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Comparison of Strength and Retention of Fiberglass Post in Immediate and Delayed Post Space Preparation after Endodontic Treatment

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ABSTRACT

Aims Root canal treatment is one of the treatments that weakens the tooth crown. The use of fiberglass posts has been considered due to its effect on the strength of teeth. The aim of this study was to evaluate the role of post preparation time on the strength and retention of fiberglass posts after endodontic treatment.

Materials & Methods In this experimental study, 48 samples were selected using convenience sampling method and randomly divided into two experimental groups of 24 samples (including immediate and 48 hours post space preparation after endodontic treatment). All samples were maxillary and single-channel. After roots preparation, the roots were washed with 5 ml of distilled water to remove debris and then dried with a paper cone (Aria Dent, Iran). Any residual goiter in the root wall was evaluated by radiography.

Findings The mean strength (p=0.04) and the mean retention of fiberglass posts (p=0.001) in the group prepared immediately after the root canal treatment were significantly less than the group prepared 48 hours after the root canal treatment.

Conclusion Post preparation after 48 hours of root canal treatment can increase the strength and retention of fiberglass posts.

Keywords Root Canal Preparation; Fiberglass; Strength; Retention

CITATION LINKS

[1] Post retention: The effect of sequence of post-space preparation, cementation ... [2] Microbiological basis for endodontic treatment: Can a maximal ... [3] Periapical health and treatment quality assessment of root-filled ... [4] Influence of coronal restorations on the periapical health ... [5] Effect of timing and method of post space preparation on sealing ... [6] Comparison of apical sealing of two canal sealers between immediate ... [7] Outcome of endodontic treatment of teeth filled using ... [8] Comparison between immediate and delayed post space preparations ... [9] Post-space treatment influences the bond strength in endodontically ... [10] The effect of immediate vs. delayed post space preparation on ... [11] Apical displacement and residual root canal ... [12] The effect of two endodontic sealers and interval before post-preparation ... [13] Pull-out retentive strength of fiber posts cemented at different times ... [14] Effects of immediate and delayed intraradicular preparation ... [15] Effect of cement types and timing of cementation on the retentive ... [16] Influence of type of cement and their thickness ... [17] Retention of fiber posts cemented at different time ...

Introduction

Root canal treatment is one of the treatments that weakens the tooth crown. The reason for the restoration of root canal teeth depends on the clinical situation that causes endodontic treatment. In addition to the reduction and weakening of the internal and external tissue, the decrease in the amount of moisture and the brittleness of teeth without pulp causes the restored teeth to be less resistant to stress and not desirable as a base tooth. This is why an endodontic tooth must be reinforced for the crown and the breech base.

Endodontically treated teeth with inadequate crown structure need a radicular post to help restore the tooth to proper function [1]. Therefore, finding an efficient and timely method to prepare the post space in such a way as to cause less change in the amount of apical flood of the canal has been the subject of various discussions and researches for many years. After endodontic treatment, tooth strength decreases by 14%. Following this reduction, functional forces inside the mouth cause longitudinal and transverse fractures in the root and crown area. In some cases, these fractures make restoration impossible and eventually lead to tooth loss [2, 3]. The prevalence of failure has been reported from 11% (in 1980) and 1.6-4.6% (in 1998) to 2-5% (in 1999) [4]. To compensate for this weakness, internal and external strengthening of the tooth is necessary.

Various studies in recent years have shown that various factors are important in the strength and stability of the fiberglass post. One of the most important problems of endodontics is the strength and stability of the post space to fiber [5]. Various factors such as emptying time after preparing the post space affect and cause root canal failure [6, 7].

The post space may be prepared immediately after the endodontic steps are completed using a hot plumber or delayed after the sealer has completely hardened by rotary means [8]. Regarding the appropriate time for post space preparation, some believe that immediate post space preparation after root canal treatment does not reduce the sealer strength much because the sealer has not yet reached its final strength, while delayed post space preparation causes a significant reduction in sealer strength. As a result, the sealing property is reduced, so many recent studies have shown that immediate provision of post space is better [9]. On the other hand, some other studies have not reported a significant difference between immediate and delayed post space preparation methods [10, 11].

So far, most studies have examined the effect of adhesives and types of cements on the strength of fiberglass post and have not evaluated the preparation time of the post space alone. Today, post is widely used as a relatively hard restorative material in the reconstruction and restoration of teeth that have lost most of their crowns after root canal treatment. However, post preparation time and type of fiberglass affect the post quality.

The aim of this study was to evaluate the role of post preparation time on the strength and retention of fiberglass posts after endodontic treatment.

Materials and Methods

This experimental study was performed in the dental department of Ahvaz University of Medical Sciences and also in the material laboratory of Khajeh Nasir Tusi University in Ahvaz, Iran.

Based on type 1 error = 0.05 (95% confidence level), type 2 error = 20% (80% power) and effect size = 1, the number of samples in each group was estimated to be 24 people. The samples were extracted from the teeth of patients referred to the dental department of Ahvaz University of Medical Sciences in Ahvaz, Iran. All samples were maxillary and single-channel.

The samples were selected using convenience sampling method and randomly assigned to two experimental groups of 24 samples including groups 1 and 2.

In group 1, immediately after the root repair, the researcher emptied the post space with thermal insulation and placed the fiberglass post. In group 2, 48 hours after root repair, the researcher emptied the post space with piezoelectric and placed the fiberglass post.

Inclusion criteria included premolar to premolar single canal teeth that had a healthy crown at least 1 mm above the Cementoenamel Junction (CEJ) and had straight roots and a canal without decay, filling, and fracture. Exclusion criteria included teeth with curved and calcified roots and multiple canals with lateral canals and teeth with caries close to CEJ single-channel. However, teeth with curved roots, internal and external resorption, root fracture, open apex, severe calcification and extra canals were excluded.

Each tooth was incised 1 mm higher than CEJ by a diamond disc (Degussa Dental; Hanau, Germany) with a low-speed handpiece and water cooling (Figure 1).

Figure 1) The crown of the tooth was cut one millimeter higher than the CEJ.

All root canals were prepared by a trained operator. Root canals were prepared with a working length of 1 mm relative to the tooth apex. Cleaning and shaping was performed using stainless-steel hand tool (Mani Inc.; Tochogi, Japan) in step back method. The canals were washed with 10 ml of 0.2% chlorhexidine and the final rinse was done with distilled water, and finally they were dried using absorbent paper (Aria Dent; Iran). Root canal filling was done by lateral compaction method with Gota Perka cone (Aria Dent; Iran) and sealer ZOE (Golchadent; Iran) and the access cavities were temporarily filled with Quizol and were kept in 100% humidity at 37°C for 24 hours. After storage, the temporary restoration was removed and the post space was prepared by Piezo Reimer No. 2 (Mani Inc.; Tochogi, Japan) to a depth of 9 mm measured from the buccal root surface, holding at least 4 mm of gutta-percha. The roots were washed with 5 ml of distilled water to remove debris and then dried with a paper cone (Aria Dent, Iran). Any residual goiter in the root wall was evaluated radiographically.

The selected posts in this study were Angelus 2 (Angelus; Brazil). The surface of the posts was washed with 99.6% ethanol for 30 seconds and dried for 10 seconds and then cemented with self-adhesive self-adhesive resin cement (3M.; USA) according to the manufacturer's instructions. After that, the posts were cemented. The cement was inserted into the canal with a Lentolo drill (Mani Inc.; Tochogi, Japan), and then the posts were pressed into the canal and the excess cement was removed with a brush.

The cement was cured by LED (output 1000 Mw/cm^2; LAVA LED, Ultradent Products, Inc.; South Jordan, UT, USA) for 40 seconds (20 seconds from buccal and 20 seconds from lingual). The cure was in direct contact with the buccal and lingual surfaces, and then the teeth were placed at 37°C for 24 hours (Figure 2).

Figure 2) Samples cemented with fiberglass post

Tensile test: Each root was cut with a cutting machine and a diamond disk (Presi, Hecatomb; France) to make 4 pieces of 1 mm thickness. The first piece was not used. Finally, there was one piece for each root region (coronal, medial, apical). The apical side of each piece was marked with permanent ink. The thickness of each piece was checked by a digital caliper. A special traction device was used to perform the extraction test. The acrylic resin mold had a space of 2.5 mm in the central part of the pieces during the tensile test. This force was applied at a rate of 0.5 mm/min until failure. The bond strength conversion was performed by dividing the fracture load in Newtons (F) by the root tensile interface (A).

The interface range was determined by AutoCAD 2006 software based on scanned images of all sections before the tensile test. Data were statistically analyzed using independent t-test.

Findings

The mean strength in the group prepared immediately after the root canal treatment was less than the mean strength in the group prepared 48 hours after the root canal treatment and the difference between them was statistically significant (p=0.04). Also, the mean retention of fiberglass posts in the group whose post was prepared immediately after endodontic treatment was less than the group which was prepared 48 hours after root canal treatment, which was statistically significant (p=0.001; Table 1).

Table1) Comparison of mean strength and mean retention of fiberglass post in immediate and delayed post space preparation after endodontic treatment

Variable	Immediately	After 48 hours	P-value
Strength (mm)	5.39±0.97	8.66±1.45	0.04
Retention (mm)	336.70±83.20	370.90±57.90	0.001

Discussion

The results indicated that the mean strength and retention in the group prepared immediately after root canal treatment was less than the group prepared 48 hours after root canal treatment. Yuanli *et al*. conducted a study to evaluate the effect of immediate and delayed post space preparation as well as the type of sealer on post fiber strength. The results showed that the bond strength of fiberglass posts was higher when the post was prepared immediately than when it was delayed. The results also showed that the type of sealer, regardless of preparation time, had no effect on the strength of fiberglass posts [12]. This study is not in line with our study. The reason for the inconsistency of the results can be found due to the difference in the sealer used in the above study. Because in our experiment, unlike the Yuanli's study, the sealer was not bioceramic. Also, the times studied in Yuanli's study were immediate and one week, while the present study was conducted as an immediate and 48-hour preparation.

Aleisa *et al*. conducted a study to evaluate the effect of post preparation and the type of cements used on the strength of fiberglass posts. In this study, 24 hours and 2 weeks were used for adhesion.

Paracore, Variolink II, and RelyX cements were also used. After evaluations, the results showed that 24-hour gluing can have a significant effect on the adhesion of fiberglass posts [13]. The results of this study can be similar to the results of our study in terms of time; considering that in our study, increasing the post space preparation time after root canal treatment increased the adhesion of fiberglass posts.

In 2015, Machado *et al*. conducted a study to evaluate the effect of fast and delayed post space preparation on fiberglass post bond strength. Twelve bovine teeth with standardized incision roots to 19 mm were used. Two experimental groups were created based on different preparation times (immediate and delayed). After gluing the posts, the specimens were subjected to pressure testing. Delayed preparation showed higher bond strength than immediate preparation. However, in this study, the specimens were subjected to a pressure test and differed in this respect from our study, which examined the tensile test [14]. But in the present study, the results were consistent with our study. This alignment may be due to post space preparation time, which was the same in both studies. In addition, the type of adhesive and cement used in the two studies were the same in terms of brand type, with the difference that in the Machado's study, cylindrical fiberglass posts were used, while in the present study, two drop posts were used. Also, the adhesive used in Machado's study was not dual.

In 2012, Aleisa *et al*. conducted a study to evaluate the effect of cement type and cement preparation time on the post trap and its strength. In this study, the duration of 24 hours and 2 weeks was examined. The results showed that the bond strength was higher in the groups that used ParaCore and Unicem cements compared to the group that used Variolink II. It was also found that the gluing time has no effect on the strength of fiberglass posts [15]. Although the present study showed that there is no significant difference between the two groups in the use of ParaCore and Unicem cements, but in two groups (24 hours and two weeks after root canal treatment) in the Variolink II cement, the bond strength in the preparation increased one week after the root canal treatment.

In 2019, Taneja *et al*. performed a three-dimensional finite element analysis to evaluate the effect of cement type and thickness on stress distribution at the dentin-cement interface of glass-fiberglass post designed by computer [16]. In this study, which studied three cores of Paracore, Variolink II, and RelyX, it was observed that the highest and lowest stress in dentin occurs in the cores of ParacoreI and RelyX, respectively. Von Mises stresses in dentin can also be minimized by keeping the cement thickness to a minimum and choosing a cement whose modulus of elasticity is close to the modulus of elasticity of dentin. Therefore, Variolink II cement with an elasticity coefficient close to dentin can be interpreted as compatible with the study of Variolink II cement and incompatible with ParacoreI and RelyX [16].

In 2008, Vano *et al*. conducted a study to evaluate the effect of fast and delayed preparation of post space and type of cement on post-fire trap and its strength. The times selected in this study to prepare the post space were immediate, 24 hours, and one week. Evaluations showed that the delayed preparation of the post space can have a significant effect on the strength of the fiberglass post bond [17]. This study was consistent with our study in terms of time, because the results of our study showed that 48 hours after root canal treatment, post space preparation increased the amount of fiberglass post.

The present study was conducted only in limited times and it would have been better to study it in several different times. Also, it would be better to check the effect of various resins on fiberglass posts.

In future studies, the following should be considered:

1- The effect of post time and type of resins used on the post trap should be evaluated.

2- It is better to check the fiberglass post at different intervals.

3- The study should be conducted on a higher statistical population.

Conclusion

Post preparation after 48 hours of root canal treatment can increase the strength and retention of fiberglass posts. The difference in post-fiber bond strength in delayed preparation and immediately after post-root canal treatment can be found in the effect of agenol used in sealer and reducing the bond to tooth tissue. Also, unlike zinc oxide sealers, bioceramic seals have a negative effect on the bond strength of fiberglass posts. Finally, in delayed preparation, the reduction of stress and concentration of stress due to abruption compared to immediate preparation can be considered effective on the strength of post-fiber bond to dental tissue and its increase.

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Ethical Permissions: All the procedures performed in the study involving human participants were in accordance with ethical standards of local ethics committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.REC.1400.546), as well as 1964 Helsinki declaration. Informed written consent was obtained from all patients and normal subjects.

Conflicts of Interests: The authors declare no conflict of interest.

Authors' Contribution: Zoratipour A. (First author), Introduction author (20%); Dabbaghi A. (Second author), Methodologist/ Statistical analyst (30%); Ebrahimi Zaker M. (Third author), Original researcher/ Discussion author (50%)

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