Original Article

Retention of Fiber and Cast Posts with Different Lengths: A Comparative Study

Z. Khamverdi [1], Sh. Kasraei [2]

[1]Assistant Professor, Department of Operative Dentistry, School of Dentistry, Hamadan University of Medical Sciences, Hamadan, Iran
[2]Assistant Professor, Department of Operative Dentistry, School of Dentistry and member of Dental Research Center, Hamadan University of Medical Sciences, Hamadan, Iran

Abstract:

Objective: There is no definitive data on the strength of glass fiber and cast posts with different length. This *in vitro* study was designed to investigate and compare the effect of length on the retentive strength of glass fiber and cast posts.

Materials and Methods: Sixty recently extracted intact maxillary canine teeth were cut 1 mm above the CEJ. The specimens were endodontically treated and randomly divided into four groups (n=15). Specimens in groups FP(9) and FP(12) were prepared using Fiber post with 9 and 12 mm in length while groups CP(9) and CP(12) used cast post with 9 and 12 mm length respectively. The force required to dislodge each post was recorded as retentive strength. Collected data were statistically analyzed using two-way ANOVA and post-hoc tests (α=5%).

Results: The mean retentive strength of groups FP(9), FP(12), CP(9) and CP(12) were 203.74 (SD=38.46), 324.54 (SD=42.92), 156.82 (SD=32.69), and 210.73 (SD=54.60) respectively. The results revealed a significant difference among retention values of tested groups, except for the FP(9) and CP(12) ($P<0.05$).

Conclusion: Under the condition of this study, the retention of fiber posts was significantly more than cast posts with the same length. On the other hand, post length seems to have an impact on the retention of fiber and cast posts.

Key Words: Post and Core Technique; Dental Restoration, Permanent; Lightpost; Dental Prosthesis Retention

Journal of Dentistry, Tehran University of Medical Sciences, Tehran, Iran (2007; Vol: 4, No.4)

Corresponding author:
Z. Khamverdi, Operative Dentistry, School of Dentistry, Hamadan University of Medical Sciences, Hamadan, Iran
zkhamverdi@yahoo.ca

Received: 17 October 2006
Accepted: 6 June 2007

INTRODUCTION

One of the main purposes of post and core in endodontically treated teeth is to provide a support to replace the lost tooth structure and retains the final restoration [1-3]. Several studies have shown that most failures occurred in endodontically treated teeth are due to the post dislodgment [4,5]. Therefore, retention of the post can be critical for the long term success of a restoration. Retention depends on various factors including post length, diameter, and design, as well as luting agents and canal shape [6-8]. Leary et al [9] also found that posts with a length of at least three quarters of the root had the greatest rigidity and the least root deflection when compared to the short posts. Nergiz et al [10] indicated that the post retention is highly influenced by its length. Importance of the post length has been emphasized in previous studies, while many studies have focused on metal posts [11-14].

With the advancement of adhesive dentistry and increasing demands for esthetic restorations, the tooth-colored posts were introduced,

Table 1. Means, Standard Deviations (SDs), and Standard Errors (SEs) of retentive strength in tested groups.

Tested groups	N	Mean (N)	SE (N)	SD (N)	Med (N)	Max (N)	Min (N)
FP(9)	15	203.74	10.27	38.46	209.42	253.87	147.09
CP(9)	15	156.82	8.44	32.69	154.49	209.11	108.54
FP(12)	15	324.54	11.47	42.92	310.21	392.87	274.6
CP(12)	15	210.73	14.09	54.60	196.7	287.47	143.06

which could be bonded to tooth structure. For this reason, such systems would be valuable for the clinician [15,16]. Since a few studies were conducted to evaluate the fiber posts retention, the effect of their length on the retention has remained unclear [17,18]. Gallo et al [19] evaluated the retention of composite fiber and stainless steel posts. They concluded the length in retentive potential of fiber posts was not a determinant factor because of the bonding properties of the adhesive cement [19]. Nissan et al [20] revealed when the post length is short, resin cement could compensate the retention in Paraposts and Dentatus prefabricated posts. Another study indicated that using short threaded posts (4 mm) did not considerably decrease the retention [21].

Since there are still some doubts about the effect of post length on its retention, this *in vitro* study was designed to investigate and compare the effect of length on the retentive strength of glass fiber and cast posts.

MATERIALS AND METHODS

Sixty recently extracted, intact human maxillary canine were selected and stored in 0.2% thymol solution.

The teeth were sectioned horizontally 1mm above the cementoenamel junction with diamond discs (Ref.070, D&Z, Berlin, Germany). Then root canals were prepared through the step-down method with 5.25% sodium hypochlorite irrigation. The canals were obturated by lateral condensation technique with Gutta percha (Aria dent, Asia Chemi Co, Tehran, Iran) and a root canal sealer (AH26, Dentsply, DeTrey, Kon-stanz, Germany). The specimens were randomly divided into four groups of 15 teeth each: FP(9), CP(9), FP(12), and CP(12).

Then the corresponding drill to each post system, provided by the manufacturer, was used to prepare the post space to the desired depth.

Post spaces were prepared with a Gates Glidden drill #3 (Fibio core, Anthogyr, Sallanches, France) to the desire depth; 9 mm for groups FP(9) and CP(9) and 12 mm for FP(12) and CP(12). In order to eliminate the effect of post diameter, post spaces were prepared with similar diameter for all groups.

The post spaces were dried with paper points followed by oil-free air. In groups FP(9) and FP(12), a tapered fiber post #3 (Fibio Core, Anthogyr, Sallanches, France) was selected. The fiber post cementation procedure was as follows:

Primers (ED primer, Kuraray Medical, Inc., Okayama, Japan) were mixed according to the manufacturer's directions and applied to the prepared root canal wall using a bristle brush. After 60 seconds, the post space was gently air-dried and excess primer was removed with paper points (Aria dent, Asia Chemical Co, Tehran, Iran). All fiber posts were washed in isopropyl alcohol and dried prior to coating with freshly mixed resin cement (Panavia F2.0, Kuraray Medical, Inc.). The fiber posts were inserted into the post spaces using finger pressure, excess cement was removed, and the remaining cement around the post was protected with oxygen-inhibiting gel (Oxyguard II, Kuraray Medical, Inc.).

In groups CP(9) and CP(12), post and core patterns were fabricated using a self-cured acrylic resin (GC Resin Pattern, GC America, Alsip, IL) according to the manufacturer's rec-

Table 2. Result of two-way ANOVA.

Source	df	Sum of squares	Mean Square	F	P value
Post type	1	93541.86	93541.86	50.57	0.000
Length	1	110516.96	110516.96	59.74	0.000
Post type Length	1	16196.28	16196.28	8.75	0.006

ommendations. Post and core patterns were cast in a base metal alloy (Thermobond, Dedecon Co, LosAngeles, CA). Then posts were cemented with a standard zinc phosphate cement (Harvard cement, Richter & Hoffmann, Harvard Dental GmbH, Berlin, Germany), which was mixed on a cooled (6°C) glass slab according to the manufacturer's instructions. The cement was placed into the root canals with a lentulo spiral (Dentsply Maillefer, Ballaigues, Switzerland).Then posts were lightly coated with cement, and were seated in the prepared post spaces. The finger pressure was maintained for 10 minutes until the cement was set. All posts were cemented by one operator. All specimens were placed into separate mesh bags and thermocycled for 2500 cycles in water baths between 5°C (SD=1) and 55°C (SD=1) with dwell time of one minute in each bath and 15 seconds transition time between baths.

To ensure that the tension was applied in an axial direction to the posts, specimens were mounted in the center of the acrylic resin blocks (Acropars, Marlic Co. Tehran, Iran). In order to prevent dehydration during curing of acrylic resin, the teeth were stored in distilled water at 37°C. Tensile force was applied at a crosshead speed of 1mm/min using a universal testing machine (Zwick Z010; Zwick GmbH & Co. KG, Ulm, Germany). The force required to dislodge the posts was recorded in Newton. The collected data were analyzed using two-way ANOVA and post-hoc tests at $P<0.05$ level of significance.

RESULTS

The retentive strength of FP(12) showed the highest value among the test groups, whereas the retentive strength of CP(9) was the lowest (Table 1).

The results of two-way ANOVA (Table 2) indicated statistically significant influence of post type, length, and also an interactive effect between them ($P<0.05$). Tukey HSD (post-hoc) test confirmed that there are significant differences among all pairs of tested groups except FP(9) mm and CP(12) mm groups (Table 3).

DISCUSSION

Various factors have been identified to affect the retention of posts. Although, there are great numbers of studies on this field, results still lead to indistinctive conclusions in literature [5,6,8,9].

Our results demonstrated that the fiber post groups were more retentive than cast post groups with similar lengths. One explanation for the lower retention of the cast post groups is that the cement was different from fiber post groups. The resin cement used in fiber post groups, had the potential to bond to the post and the tooth structure, whereas zinc phosphate cement did not have this potential.

Another factor evaluated, in this study, was post length, which could affect the retention of posts. Innella et al [22] confirmed that increasing the length of post did not result in a significant increase in the retention. Our findings in the present study did not support results of the previous studies [19-22].

The greater retention in the posts with longer length could be the result of larger surface area.

According to the results obtained from FP(9) and CP(12) groups, when root length is short, fiber posts could be suggested. It reduces the

Table 3. Paired comparisons of the retentive strength of the tested groups.

Paired Tested Groups	Mean difference	Standard Error	P value
FP(9) / FP(12)	120.79	16.25	0.000
FP(9) / CP(9)	46.92	15.98	0.024
FP(9) / CP(12)	6.98	15.98	0.972
CP(9) / FP(12)	167.72	15.98	0.000
CP(9) / CP(12)	53.91	15.70	0.006
CP(12) / FP(12)	113.80	15.98	0.000

unnecessary dentin removal, which could result in an increase of fracture risk, in order to provide more retention. It seems that fiber post is a better choice in short teeth.

The material used for cementation of cast posts was zinc phosphate cement. Earlier studies have compared the retentive strengths of cast posts using resin cement and zinc phosphate cement. Some studies showed that the cement type is not a main factor in the post retention [23-25]. However, the results of this study were not in agreement with the findings of those studies [26,27].

In a study, Wrbas et al [28] compared the effect of different luting cements on the retention of fiber posts. They concluded that Calibra (Dentsply DeTrey, Konstanz, Germany) and Panavia F2.0 cements provided the highest retention [28]. Therefore, Panavia F 2.0 was selected in this study.

According to Chan et al [29] study, sandblasting can increase the retentive strength of post; hence the post surfaces were sandblasted in all test groups.

The minimum post length should be as long as the clinical crown; the minimum length of 9 mm selected as post length to achieve the standard condition [5,8]. Using short posts is especially high risk and has a higher failure rate. The effect of load on shorter post is much greater because of leverage effect due to the transversal occlusal forces.

The retentive strength of posts can be measured through different methods based on tension, shear and torque tests [10]. The tensile tests are commonly employed in different studies [10,11,13]; therefore it was selected for the present study.

In this study, mode of dislodging was not evaluated. The specimens were prepared in a way that no coronal tooth structure remained; as the amount of remaining coronal tooth structure plays a major role on the longevity of restoration in endodontically treated teeth [30]. Future researches are recommended to determine the effect of the amount of remaining coronal tooth structures on fiber post retention compare to the cast post and core.

CONCLUSION

Within the limitations of this study, the retention of fiber posts was significantly more than the cast posts with the same length. On the other hand, post length appeared to increase the retentive potential of both fiber and cast posts; however, it is more critical in cast post and cores.

ACKNOWLEDGMENT

This study was supported by grant from dental research center and Hamadan University of Medical Sciences. Authors would like to thank Dr. Gholami and Dr. Yarali for their assistance in collecting data.

REFERENCES

1-Love RM, Purton DG. Retention of posts with resin, glass ionomer and hybrid cements. J Dent 1998 Sep;26(7):599-602.

2-Rosin M, Splieth C, Wilkens M, Meyer G. Effect of cement type on retention of a tapered post with a self-cutting double thread. J Dent 2000 Nov;28(8):577-82.

3-Vargas JW, Liewehr FR, Joyce AP, Runner RR.

A comparison of the in vitro retentive strength of glass-ionomer cement, zinc-phosphate cement, and mineral trioxide aggregate for the retention of prefabricated posts in bovine incisors. J Endod 2004 Nov;30(11):775-7.
4-Reel DC, Hinton T, Riggs G, Mitchell RJ. Effect of cementation method on the retention of anatomic cast post and cores. J Prosthet Dent 1989 Aug;62(2):162-5.
5-Stockton LW. Factors affecting retention of post systems: a literature review. J Prosthet Dent 1999 Apr;81(4):380-5.
6-Standlee JP, Caputo AA, Hanson EC. Retention of endodontic dowels: effects of cement, dowel length, diameter, and design. J Prosthet Dent 1978 Apr;39(4):400-5.
7-Tilk MA, Lommel TJ, Gerstein H. A study of mandibular and maxillary root widths to determine dowel size. J Endod 1979 Mar, 5(3):79-82.
8-McLean A. Predictably restoring endodontically treated teeth. J Can Dent Assoc 1998 Dec;64(11): 782-7.
9-Leary JM, Aquilino SA, Svare CW. An evaluation of post length within the elastic limits of dentin. J Prosthet Dent 1987 Mar;57(3):277-81.
10-Nergiz I, Schmage P, Ozcan M, Platzer U. Effect of length and diameter of tapered posts on the retention. J Oral Rehabil 2002 Jan;29(1):28-34.
11-Cooney JP, Caputo AA, Trabert KC. Retention and stress distribution of tapered-end endodontic posts. J Prosthet Dent 1986 May;55(5):540-6.
12-Stockton LW, Williams PT. Retention and shear bond strength of two post systems. Oper Dent 1999 Jul-Aug;24(4):210-6.
13-Stockton LW, Williams PT, Clarke CT. Post retention and post/core shear bond strength of four post systems. Oper Dent 2000 Sep-Oct;25(5):441-7.
14-Cohen BI, Pagnillo M, Musikant BL, Deutsch AS. Comparison of the retentive and photoelastic properties of two prefabricated endodontic post systems. J Oral Rehabil 1999 Jun;26(6):488-94.
15-Qualtrough AJ, Mannocci F. Tooth-colored post systems: a review. Oper Dent 2003 Jan-Feb;28(1):86-91.
16-Qualtrough AJ, Chandler NP, Purton DG. A comparison of the retention of tooth-colored posts. Quintessence Int 2003 Mar;34(3):199-201.
17-Bateman G, Ricketts DN, Saunders WP. Fibre-based post systems: a review. Br Dent J 2003 Jul 12;195(1):43-8.
18-Prisco D, De Santis R, Mollica F, Ambrosio L, Rengo S, Nicolais L. Fiber post adhesion to resin luting cements in the restoration of endodontically-treated teeth. Oper Dent 2003 Sep-Oct;28(5):515-21.
19-Gallo JR 3rd, Miller T, Xu X, Burgess JO. In vitro evaluation of the retention of composite fiber and stainless steel posts. J Prosthodont 2002 Mar; 11(1):25-9.
20-Nissan J, Dmitry Y, Assif D. The use of reinforced composite resin cement as compensation for reduced post length. J Prosthet Dent 2001 Sep;86(3):304-8.
21-Cohen BI, Condos S, Musikant BL, Deutsch AS. Retention properties of a split-shaft threaded post: cut at different apical lengths. J Prosthet Dent 1992 Dec;68(6):894-8.
22-Innella R, Autieri G, Ceruti P, Gassino G. Relation between length of fiber post and its mechanical retention. Minerva Stomatol 2005 Sep;54(9): 481-8.
23-Habib B, von Fraunhofer JA, Driscoll CF. Comparison of two luting agents used for the retention of cast dowel and cores. J Prosthodont 2005 Sep;14(3):164-9.
24-Balbosh A, Ludwig K, Kern M. Comparison of titanium dowel retention using four different luting agents. J Prosthet Dent 2005 Sep;94(3):227-33.
25-Ertugrul HZ, Ismail YH. An in vitro comparison of cast metal dowel retention using various luting agents and tensile loading. J Prosthet Dent 2005 May;93(5):446-52.
26-Sen D, Poyrazoglu E, Tuncelli B. The retentive effects of pre-fabricated posts by luting cements. J Oral Rehabil 2004 Jun;31(6):585-9.
27-Goldman M, DeVitre R, Tenca J. Cement distribution and bond strength in cemented posts. J Dent Res 1984 Dec;63(12):1392-5.
28-Wrbas KT, Kampe MT, Schirrmeister JF, Al-

tenburger MJ, Hellwig E. Retention of fiber posts dependent on different resin cements. Schweiz Monatsschr Zahnmed 2006;116(1):18-24.
29-Chan KC, Boyer DB, Denehy GE, Aunan DC. Effect of metal etching on crown retention. J Prosthet Dent 1986 Jan;55(1):18-21.
30-Zalkind M, Shkury S, Stern N, Heling I. Effect of prefabricated metal post-head design on the retention of various core materials. J Oral Rehabil 2000 Jun;27(6):483-7.