Removal time of fiber posts versus titanium posts

ROBERT Q. FRAZER, DDS, ROBERT E. KOVARIK, DMD, MS, KENNETH B. CHANCE, DDS, MS & RICHARD J. MITCHELL, PhD

ABSTRACT: Purpose: To evaluate the time needed to remove a glass reinforced fiber post versus a titanium post.

Methods: 40 extracted anterior teeth were mounted in acrylic blocks then treated endodontically. They were randomly assigned to three groups. The teeth were sectioned horizontally, with the coronal portion removed. The fiber posts were cemented with resin cement and the titanium posts were cemented with glass ionomer or resin cement. The fiber posts were removed by coring them out internally. The titanium posts were removed by creating a trough around the post then vibrating with ultrasonic energy. The teeth were examined visually and radiographically to ensure complete removal of the post and cement. Removal time included the time to make radiographs necessary to ensure complete removal.

Results: Post-cement combination significantly affected the median rank of the removal time (Kruskal-Wallis test; H=12.709; P=0.002). The mean rank removal time of titanium posts cemented with resin cement were significantly higher than the mean rank of the other two post-cement combinations (Dunn’s multiple comparison test; P<0.05). There was no significant difference between the other two combinations. (Am J Dent 2008;21:175-178).

CLINICAL SIGNIFICANCE: When removing a fiber post, there is no need to create a trough around the fiber post or to use ultrasonic vibration than may weaken the tooth. The canal space can be cleaned and a new post placed or the canal can be enlarged and additional retentive features added.

Introduction

Though advancements in endodontic techniques, sealers, fillers, posts and cores continue, as many as 36% of root canals will eventually require re-treatment, and at least a quarter of these will involve removal of a post.1

Cast posts had been advocated for over a century, but prefabricated posts have become the predominant modality over the last 50 years. In the last two decades, the trend has been away from stainless steel towards titanium alloy, from active (threaded) posts towards passive, and from wedge-shaped posts towards parallel.2

The dental literature is anything but unanimous about the ideal technique for the removal of posts. A number of case studies describe the use of mechanical removal devices that can be used without root fracture, but there is very little supporting their efficacy.3-6 Most of these devices involve creation of a circumferential gutter around the coronal extremity of the post in order to adequately grasp and extract the post. Such gutters increase the amount of tooth sacrificed during post removal.

A 1993 survey of U.S. endodontists disclosed that for post removal, most would rather employ a hemostat (67%) and/or drill them out with burs (62%). Some respondents reported they thought post removal devices were too dangerous, could not be used universally, or that they did not work. A 2002 survey of Australian and New Zealand endodontists revealed that ultrasonic vibration was used by 95% of respondents.

Ultrasonic energy applied to the exposed metal post for 16 minutes would break down the zinc phosphate cement, and could reduce the amount of force necessary in vitro to extract metal prefabricated posts.7 Two studies demonstrated that some ultrasonic sources and tips were more effective than others. Also, application of ultrasonic energy to posts created microcracks in the remaining dentin, and that it took longer to remove posts after ultrasonic energy application than it took with a Gonan remover.8 Contradicting the conclusions of Johnson et al,4 Hauman et al found that neither alloy type, cement type or 16 minutes of ultrasonic vibration decreased the force required to remove titanium posts. After comparing the 4 mm deep gutter technique to a 10-minute ultrasonic procedure, Chandler et al12 concluded that neither approach was particularly successful.

In most cases, the practitioner is resigned to approach the removal of these posts on a case-by-case basis armed only with an insurance code and little formal training for the procedure. Regardless of the preferred removal technique, the properties of a metallic post and the typical length of their penetration dictate that the post be removed intact. Clinically, the ease or difficulty of removal may depend on numerous factors, including: the condition of the tooth, leakage, corrosion activity, length of post insertion, and presence of a restoration and/or prosthesis. Titanium posts cemented with adhesive resin cements were more difficult to remove after ultrasonic vibration than those cemented with zinc phosphate or glass-ionomer cements.13

The consensus of the dental literature fails to support any particular method for post removal. Current textbooks and conversations with experienced clinicians suggest that removal procedures should include: (1) a circumferential trough created with a bur, (2) ultrasonic energy to dissolve cement, and (3) some tugging to remove the post.14

In 1990, Duret et al15 patented an endodontic post made of carbon fiber reinforced composite. Introduced as the Composipost these became immediately popular in Europe, and were introduced to the US marketplace in 1995 as the C-Post.16 Exhibiting good strength and an elastic modulus (rigidity) close to that of dentin and a fraction that of metal, these posts have been shown to reduce, if not eliminate the incidence of root fracture in vitro16,17 and in vivo.18,19 Even when bonded in place with bonding agent and resin cement, the carbon fiber posts could be easily removed by hollowing them out from their center.20 Because of the inherent clinical advantages of fiber posts, this basic technology has been widely imitated and improved upon. Recently marketed fiber posts are
Fiber posts, from a variety of manufacturers, can be removed in a matter of minutes without a circumferential trough, ultrasonic vibration and/or pulling/prying. Only Lindemann et al. compared the time to remove fiber posts with the time to remove titanium posts. The present in vitro study compared the time required to remove metal and fiber posts and to examine the role of luting cement on the removal time of titanium posts.

Materials and Methods

Endodontic preparation of teeth - Forty extracted maxillary central, lateral and canine incisors were mounted in acrylic blocks at the level of the CEJ. The minimal apical size was a #35 file, and apical stepback flaring was accomplished with hand instrumentation. The middle and coronal flaring was made with ProFile Orifice Shapers (#20–#60). The canal was repeatedly irrigated during instrumentation with an aqueous solution of 5.25% NaOCl. The root canals were obturated by lateral condensation with gutta percha and Roth’s Root Canal Cement.

Post space preparation - All teeth had the crowns removed to within 1 mm of the CEJ. All teeth were radiographically imaged and size and length of post were chosen by the following criteria. The length of post was chosen so that it extended at least 1 mm of remaining tooth structure. Post lengths ranged between 6 and 10.5 mm. Post diameters were either 5 or 5.5. To determine the diameter of the prepared root canal, a radiograph displaying the canal space in the apical and middle third of the root was measured and a diameter was selected that did not remove excessive dentin in the apical third. Post space preparation was accomplished by initially using Gates Glidden burs of increasing diameter and finalizing the preparation with the post-space-preparation drill supplied by the post manufacturer corresponding to the chosen post diameter.

The teeth were randomly divided into three groups. Each group was restored with a different combination of prefabricated post and luting cement. Prefabricated metallic and fiber posts from a single manufacturer were studied. Group 1 teeth received a fiber post (ParaPost FiberLux Post) luted with an adhesive resin cement (ParaCem Cement). Group 2 teeth received a parallel sided, serrated, metal post (XH Titanium Post) luted with the adhesive resin cement used in Group 1. Group 3 teeth received the same metal post as in Group 2, but was luted with a glass-ionomer cement (Ketac-Cem). To avoid bias due to a learning curve, the groups were restored in random sequence.

Post cementation techniques

Group 1: Fiber post/adhesive resin cement. Conditioner (ParaBond) was applied to the canal space with a brush, massaged for 30 seconds, and dried with a paper point followed by a light jet of air. The adhesive (ParaBond) was applied with a brush and left for 30 seconds. Excess was removed with a paper point and air dried. The fiber post corresponding to the final drill size was cleaned with isopropyl alcohol. Equal amounts of cement base and catalyst (ParaCem) were mixed for 20–30 seconds and placed on top of the post and cured at 350 mW/cm² intensity for 60 seconds.

Group 2: Metal post/adhesive resin cement. The specimens in this group were prepared using the same procedures as those in Group 1, except that the metal post was used instead of the fiber post.

Group 3: Metal post/glass-ionomer cement. The prepared canals were dried with paper points. The glass-ionomer cement was mixed and applied to the surface of the post. A lentulo spiral was used to spin cement into the canal space. The post was inserted and light finger pressure was applied for 60 seconds. Excess cement was wiped away and a curing wand tip (Optilux 400) placed on top of the post and cured at 350 mW/cm² intensity for 60 seconds.

Post removal techniques

Fiber post removal - The method for removal of these posts was that suggested by the manufacturer’s instructions for the studied fiber post system. The teeth were horizontally sectioned with the coronal portions removed. The center of the post was indented using a #1/2 round bur at high speed. An initial channel was made through the center of the fiber post using a drill (Kodex K95) at slow speed. The center of the post was then carefully drilled to its full length with an end-cutting drill (Tenax Starter Drill (TE-DC-1)). The fiber post was gradually ground out by using the manufacturer’s set of drills. Drills of gradually increasing diameter were used until the original diameter of the preparation was attained. After grinding out the post, radiographs were made to confirm that the post had been completely removed. The start time for the procedure was recorded to the nearest second as the moment when the centering hole was begun. The finish time was recorded as the moment when a radiograph revealed that all cement had been removed.

Metal post removal - The titanium posts were removed with an ultrasonic vibration technique. A piezoelectric ultrasonic scaler (P5 Booster) was used at the setting of 13. A fine tapered ultrasonic tip (P1) was used to cut a trough around the metal post until slight movement of the post was noticed. College pliers were then used to try and lift out the post. Water did not make this determination difficult because the flow was minimal. The diameter of the preparation was gradually worked up to remove all cement located in the canal and the original diameter of the preparation was attained. As above, the proce-
dure was continued until cement removal was confirmed; therefore, multiple radiographs may have been required. The start time for the procedure was recorded as the moment that the trough around the tooth was begun. The finish time was recorded as the as the moment when a radiograph revealed that all cement had been removed.

Results

The Figure shows the mean removal times. The initial plan was to use an ANOVA to analyze this data. The underlying assumption of ANOVA is that the sample populations to be compared each have a normal distribution and that the variances of the means are homogeneous.24 Tests for normality25 showed that the sample population of each group was normal. However, the null hypothesis that the variances of the removal times are equal was rejected (Levene's Test for Homogeneity of Means, \( F = 7.16; P = 0.0028 \)).

Since ANOVA could not be used, a one-way Kruskal-Wallis ANOVA of median ranks was used. This is a nonparametric test, which requires neither a normal distribution nor homogeneous variances.26 The one-way Kruskal-Wallis ANOVA of median ranks is the nonparametric analogue of the parametric ANOVA.24 The data was converted to ranks and the Kruskal-Wallis test was run for the effect of group on the rank of the removal time. Test group was found to significantly affect the median rank of the removal time (\( H = 12.709; P = 0.0026 \)). Dunn's multiple comparison test (\( P < 0.05 \)) showed that the median rank of the removal time for titanium posts cemented with resin cements was significantly higher than the median rank of either of the other two groups. Groups 1 and 3 were not significantly different from one another.26

Kruskal-Wallis one-way ANOVA were also used to investigate whether post length or post diameter had a significant effect on removal time. For each of the groups, post length was found to have no significant effect on rank removal time (Group 1, \( H = 3.69, P = 0.72 \); Group 2, \( H = 6.82, P = 0.23 \); Group 3, \( H = 4.81, P = 0.44 \)). Similarly, post diameter also had no significant effect on removal time (Group 1, \( H = 0.75, P = 0.39 \); Group 2, \( H = 0.83, P = 0.36 \); Group 3, \( H = 0.32, P = 0.57 \)).

Discussion

This study confirms previous studies21-23 showing that fiber posts can be removed in very little time. Treatment of failed post-containing restorations need not take excessive time. The mean removal time for fiber posts reported here was longer than that found by either of the previous studies (1.2-1.4 minutes,23 0.3-0.7 minutes,22 and 2.5-7.0 minutes23). The longer removal times in this study were due to the time required to make radiographs of the canals to confirm complete cement removal. Gesi et al22 did not check for complete cement removal but rather stopped canal preparation when gutta percha first appeared. Following removal of the post, Lindemann et al23 sectioned the roots vertically and used an optical microscope to score the removal effectiveness. Cormier et al20,21 used the technique of Sakka20 where canal preparation was complete when the post was removed to the cement layer.

The present study confirms the result of Lindemann et al23 that fiber posts can be removed much more quickly than titanium posts that have been luted with adhesive resin cement. This study also shows that removal time for titanium posts can be reduced if the posts are luted with a glass-ionomer cement. Unfortunately, luting with glass-ionomer cement cannot be recommended. To achieve the highest retention values, titanium posts are routinely cemented with adhesive resin cement rather than with glass ionomer or zinc phosphate cements.27,28

In this study the posts were cut off at the level of the CEJ. In previous studies13,10,29,30 the posts were left projecting above the top of the root for use as a handle. Removal of the post at the level of the root simulated the complete fracture and loss of the tooth crown. This makes removal of titanium posts much more difficult. If the tooth is trenched around the post to allow an instrument to grasp the post, the tooth may be further weakened. There should be sufficient tooth structure above the osseous crest to allow for the creation of a ferrule preparation. Long term survival of the tooth might be jeopardized if there is not space for at least a 1.5-2 mm ferrule.30

This study confirmed that fiber posts can be more rapidly removed than titanium posts. Moreover, removal can be accomplished without resorting to ultrasonic vibration that may further weaken the tooth.3 Fiber posts exhibited adequate clinical performance.18,31 That they can be quickly and safely removed is another reason to choose fiber posts for the restoration of endodontically treated teeth.

References


---

**Articles Accepted for Publication**

- **Oral cancer: Current and future diagnostic techniques.**  
  *C. Scully, J.V. Gaban, C. Hopper & J.B. Epstein*

- **Hardness and elasticity of caries-affected and sound primary tooth dentin bonded with 4-META one-step self-etch adhesives.**  
  *Y. Hosoya, F.R. Tay, S. Miyakoshi & D.H. Pashley*

- **Comparison of detachment forces of two implant overdenture attachment types: Effect of detachment speed.**  
  *S.R. Jefferies, D.W. Boston, M.P. Damrow & C.T. Galbraith*

- **Cytotoxic effects and pulpal response caused by a mineral trioxide aggregate formulation and calcium hydroxide.**  
  *C.A. de Souza Costa, P.T. Duarte, P.P. Chaves Souza, E.M. Aparecida Giro & J. Hebling*

- **Histological evaluation of mineral trioxide aggregate and calcium hydroxide in direct pulp capping of human immature permanent teeth.**  
  *L. Sawicki, C.H. Pameijer, K. Emerich & B. Adamowicz-Klepalska*

- **The influence of dynamic fatigue loading on the separate components of the bracket-cement-enamel system.**  
  *T.J. Algera, C.J. Kleverlaan, B. Prahl-Andersen & A.J. Feilzer*

- **Translucency of varied brand and shade of resin composites.**  
  *B. Yu & Y-K. Lee*

- **Effect of different 1% chlorhexidine varnish regimens on mutans streptococci levels in saliva and dental biofilm.**  
  *L.G. Maia Ribeiro, L.N. Hashizume & M. Malz*