

Intracanal Retention of Glass Fiber Posts

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Abstract

Objective: Fiber-reinforced composite (FRC) posts have recently become more popular for restoring endodontically treated teeth because of providing esthetics, better stress distribution and lower risk of root fracture. Resistance against tensile forces dislodging the post from the root canal is a prerequisite for these posts. This study aimed to evaluate the tensile retention (strength) of intracanal glass fiber posts produced by three manufacturers.

Methods: In this interventional study, the crowns of 30 sound human maxillary central incisors were cut at the cemento-enamel junction and the roots were endodontically treated. Post space was prepared to a length of 10mm and the specimens were divided into three groups of 10. HtCo, Anthogyr and Svenskposts were used in groups 1, 2 and 3, respectively. The posts were cemented with Panavia F2 resin cement according to the manufacturer's instructions. Specimens were then immersed in water at 37°C for 30 days and were then subjected to 7500 thermal cycles between 5-55°C. Intracanal tensile retention (strength) was measured at a crosshead speed of 0.5 mm/min. Data were analyzed using one-way ANOVA at $p < 0.05$ level of significance.

Results: The mean retention was 188.53 (15.43), 183.81 (16.37) and 192.19 (17.50) N in HtCo, Anthogyr and Svensk posts, respectively. Statistical analyses showed no significant difference in this regard among groups ($p = 0.111$).

Conclusion: Within the limitations of this study, retention of HtCo glass fiber posts in the root canals was similar to that of two other posts.

Key words: Bond strength, Glass fiber post, HtCo post, Resin cement, Retention, Thermal cycles.

Please cite this article as:

Akbari M, Moghaddas MJ, Golshan SH, Boruzi Niat A. Intracanal Retention of Glass Fiber Posts. *J Dent Sch* 2015; 33(1): 189-195.

Received: 29.04.2014

Final Revision: 31.01.2015

Accepted: 09.02.2015

Introduction:

Restoration of severely damaged, endodontically treated teeth often requires the use of intracanal posts. Different types of intracanal posts are available including the prefabricated metal posts, cast posts, carbon posts and tooth-colored posts such as zirconia and FRC posts.

In the recent years, use of FRC posts is increasing for restoration of endodontically treated teeth. The advantages of these posts over the cast posts include esthetics, bond to tooth structure, better distribution of stress, lower risk of root fracture, no risk of corrosion and easier

retrieval whenever necessary (1,2). Studies have shown that if the components of a restoration have elasticity moduli close to one another, stress is more evenly distributed when the restored tooth is in function. This decreases the concentration of stress at the interfaces, and FRC posts possess this characteristic (3). Alloys used for cast posts have modulus of elasticity 7 to 10 times that of dentin (4). Glass FRC posts were introduced in 1992. These posts are made of glass fibers embedded in a resin matrix in the same direction. The matrix of these posts is made of epoxy resin, which has high degree of polymerization and a cross-linked structure (5).

Glass fiber posts can be made of different glasses. The most commonly used form of glass in the fabrication of glass fiber posts is a mixture of SiO_2 , B_2O_3 , Al_2O_3 and alkaline metal oxides (6). Some researchers believe that use of FRC posts increases the fracture resistance of endodontically treated teeth; while some others believe that these posts only decrease the risk of non-restorable fractures and do not strengthen the tooth structure. However, bond to root dentin is a prerequisite for this advantage (7,8). Naumann *et al.* in a 10-year study in 2012 observed that the fracture resistance of FRC posts depends on the type of tooth and number of remaining walls (9).

Studies have shown that surface treatment of FRC posts can affect their bond strength (10,11). Guler *et al.* in 2012 demonstrated that application of phosphoric acid and hydrofluoric acid increased the bond strength of glass fiber posts; although these posts underwent structural degradation (12). Rodig *et al.* in 2010 noticed that glass fiber posts yielded higher bond strength than quartz fiber posts (13). Studies have shown that poor intracanal retention is among the most important factors responsible for the failure of endodontic posts. This retention depends on several factors such as the bond strength, length and design of post and diameter of post (14-17).

HtCo posts are the first type of glass fiber posts manufactured in Iran. These posts have glass fibers and are available in different diameters. If the efficacy of HtCo posts is comparable to that of Anthogyr and Svensk posts, they may be used as a more affordable alternative to foreign-made products. This study aimed to assess the bond strength (intracanal retention) of these posts and compare it with that of two similar foreign-made products.

Methods:

This interventional study was conducted on 30

human maxillary central incisors with almost equal root lengths and diameters. The teeth were free from caries, cracks or severe curvature. After debridement, they were stored in 0.1% thymol solution. Using a diamond disc (Brasseler, Leipzig, Germany) along with water and air spray, the crowns were cut at the cemento-enamel junction. Teeth with oval canals or canal diameter > 2mm were excluded from the study.

Root canal treatment was done by hand K files up to #50 (Dentsply, Germany) using the step-back technique along with irrigation with 0.5% sodium hypochlorite. Root canals were filled with gutta percha (Ariadent, Tehran, Iran) and AH-Plus resin sealer (Dentsply, Germany). The access cavity and the root apex were sealed with wax (Demedis, Dusseldorf, Germany). Specimens were incubated at 37°C and 100% humidity for three days and were then randomly divided into three groups of 10. After wax removal, post space was prepared to 10mm length from the cemento-enamel junction using #2 drill (Htco, Iran) specific for post-space preparation (all teeth required slight root dentin removal by #2 drill). A new drill was used for every 10 specimens. Saline solution (Razi, Tehran, Iran) was used for root canal irrigation during preparation and the canals were then dried with paper points (Ariadent, Tehran, Iran). HtCo posts (HtCo, Mashhad, Iran) with a smooth surface and double-taper design were used in group one (Figure 1).



Figure 1- HtCo post

Anthogyr posts (Fibiocore, Sallanches, France) were used in group two and Svensk posts (Dentorama, Stockholm, Solna, Sweden) were used in group three. The posts in the three groups were cemented using Panavia F2 (Kuraray, Japan) according to the manufacturer's instructions. First, ED-Primer was applied to intracanal dentin surfaces and also on the post surface using a microbrush. The primer layer was thinned by gentle air spray. Equal amounts of the two pastes were mixed and applied on the post surface. The post was then inserted into the canal. Excess cement was eliminated and light curing was done for 40 seconds using C8 Blue Phase light curing unit (Ivoclar Vivadent, Schaan, Lichtenstein). The specimens were then mounted in auto-polymerizing acrylic resin (Acropars, Iran) in such a way that 2mm of the coronal part of the root was out of the resin (Figure 2).



Figure 2- Prepared specimens

The teeth were stored at 37°C and 100% humidity for 30 days and were then subjected to 7500 thermal cycles between 5-55°C with a dwell time of 30 seconds and transfer time of 15 seconds (18). Intracanal retention (bond strength) was determined in a Zwick machine (Zwick, Ulm, Germany) after mounting the

specimens in the jig and application of tensile load until post retrieval at a crosshead speed of 0.5 mm/min (19)(Figure 3). Sample size was calculated to be 10 specimens in each group based on a similar study (20) and considering 80% study power. Data were statistically analyzed using SPSS version 11.5. Normal distribution of data was tested using Kolmogorov Smirnov test and then data were analyzed by one-way ANOVA at 0.05 level of significance.

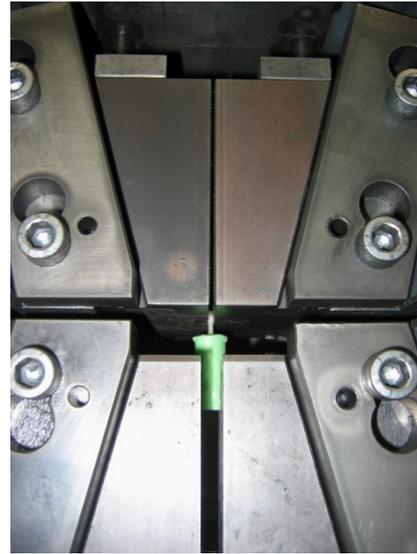


Figure 3- Load application to determine the force required for post retrieval from the root canal system

Results:

The mean and standard deviation of load required for post retrieval from the root canal system in different groups are presented in Table 1.

Table 1- The mean and standard deviation of bond strength (load required for post retrieval) in different groups

| Post | HtCo | Svensk | Anthogyr |
|--|----------------|---------------|----------------|
| Mean (standard deviation of bond strength) (N) | 188.53 (15.43) | 192.19 (17.5) | 183.81 (16.37) |

Considering the normality of data and equality of variances, one-way ANOVA revealed no significant difference in the mean bond strength among different groups ($p=0.111$).

Discussion:

The results of this study showed that the retention of HtCo intracanal posts was similar to that of two other types of posts and no significant difference was noted in this regard among them. Several studies have shown that factors such as length (14), design (16), material, light-transmitting ability (17, 18) and diameter (15) of intracanal posts as well as the type of cement (19) affect the retention of intracanal posts. Thus, in the current study, we used the same type of luting cement for all groups and the length and diameter of posts in all groups were equal in order to decrease the effect of confounding factors.

Aleisa *et al.* in 2013 showed that the intracanal retention of glass fiber posts may be variable with the use of different resin cements and ranged from 120 to 280N depending on the type of resin cement used (19). Our obtained values were also within this range, which shows that the tensile strength of posts evaluated in our study was within the acceptable range. However, as stated earlier, many confounders may affect the results.

Mosharraf and Ranjbarian in their study in 2013 on Anthogyr posts showed that surface preparation of posts had no significant effect on their bond strength (21). In our study, no surface preparation was done for posts (as recommended by the manufacturer). Also, since eugenol-containing sealers lead to incomplete polymerization of resin cement and subsequently decreased retention of posts (22), AH-Plus resin sealer was used in our study. Aleisa *et al.* in 2012 showed that use of eugenol-containing sealers can significantly decrease the retention of

intracanal glass fiber posts. The bond strength of posts cemented in root canals endodontically treated with resin sealers was in the range of 150 to 250N, which is similar to our finding (23). Al-Ali in his study in 2009 on resin cements used for luting metal posts showed that the highest retention was approximately 120N (24); which shows that resin cement bond to glass fiber post surface increases their intracanal retention (as compared to our study).

To simulate oral environment in our study, the specimens were kept in water and were then subjected to thermal cycles. Studies show that humidity and thermal cycles have different effects on intracanal retention of fiber posts. Humidity results in hydrolysis and decreased strength of the fibers of FRC posts and reduces the flexural strength of these posts (2, 24). Purton *et al.* in 2003 showed that thermocycling did not decrease the retention of lucent Anchor and Light posts cemented with Panavia F2 and it seems that thermocycling has less effect on retention of posts cemented with resin cements (25). Stewardson *et al.* in 2010 demonstrated that thermocycling decreased the flexural strength of most types of FRC posts and only increased the flexural strength of Postec posts (26).

In our study, ED-Primer was applied on the surface of posts. Bulbosh and Kern in their study in 2006 concluded that application of ED-Primer did not increase the retention (27). According to the manufacturer's instructions, no surface treatment was done for posts in our study and ED-Primer was used to prepare root dentin surfaces as recommended by the manufacturer. Al-Harbi and Nathanson (2003) stated that application of dentin bonding agent along with resin cement increased the retention of posts in the root canal system (28).

Several factors may interfere with a suitable bond to root dentin including non-compatibility of bonding agents, incomplete polymerization of

bonding agents due to inadequate access to canal walls and high C factor (29). In the root canal, due to the very small unbonded surface area, the C factor is as high as 200, especially when light-cure cements are used. Such a high level of stress is capable of separating the cement from dentin and compromising the bond strength (30). Akkayan and Gulmez (2002) showed that teeth restored with quartz fiber posts had higher fracture resistance than teeth restored with glass fiber posts (3). Moreover, Kremeier *et al.* in 2008 showed that the intracanal retention of quartz fiber posts was higher than that of glass fiber posts (17).

Limitations of our study did not allow evaluation of the mode of failure. Evaluation of the mode of failure can reveal the weak bonding site. Knowledge in this regard can help find methods to increase the bond strength at the weak spot. For instance, if the failure occurs at the post surface, it may be improved. If the failure (separation) occurs at the root dentin surface with the cement remaining on the post surface, it indicates problems with the bond of cement to dentin and higher retention may be achieved by

changing the type of cement. The current study only evaluated the retention of HtCo posts and future studies are required to evaluate other characteristics of this post for extensive use in the clinical setting.

Conclusion:

Within the limitations of this *in vitro* study, the results showed no significant difference among HtCo posts manufactured in Iran and the two foreign-made products in terms of intracanal retention.

Acknowledgement

This research project was funded by a grant from the Research Deputy of Mashhad University of Medical Sciences (grant #86522) and the authors would like to express their gratitude to this university.

Conflict of Interest: “None Declared”

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