the loss of structural integrity associated with the access preparation, rather than changes in the dentin, that lead to a higher occurrence of fractures in compared with “vital” teeth^(6,7,8).

ETT with extensive loss of coronal structure are usually restored with a post and core over which a crown is constructed. This procedure requires partial removal of the root canal filling material to prepare adequate space for the post and retention of the intracanal post is determined by mechanical features⁽⁹⁻¹⁴⁾. Cast posts and cores have been the standard for many years and are still used by clinicians⁽¹⁵⁻¹⁷⁾. These may be indicated when a tooth is misaligned or when the coronal structure is minimal and the core must be angled in relation to the post to achieve proper alignment^(13,18). While metallic posts are generally easy to retrieve when endodontic retreatment is necessary^(16,20), removal of large amounts of sound tissue⁽¹⁹⁾ and the core stiffness is different from dentin^(7,11). The major disadvantage of metallic posts is the dark shadow that appears on the marginal gingiva, which is caused by the oxidation process^(18,21). Among the materials used for aesthetic procedures, glass-fiber posts have gained popularity due to favorable biomechanical properties^(20,22-24). They are more flexible than metallic cast posts and forces are better distributed, resulting in fewer root fractures^(18,25). Besides, these prefabricated posts are advantageous in cases where the coronal tooth structure is not extensively lost^(14,22,25).

In some cases, the restoration or the root canal seal fail, removal of the post may be necessary to allow nonsurgical retreatment. Ideally, the post should be retrievable without substantial loss of tooth structure or damage to the tooth. Fiber posts reportedly can be removed with conventional rotary instruments or by use of solvents, minimizing the effect on remaining dentin.^(26,27) While the process may be more time-consuming or difficult, metal posts also can be removed safely,⁽¹²⁾ typically after loosening the post with ultrasonics. Ceramic posts are considered difficult to remove, often requiring cutting with rotary instruments.⁽¹⁸⁾ So, the ability to remove an existing post depends on the type of material that it is fabricated from. Most current techniques for the removal of metal posts involve the enlarging of the canal around the residual post until it can be manipulated or seized by a hand instrument. These techniques may further weaken the already frail roots and may render the tooth with poor prognosis or rather irreparable. In most fiber post removal situations, the clinician is generally confronted with a fiber post of unknown origin. In these instances, most removal kits would be ineffective because manufacturers for their respective post systems specifically design them. An off-axis drilling or even perforation may occur as a result of loss of distinction between the fiber post and root dentine. A universal fiber post removal system would be beneficial to allow removal of any fiber post system. The aim of this research is to compare between different techniques of fiber post removal in speed and effectiveness to recommend the safest and most efficient one. The hypothesis of this research is that there will be difference among tested techniques in both efficiency and effectiveness.

METHOD AND MATERIALS

Thirty-six extracted, maxillary first molar were selected. All teeth were selected free of any fractures as evaluated under digital microscope (Dino-Lite,

241Taiwan) and radiographically. All teeth were cleaned and sterilized in an autoclave at 121°C, 15 Psi for 40 minutes. They were then mounted 2mm below the cement-enamel junction (CEJ) in an auto-polymerized acrylic resin (Vertex-Dental B.V., The Netherlands) blocks with a size of 10mm x 10mm x 20 mm. Palatal canals were manually instrumented using K-files (Dentsply Maillefer, Switzerland) with #40 master apical file using crown-down technique. A consistent irrigation and lubrication regimen was followed using 5.25% NaOCl (The Clorox Company, USA), RC-Prep (Premier Dental Products), and no. 20 K-file to working length to ensure regular action of the irrigant and the lubricant in flushing out debris and lubricating files within the canal. After final irrigation with 2ml of distilled water, the canals were then aspirated and dried with absorbent paper points (Dentsply Maillefer, Switzerland). They were obturated with gutta-percha points (Dentsply Maillefer, Switzerland) and endodontic sealer (AH Plus, Dentsply, DeTrey, Germany) using lateral condensation technique. Mesial and palatal walls were removed in all teeth 1 mm above the CEJ, using round-end taper diamond bur # S6856 314 018 (Komet, Brasseler, Germany) in a high-speed handpiece under water spray. Specimens were placed in distilled water at room temperature for 72 hours. Post space preparation was initiated by the removal of 9 mm of gutta-percha with Gates Glidden #1 drills (Dentsply Maillefer, Switzerland) then completed using Peeso reamers #1 to #3 (Largo, Dentsply Maillefer, Switzerland). The manufacturer supplied post drill was used then to final prepare the post-hole. All post-holes were thoroughly flushed using NaOCl then distilled water and later dried by blasts of air then paper-points. All canals were painted with self-etching adhesive (Xeno V+, Dentsply, UK) using Microbrush-X (Microbrush, Grafton, USA) for 20 sec. The material was then thinned out using air blasts for 5 sec. and cured for 10 sec. using LED-curing light (Elipar S10, 3M ESPE, USA). Gradia Core (GC Corporation, Japan) was dispensed into canal and adjusted GC fiber post

(GC Corporation, Japan) was inserted into canal. Curing light was applied on the post head for 20 sec. The remaining crown was filled around the post with Gradia Core. (Fig. 1) For all groups a 1.5 length ferrule and 0.5 mm chamfer finish line was prepared using round-end taper diamond bur with guiding pin # 8881 P (Komet, Brasseler, Germany) on a parallelometer (Amann Girrbach, Germany). The teeth were divided into four groups according to post removal technique according to (Table 1 and Fig. 2).



Fig (1) Sample before preparation.

TABLE (1) Sample grouping

Group	Removal technique	No of samples
A	Peeso reamers (Largo,Dentsply Maillefer, Switzerland)	9
B	Roane Gates Glidden drills (Miltex GmbH, Rietheim- Weilheim, Germany)	9
C	Needle bur #859 314 010 (Komet, Brasseler, Germany)	9
D	Thermafil Post Space Bur # 5 length 25 (TPS) (Dentsply Maillefer, Switzerland)	9
Total		36



Fig. (2) A: Peeso reamer. B: Roane reamers.

C: Needle bur. D: Thermanfil Post Space Bur.

All teeth were randomly divided between three general practitioners, twelve teeth each. Each three teeth were removed following corresponding technique.

Data collection

Post removal times, representing efficiency, for each tooth were recorded, starting just before mounting the first bur on the drill and ending when the apical gutta-percha was fully exposed in the canal or failure to continue drilling.⁽²⁵⁾

Evaluation of effectiveness of fiber post removal

After post removal was completed, the teeth were grooved longitudinally on the facial and lingual sides with a carbide-tipped bur in a high-speed water-cooled hand-piece, and the roots were split using a chisel. (Fig. 3) The 2 halves of the root were placed back in the tooth's numbered vial and later evaluated. Using digital microscope, x-ray and CBCT the effectiveness of fiber post removal was graded on a 5-point scale ordinal as follows:

1. Only dentin can be seen after post removal.

2. Only cement can be seen after post removal.
3. Less than 25% of the post fibers are left after post removal.
4. 25% to 50% of the post fibers are left after post removal.
5. More than 50% of the post fibers are left after post removal.
6. Off-axis drilling or perforation.

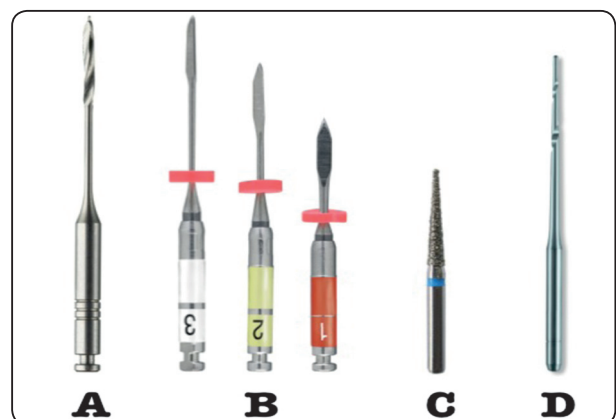


Fig. (3) Sectioned samples.

RESULTS

In this study, thirty-six fiber posts and resin core-restored teeth were randomly divided between three general practitioners for post removal using four different techniques. Time (efficiency) was measured and effectiveness was scored according to strict 6-point scale using both periapical X-rays (Fig.4) and CBCT imaging (Fig.5) in conjunction of professional measuring software (ISM-PRO, 241Taiwan).

The mean, median and standard deviation regarding efficiency of each group are listed in table 2 and chart 1. One-way ANOVA revealed no significant difference between groups (P Value= 0.47) or among groups using either techniques (Table 3). Group A scored the shortest mean removal time (9.5 min) while group B scored the longest

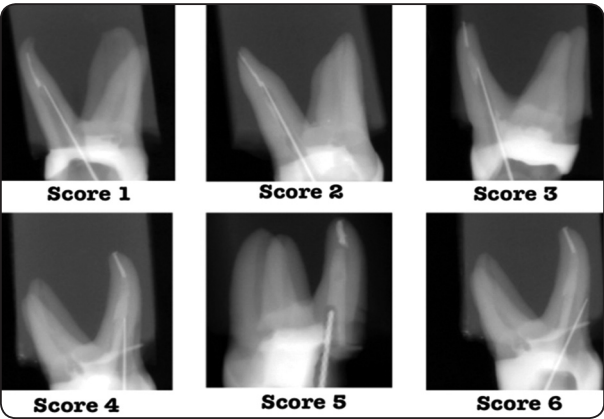


Fig. (4) Scale-scoring using periapical x-rays

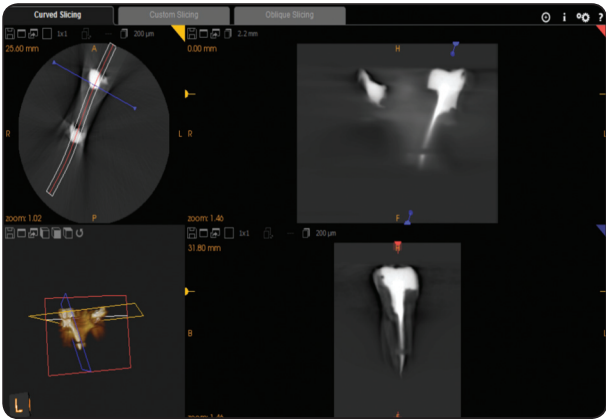


Fig. (5) Scale-scoring using CBCT

mean removal time (14.4 min). On the other hand, the mean, median and standard deviation regarding effectiveness of each group are listed in table 4 and chart 2. The number of off-axis drilling (grade 6) is shown in Chart 3. The number of scale-scoring among tested groups is shown in Chart 4. One-way ANOVA revealed no significant difference between groups (P Value= 0.14) or among groups using either techniques (Table 5). Group D scored the best mean scores (2.4) while group A and B scored the least mean scores (3.9). Regarding Score 6 (off-axis drilling), only group C recorded 2, and group D: 1.

TABLE (2) Efficiency (time) Mean, Median and standard deviation values of the tested groups.

	Mean	Median	Standard Deviation
Group A	9.54	8.2	3.41
Group B	14.43	11.25	10.78
Group C	11.05	9.06	4.4
Group D	11.32	11.66	5.18

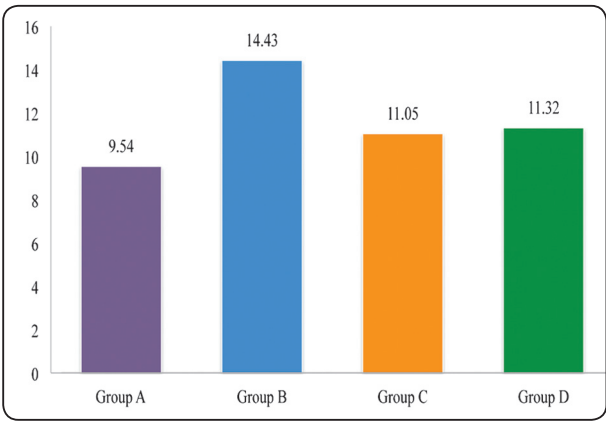


CHART (1) Efficiency (time) Mean values of tested groups.

TABLE (3) One-way ANOVA values of efficiency among tested groups.

	Group A	Group B	Group C	Group D
Group A		0.2	0.61	0.4
Group B	0.2		0.33	0.75
Group C	0.61	0.33		0.94
Group D	0.4	0.75	0.94	

TABLE (4) Effectiveness Mean, Median and standard deviation values of the tested groups.

	Mean	Median	Standard Deviation
Group A	3.89	5	1.45
Group B	3.89	5	1.45
Group C	2.67	2	2.12
Group D	2.38	1.5	1.74

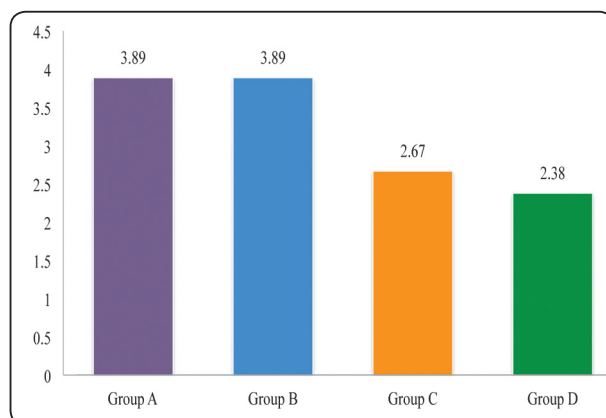


CHART (2) Effectiveness Mean values of tested groups.

TABLE (5) One-way ANOVA values of effectiveness among tested groups.

	Group A	Group B	Group C	Group D
Group A		1.0	0.41	0.4
Group B	1.0		0.63	0.4
Group C	0.41	0.63		1.0
Group D	0.4	0.4	1.0	

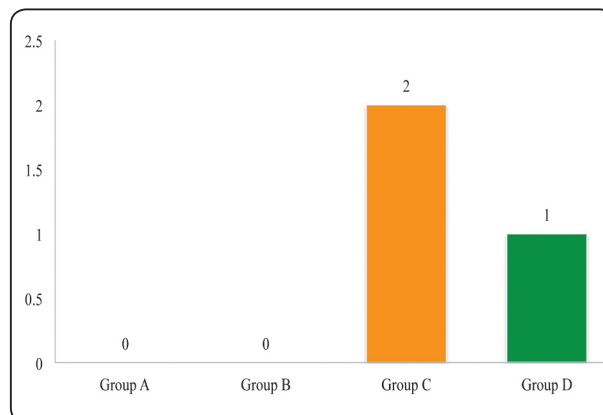


CHART (3) Amount of off-axis drilling and perforations of tested groups.

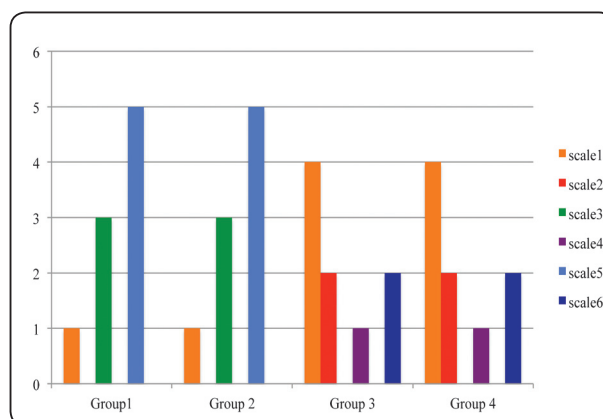


CHART (4) Number of scale-scoring among tested groups.

DISCUSSION

Posts provide retention of the core to the remaining root, for the support of prosthetic restorations ^(13,21,23,28) and prevent microleakage through the interior of intraradicular canals ^(11,29,30). However, clinical longevity of a post-and-core restoration is influenced by many factors, including the direction of occlusal load ⁽³¹⁾, thickness of remaining dentin ^(13-15,18), design of the dowel ^(9,20,31,32) and the type of post ^(18,19,33).

Clinically fiber post removal is one of the most complicated and sensitive situations in dentistry. As simple as it appears, but it need time and skilled hands and precision. In theory fiber post is composed

of a low modulus of elasticity material that can be easily removed, but in practice it is extremely difficult to distinguish between fiber post material and root dentine.

In anterior teeth it might be easy to locate the wide diameter post and its long axis, which is parallel to the long axis of the tooth. But in posterior teeth, the situation is different, the post is usually narrower than that used in anterior teeth, and usually placed in the widest canal; upper palatal and lower distal root. (Fig. 6: A& B) This way it is not parallel to the long axis of the tooth. As a result of that, it is difficult to direct the post removal reamer within the post parallel to its long axis. And as a consequence off-axis drilling and root perforation may occur.

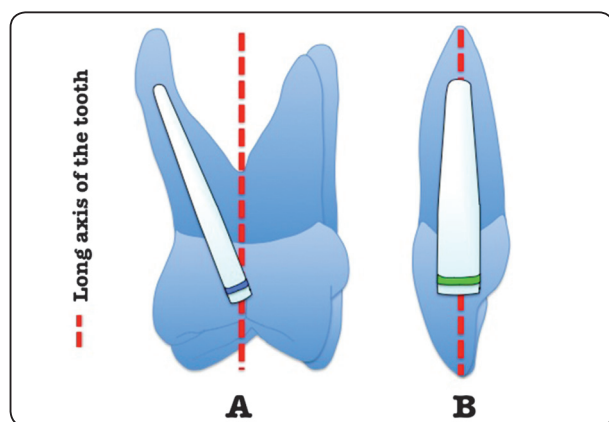


Fig. (6) A: Long axis of maxillary molar in relation to post. B: Long axis of maxillary incisor in relation to post.

All of the studies done before were on single rooted teeth and mostly on maxillary central incisors that utilizes widest diameter fiber post parallel to its long axis. Examples to that researches done by; De Rijk.⁽²⁶⁾ who described post removal as a quick and simple procedure furthermore he added that the unique structure of the fiber posts, consisting of stretched parallel fibers within a resin matrix, is said to help guide the removal drills and burs and to keep them within the confines of the post, thus eliminating the risk of root perforations.⁽²⁶⁾

Sakkal⁽³⁴⁾ and later De Rijk⁽²⁶⁾ described procedures to remove fiber posts using a kit containing a pilot drill, a removal drill, and a Peeso reamer. They added that; fiber posts are removed by drilling a pilot hole to make a channel through the center of the fiber post to full length and then hollowing out the post with successively larger-diameter drills until the post is removed. Recent studies have investigated the removal times of fiber posts after failure and concluded that fiber posts were readily retrievable using a fiber post removal kit.⁽³⁵⁾ An in vitro study by Gesi et al⁽³⁶⁾ evaluated the removal of 3 types of fiber posts using a fiber post removal kit from RTD and a diamond bur and Largo (Peeso reamer) bur. Their statistical analysis found that the carbon-fiber post removal was significantly faster than the removal times for the glass-fiber or quartz fiber post systems. Another in vitro study by Lindemann et al⁽³⁷⁾ evaluated the removal of a metal post and 3 different fiber post types using the manufacturer's recommended post removal system and comparing it to the removal of the same posts with a diamond bur and ultrasonic handpiece. Their results suggested that the respective recommended removal kits were significantly more efficient, while the diamond bur and ultrasonic hand-piece took longer but were more effective. Opposite to the previous studies, the present study aimed to post removal techniques in multi-rooted teeth.

Gesi, et al,⁽³⁶⁾ proposed a 5-point ordinal scale for post removal. A 6th point was added to this study for more precision.

In this study, no significant difference was found between groups in the amount of time needed for removal of fiber post using either techniques. When effectiveness was examined under the digital microscope no difference was found between or among groups either techniques. But when analyzing the results; Peeso reamers didn't cause any off-axis drilling. Roan reamer is a NI TI reamer. Post removal using these reamers was very difficult

with the highest heat generation due to low cutting efficiency which caused dentin burn. It did not cause any of axis-drilling nor perforations. On the other hand needle diamond bur was the least in heat generation but due to its high cutting efficiency and sharp cutting tip it has the highest recorded root perforations (2) and low heat generation. TPS Bur; it is specifically designed for the elimination of the coronal part of the thermafil plastic core. It had only one off-axis drilling. It has a high cutting efficiency due to its design with helical grooves that glides into the fiber post body. After the second tooth, It caused a high heat generation accompanied by the bur itself being burnt rendering it useless. (Fig. 7: A& B) Peeso, Roan reamers and TPS bur had a safe none cutting tip. Only needle bur had a sharp cutting tip.

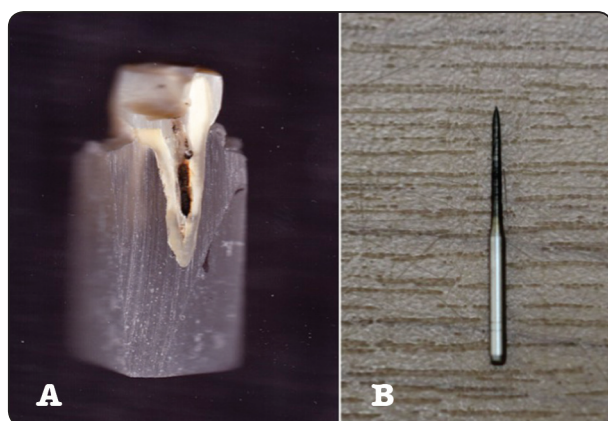


Fig. (7) A: Burnt root dentin. B: Burnt TPS bur.

It should be noted that when selecting a post removal system, both speed and effectiveness remain important factors to consider, while safety of the post removal system is of utmost importance. Further studies may be needed to find a better post removal technique in multi-rooted teeth and to evaluate the amount of root dentin removed with each of the post removal systems. In the end, the hypothesis of the research was failed to be proven, as there were no significant difference among tested groups in both efficiency and effectiveness.

CONCLUSIONS

Within the limitation of the study, it can be concluded that; none of the techniques used was significantly effective or efficient in removing fiber post. Needle diamond bur, should not be considered in fiber post removal as it caused the most off-axis drilling due to its sharp cutting tip.

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