Comparison of the Efficiency and Effectiveness of Various Techniques for Removal of Fiber Posts

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Abstract

A study was conducted to determine the efficiency and effectiveness of several techniques for fiber post removal. Four groups of 20 mandibular premolars were endodontically treated and obturated. Post spaces were prepared for the following post systems: ParaPost XH, ParaPost Fiber White, Luscent Anchors, and Aesthetti-Plus. After cementation, 10 posts of each group were removed with their corresponding manufacturer's removal kit and the other 10 removed with diamond burs and ultrasonics. Removal times were recorded and the teeth were sectioned vertically and microscopically analyzed for removal effectiveness based on a 0 to 5 point scale. Removal kits removed Luscent Anchors the fastest (mean = 3.9 min) and most effectively (mean = 2.6), while Aestheti-Plus posts were removed the slowest (mean = 7.3 min) and least effectively (mean = 3.4). Diamonds and ultrasonics required an average of 10 additional minutes for each fiber post system removal, yet removal effectiveness improved half a point. The results suggest recommended removal kits were significantly more efficient, while diamonds and ultrasonics were more effective. Removal kits could be enhanced with subsequent ultrasonic instrumentation to remove remaining fibers and cement.

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The restoration of endodontically treated teeth frequently requires the use of a cast or prefabricated post and core system. Recently, there has been an increased use of fiber posts and composite cores because of their mechanical and esthetic properties that allow them to blend with the permanent restoration. Studies have shown greater integrity and less stress accumulation within theses systems compared to traditional systems (1, 2). These mechanical advantages are maintained as long as fiber post systems are not contaminated with oral moisture and that fiber integrity is not disrupted during post trimming preparations (3, 4). In addition to these advantages over traditional metal posts, it has been claimed that these posts are easier to remove to allow access to the root canal space in case of a failed post system or endodontic treatment.

The latest generations of fiber posts have elastic moduli more similar to the modulus of elasticity of dentin (4, 5). A post with a modulus of elasticity greater than that of dentin can create stress at the tooth/post interface, possibly resulting in post separation and failure (7). Better dentinal bonding techniques have also been developed to ensure maximal adhesion of the post system (5). However, improved bonding of the fiber post to the canal space may cause a problem for easy removal. Most fiber post removal systems consist of an initiating pin pilot drill followed by a sequence of drills that essentially hollow out the posts. This disrupts the internal integrity of the posts, yet the peripheral portion remains solidly adhered to radicular dentin.

Recent studies have investigated the removal time of several manufacturers' fiber posts. In general, these studies report that fiber posts can be removed in a relatively short time (6, 7). However, many clinicians have found difficulty in completely removing fiber posts. Thus, there appears to be a gap in knowledge between the results of previous research (and manufacturers' claims) and the challenges that clinicians encounter with removal of fiber posts. The purpose of this study was to determine the effectiveness (how thoroughly a post is removed) and efficiency (how quickly a post is removed) of various techniques for removal of fiber posts under standardized conditions.

Materials and Methods

Eighty extracted single-rooted mandibular premolars with similar lengths and widths were used in this study. A diamond disc model trimmer was used to remove the clinical crown 1 mm above the CEJ, perpendicular to the long axis of the root. The prepared teeth were stored in a 0.2% sodium azide solution until used.

The root canals were prepared with .04 ProFile rotary endodontic files (Dentsply/Tulsa Dental Products, Tulsa, OK) and a 2.5% sodium hypochlorite solution. The filling procedures utilized the Spartan Obtura (Obtura/Spartan, Fenton, MO) with Roth's sealer to obturate the canal system. The gutta-percha fillings were removed with a #3 Gates Glidden drill (Dentsply/Maillefer, Ballaigues, Switzerland) to a depth of 8 mm for post space preparation.

One titanium alloy post and three fiber post systems were used: Group 1) ParaPost XH-control (Coltene. Whaledent, Mahwah, NJ), group 2) ParaPost Fiber White (Coltene/Whaledent, Mahwah, NJ), group 3) Luscent Anchors (Dentatus, New York, NY), and group 4) Aestheti-Plus (Bisco Dental Products, Schaumburg, IL). Twenty teeth were prepared for each post. The most common post size among the different companies, 1.5 mm, was chosen to maintain standardization. All post space preparations followed manufacturers' instructions. Dentin was etched, rinsed, and dried with oil free air. ParaPost Cement (Coltene/Whaledent, Mahwah, NJ), a self cure resin cement, was

used for all cementations. Subsequently, the teeth were individually wrapped in water moistened paper towels and stored for 24 hr in individual plastic bags.

Ten posts in each group were removed using their company's corresponding post removal system (method 1) and the other 10 posts were removed using a combination of diamond burs and an ultrasonic scaler (method 2). Method 1 for ParaPost XH utilized the Ruddle Post Removal System-PRS (Analytic/Sybron Dental Specialties, Glendora, CA) with water. All post removal procedures were performed according to the manufacturers' instructions.

Method 2 used #2 and #3 diamond burs (Brasseler, USA) to section the post at the post tooth interface to allow for adequate space for the ultrasonic tip to access the tooth post bonding interface. CT-4 and SP-1 ultrasonic tips were used to break the bonding interface and vibrate out the posts. If this failed the diamond burs were used by the investigator to remove the remnants of the fiber post.

Using a stopwatch, each extraction procedure was timed as a relative measure of the efficiency of the removal procedure. After post removal the teeth were vertically sectioned with a slow speed diamond water saw. Removal effectiveness was assessed under a light microscope as accurately and objectively as possible despite the operator and evaluator being the same individual. The following five point scale was used:

1. Only dentin can be seen after post removal
2. Only cement can be seen after post removal
3. <25% of the fibers or metal are left after post removal
4. 25 to 50% of the fibers or metal are left after post removal
5. >50% of the fibers or metal are left after post removal

A two way ANOVA test determined whether an interaction existed between the type of extraction method applied to a given post type for 1) time and 2) effectiveness. One way ANOVA and Tukey tests were used to determine where significant mean differences existed for extraction time and extraction effectiveness among all the posts and removal methods. Finally, *t*-Tests were used to determine differences in means for time and effectiveness between each post type's suggested removal method and the older accepted method.

Results

The means and SEMs for the removal and effectiveness are presented in Fig. 1. Two way ANOVA found a significant interaction, at $p \leq 0.05$, for the type of method employed for extraction of each fiber post type for both time and effectiveness. The post hoc Tukey tests indicated that the removal kits required significantly less removal time for each post type ($p \leq 0.05$). However, only the group 1 removal kit was significantly more effective in eliminating residual material from the canal walls. Diamonds and ultrasonics were more effective in group 2 and there were no significant differences among methods in either group 3 or 4. When individually evaluating method 1 and 2, there were statistically significant differences in mean time and effect among the different post types at $p \leq 0.05$. For method 1, group 1 was slower than all other groups, and group 4 slower than 2 and 3. Method 2 only found group 1 to be significantly slower than all other groups. For method 1, group 1 was more effectively removed than all other groups, and 3 better than 2 and 4. Method 2 only found group 3 to be more effectively removed than group 1.

Discussion

It has been suggested that one of the advantages of fiber posts is their ease of retrieval. This investigation determined that removal kits are necessary in order for the clinician to maintain efficiency; however, removal effectiveness results may be better achieved through ultrasonics and diamond burs.

The ParaPost XH was included as a control to determine whether fiber post removal was easier and more effective than removing conventional metal or titanium posts. If diamonds and ultrasonics (method 2) were applied, then fiber post removal was far quicker. Method 2 requires the clinician to grind metal posts and trench them circumferentially to fracture the bonded interface and vibrate the posts loose. Unfortunately this resulted in significant radicular dentin loss to the point of possible perforation or initiation of vertical fractures. It was also important to proceed slowly while grinding through metal posts to avoid excessive heat generation. Fiber posts lack these problems because of their composition, yet removal of all posts resulted in slight canal enlargement.

When method 1 was employed, the Ruddle PRS used on metal posts was more effective than fiber post removal kits and only took an average of 10 more minutes to use. In all cases, only cement remained in the canal with the ParaPost XH, whereas fiber post removal kits removed the majority of the post, but cement and fibers were left after

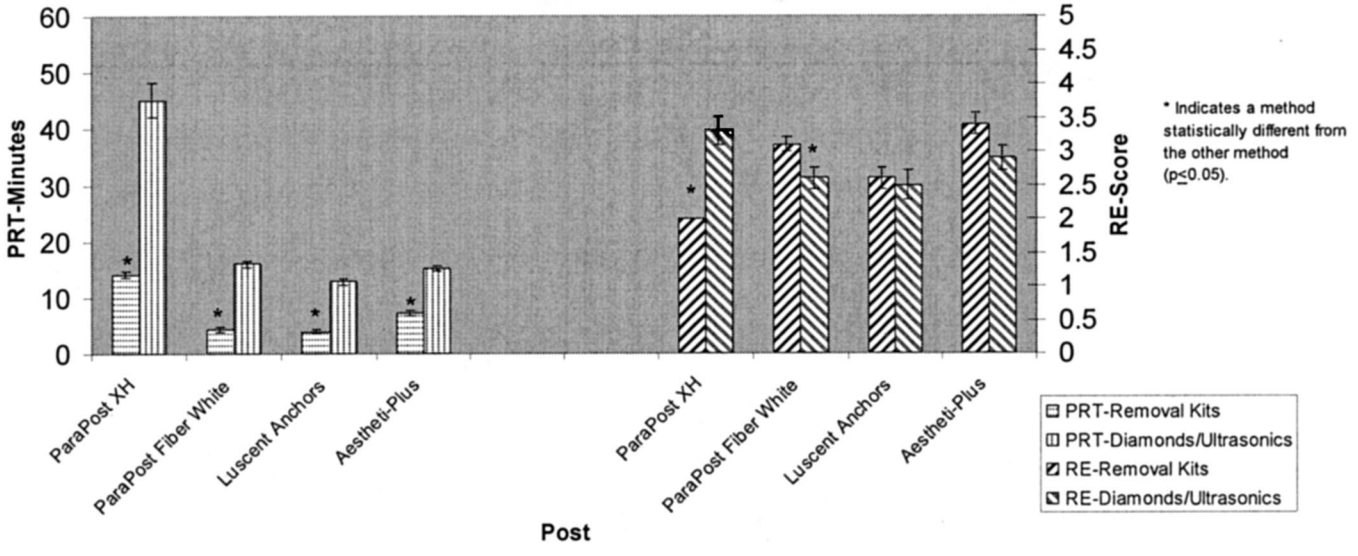

Figure 1. Mean post removal times (PRT) and mean removal effectiveness (RE).

post extraction. This is probably a result of the difficulty in maintaining the removal drills in a central orientation when hollowing through the post. Of particular note, fiber posts were removed only with their corresponding removal kit and without the aid from ultrasonics or diamonds. It would be likely that better removal effectiveness could be obtained with subsequent use of ultrasonic efforts after the removal kits.

In most post removal situations, the dentist is generally confronted with a fiber post of unknown origin. In these instances, all of the removal kits tested would be ineffective since they are specifically designed by manufacturers for their own post systems. Thus, the clinician many times resorts to ultrasonics and burs that may not be necessarily destructive but do distort the canal shape and size. A universal fiber post removal system, similar to the Ruddle PRS, would be beneficial to allow preferential removal of any fiber post while maintaining canal shape and size.

Fiber post removal speed was best obtained with removal kits and fiber post removal effectiveness was best achieved with ultrasonics and diamonds. It is possible that improved performance might be obtained if fiber posts are removed with kits followed by subsequent ultrasonic instrumentation.

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