Comparative study of retention of fiber-Reinforced post at middle and cervical one thirds of root canal cemented by Glass ionomer and Self adhesive Resin cement measured at different times

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Abstract:
The purpose of this study was to compare regional bond strength at middle and cervical thirds of the root canal among glass fiber-reinforced composite (FRC) endodontic posts luted with different cements, using the push-out test to compare the performance (retention) of two types of luting cements ;Glass ionomer cement and resin cement used to cement translucent fiber post and to compare the result of the push-out test at different storage times;1 week ,1month and 2 months.
Sixty caries-free, recently extracted single-rooted human teeth with straight root canals was used in this study, The root canals were endodontically instrumented at a working length of 0.5 mm from the apex by means of conventional instruments for hand use (Dentsply, Switzerland) up to size 35.then root canal filling was performed followed by post space preparation up to 8mm including cervical and middle one third of root canal then the fiber post was cemented into canal post space then the root was sectioned to get cervical (4 mm in length) and middle (4 mm in length) thirds ,these thirds were examined by push out test to get values of retention of fiber post inside these canal thirds .The results of this study has been showed that there was higher significant more push out bond strength between fiber post and root at cervical third as compared with middle third also the results showed that there was higher significant differences between push out bond strength between the two types of dental cements used to cement the fiber post to the root canal and after 1 month and 2 months the push out bond strength was increase for both types of cements.
Keywords: glass fiber post, push out retention ,glass ionomer, self adhesive Resin

Introduction:

The root posts have been used to retain coronary restorations and to improve the distributions of stress through dental structure. There are several types of root posts commercially available in the market, among which, glass fiber posts[1].
Fiber posts have been introduced in the early 1990s to restore endodontically treated teeth with an excessive loss of dental structure as alternative to cast post-and-core and metal dowels[2]. Because their elastic modulus is claimed to be similar to that of the dentin, the risk of vertical root fracture is expected to be reduced[3]. Furthermore, quartz or glass fiber posts (white or translucent) can be used in situations of higher esthetic demands[4].

The adhesion of cements can be influenced by the anatomical and histological characteristics of the root canal, including the orientation of the dentin tubules[5]. Moreover, since the number of tubules decreases from the crown to the apical root[6], Bond strength can be determined by several techniques, but the push¬ out bond strength test is believed to provide a better estimation of the actual bonding effectiveness than a conventional shear bond strength test. Using a push-out protocol, failure occurs parallel to the post-cement-dentin interface which similar to the clinical condition Although the micro tensile method has also been applied to root dentin, the push-out test seems to be more reliable because of the absence of premature failures and the variability of data distribution[7].
The aim of the study was to compare regional bond strength at middle and cervical thirds of the root canal among glass fiber-reinforced composite (FRC) endodontic posts cemented with different cements, using the push-out test, to compare the performance (retention) of two types of luting cements Glass ionomer and self adhesive Resin cement when used to cement translucent fiber post And to compare the result of the push-out test at different storage times

Material and methods:

Methods;

Sample selection: Sixty caries-free, recently extracted single-rooted human teeth with straight root canals will be used in this study. The inclusion criteria were absence of caries or root cracks ,no fractures ,no external resoption and X-ray will be taken to confirm no signs of internal resorption ,no calcification ,single canal and absence of previous endodontic treatments. Teeth will be stored in 0.1% Thymol at room temperature.

Preparation of acrylic blocks:

Each tooth will be fixed inside and at the base of clear tube with sticky wax at it apex then the clear acrylic will be mix and pour inside the clear tube till the tooth will be completely embedded inside the clear acrylic ,then crown portion of each tooth was sectioned perpendicularly to the long axis of the tooth at the cementum-enamel junction level, using a sectioning instrument under copious water cooling leaving 12mm root length embedded inside acrylic for further steps

Root canal preparation:

The Root canals were endodontically instrumented at a working length of 0.5 mm from the apex by means of conventional instruments for hand use (Dentsply, Switzerland) up to size 35. After each instrumentation,

root canals were flushed with 2 mL of 2.5% sodium hypochlorite and dried with adsorbent paper points . Canals were filled with cold lateral gutta-percha condensation using gutta-percha size 35 as master cones and size15as accessory cones, and Ah2 root canal sealer the sealer will be mixed, according to manufacturers' instructions. after filling the access chamber with temporary filling material , all root canals were stored in distilled water at 37C for 1 week, 1mounth and 2 month period , to study the effect of storage periods on the results of this study .

Post space preparation

Filling material of the middle and cervical thirds was then removed with Pesso drills (Maillefer-Dentsply), and the canal wall of each specimen was enlarged with low speed FRC Postecl drills (Ivoclar, Schaan, Liechtenstein) under copious water cooling, following the manufacturer's instructions, creating a 8-mm length post space (measured from cemento-enamel junction) with a no. 3 post drill, keeping at least 4mm of gutta-percha apically.

Groups:

Teeth were randomly assigned into two main groups (Group A and Group B, n=30 each), depending on the type of cement will be used; self adhesive Resin (ReyxTM U100 ;USA) and Glass ionomer cement(Medicem,Promedica; Germeny). And then each group is sub-divided into three groups (n=10 each), depending on storage period;1 week(A1 and B1), 1 month(A2 and B2) and 2 month period(A3 and B3) each root was sectioned into cervical(A1c,A2c,A3c,B1c,B2candB3C)and middle(A1m,A2m,A3m,B1m,B2m and B3m) thirds.

Post luting procedure

Group A(A1,A2 and A3):

cement will be mixed according to manufacturer instruction The post space will be irrigated with distilled water and dried with paper points then the Glass ionomer and then will be used to cement the fiber post into post space (8mm of canal filling the middle and cervical one third of the canal space

Group B(B1,B2 and B3):

The post space will be irrigated with distilled water and dried with paper points then the self adhesive Resin cement will be mixed according to manufacturer instruction and then will be used to cement the fiber post into post space (8mm of canal filling the middle and cervical one third of the canal space

Preparation of Specimens for the Push-Out Bond Strength Test:

Specimen will attached to the holder to keep it fix and then with sectioning disc under cooling water the specimen will be sectioned perpendicular to the long axis under water cooling. Three slices per each root representing cross-sections of cervical and, middle of the bounded posts will be obtained. Each slice was marked on its apical side with marker. The thickness of each specimen was measured with vernea. The sections will be stored individually in black container with sterile water. Push-out tests will be performed by applying a compressive load to the apical aspect of each slice via a cylindrical plunger mounted on a Universal Testing Machine managed by pc software. Because of the tapered design of the post, three different sizes of punch pin: 1.1 mm diameter for the coronal, 0.9 mm for the middle, will be used for the push¬ out testing. The punch pin was positioned to contact only the post, without stressing the surrounding root canal walls Care will also taken to ensure that the contact between the punch tip and the post section occurred over the most extended area, to avoid notching of the punch tip into the post surface. The load was applied to the apical aspect of the root slice and in an apical-coronal direction, so as to push the post towards the larger part of the root slice, thus avoiding any limitation to the post movement. Loading was performed at a crosshead speed of 0.5 mm min) 1 until the post segment was dislodged from the root slice [8].

A maximum failure load value will recorded (Netween) and converted into MPa, considering the bonding area of the post segments. Post diameters were measured on each surface of the post/dentine sections using the digital caliper and the total bonding area for each post segment was calculated using the formula:

$\Pi(R1+R2)\ (R1-R2)^2 + h^2$

Where: R represents the coronal post radius, r is the apical post radius and h is the thickness of the slice. All fractured specimens were carefully removed and observed under stereomicroscope at 20 and 50 magnification from the cervical as well as from the apical direction to determine, for each root third, the mode of failure, which were classified into five types[9]:

(i) Adhesive between post and resin cement (no cement visible around the post).

(ii) Mixed, with resin cement covering 0-50% of the post diameter.

(iii) Mixed, with resin cement covering 50-100% of post surface.

(iv) Adhesive between resin cement and root canal (post enveloped by resin cement).

(V) Cohesive in dentine.

Results :

The results showed (figure 1 and table 1)that the group (B3c) has the highest push out bond strength while the group (A1m) has the lowest push out bond strength .

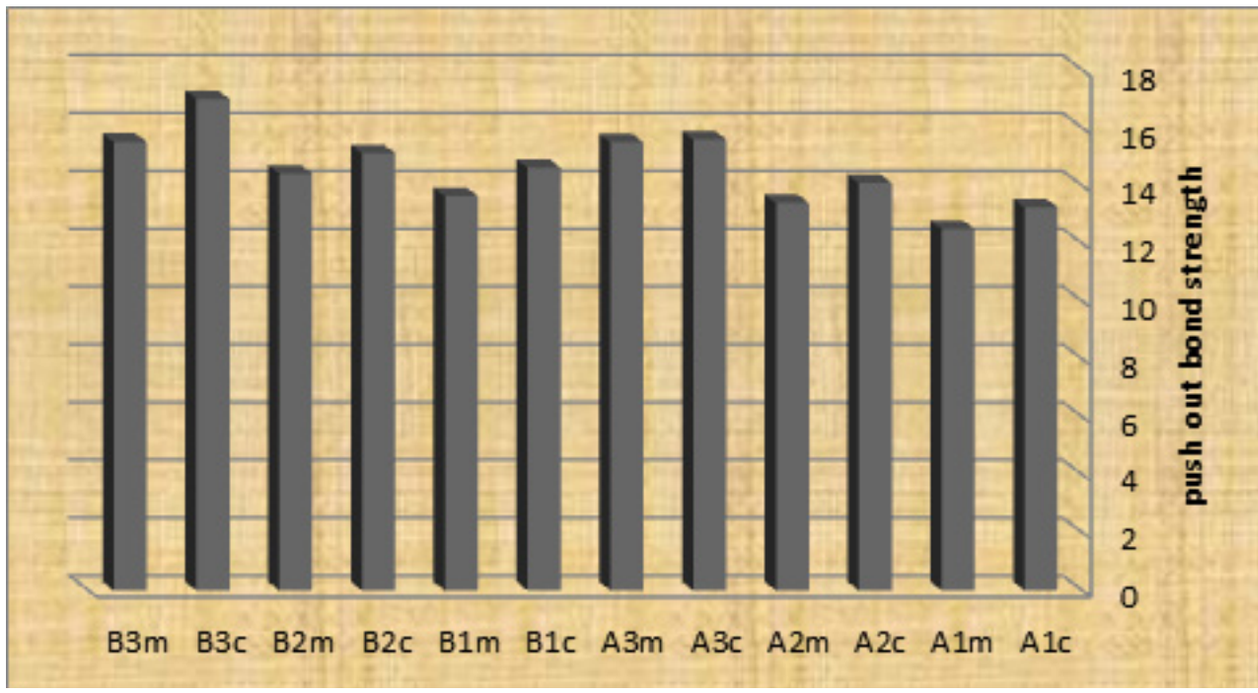

Figure 1: Push out bond strength (MPa) of all groups of this study.

Table 1 : Mean and standard deviation (MPa) of push out bond strength of all groups of this study.

Cement type	Root third	Storage period	N	Mean	±Sd
Glass ionomer cement (A)	Cervical (c)	1 week (A1c)	10	13.26	0.22
		1 month (A2c)	10	14.1	0.21
		2 month (A3c)	10	15.6	0.36
	Middle (m)	1 week (A1m)	10	12.5	0.16
		1 month (A2m)	10	13.4	0.14
		2 month (A3m)	10	15.5	0.14
Resin cement (B)	Cervical (c)	1 week (B1c)	10	14.62	0.2
		1 month (B2c)	10	15.12	0.26
		2 month (B3c)	10	17	0.37
	Middle (m)	1 week (B1m)	10	13.64	0.13
		1 month (B2m)	10	14.42	0.15
		2 month (B3m)	10	15.52	0.22

A-Push out bond strength for self adhesive resin and glass ionomer cement at middle and cervical third of root canal:

LSD test (table 2) showed that there was higher significant differences between push out bond strength between fiber post and root at cervical third as compared with middle third, except when we compared the group A3c with group A3m the result showed there was no significant differences between them.

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Table 2: LSD test to compare push out bond strength between cervical and middle third of root of tested groups

Comparism (I)Group X (J)Group	Mean differences(I-J)	Significance
(A1c) X (A1m)	0.101	0.000*
(A2c) X (A2m)	0.696	0.000*
(A3c) X (A3m)	0.095	0.349
(B1c) X (B1m)	0.98	0.000*
(B2c) X (B2m)	0.7	0.000*
(B3c) X (B3m)	1.48	0.000*

* significant at (P<0.05)

B-Push out bond strength for the type of cement (self adhesive resin and glass ionomer cement):

LSD test (table 3) showed that there was higher significant differences between push out bond strength between the two types of dental cements used to cement the fiber post to the root canal, except when we compared the group B3m with group A3m the result showed there was no significant differences between them.

Table 3: LSD test to compare push out bond strength between the two types of dental cements used to cement the fiber post to the root canal.

Comparism (I)Group X (J)Group	Mean differences(I-J)	Significance
(B1c) X (A1c)	1.36	0.000*
(B1m) X (A1m)	1.14	0.000*
(B2c) X (A2c)	1.02	0.000*
(B2m) X (A2m)	1.02	0.000*
(B3c) X (A3c)	1.4	0.000*
(B3m) X (A3m)	0.15	0.882

* significant at (P<0.05)

C-Push out bond strength for self adhesive resin and glass ionomer cement at 1 week, 1 month and 2month storage periods:

LSD test (table 4) showed that there was significant differences increase in push out bond strength for the two types of dental cements used to cement the fiber post to the root canal after one and two months

Table 4: LSD test to compare push out bond strength for self adhesive resin and glass ionomer cement at 1 week, 1 month and 2month storage periods.

Comparism (I)Group X (J)Group	Mean differences(I-J)	Significance
(A1c) X (A2c)	-0.835	0.000*
(A1c) X (A3c)	-2.344	0.000*
(A2c) X (A3c)	-1.509	0.000*
(A1m) X (A2m)	-0.897	0.000*
(A1m) X (A3m)	-3.007	0.000*
(A2m) X (A3m)	-2.11	0.000*
(B1c) X (B2c)	-0.5	0.000*
(B1c) X (B3c)	-2.385	0.000*
(B2c) X (B3c)	-1.885	0.000*
(B1m) X (B2m)	-0.78	0.000*
(B1m) X (B3m)	-1.885	0.000*
(B2m) X (B3m)	-1.105	0.000*

* significant at (P<0.05)

One-way ANOVA test (Table 5) showed that there was statistically significant difference among all the groups at the P value less than 0.01

Table (5):ANOVA test for push out bond strength for self adhesive resin and glass ionomer cement at cervical and middle roots thirds with 1 week, 1 month and 2month storage periods.

	Sum of square	df	Mean square	F	*P*(value)
Between groups	175.665	11	15.970	312.595	*P*<0.01
Within groups	5.517	108	0.051		
Total	181.182	119			

d.f.=degree of freedom *P*-value=probability

Discussion:

Various methods are available to analyze the adhesive bond strength of cement and bond strength of the fiber posts. The two most commonly used technique are the micro tensile bond strength (MTBS) and the push out test. Most scientists prefer the push out test for the analysis of fiber posts bond strength to root dentine because it has been documented that the results of this test are more reliable for posts compared to the MTBS test/By using the push out test, the premature loss of samples during the manufacturing of the specimens is reduced. Furthermore, the micro push out test enable the measurement of bond strength to very small areas such as the interior of a root canal[10].

Self-adhesive resin cements were designed to overcome limitations of both traditional and resin-based cements and simplify the bonding process. Practitioners prefer materials that are easy to use, and it has been considered that ease of use facilitates improved performance[11]. It could therefore be considered that a resin luting material that does not require the etching and bonding steps presents distinct advantages to the clinician when compared with traditional resin luting materials in terms of ease of use and potential savings in time and chair-side costs. Several studies have indicated that the bond strength values of self-adhesive cements are comparable to or even higher than those of etch-and rinse and self-etching primers luting techniques[12,13].

1. The effect of root third on bond strength of fiber post to the root canal:

The result of the present study showed that both of the two cements used demonstrate a measurable adhesive property, with the highest values for the cervical third and the lower values for the middle third.
Several factors may contribute to the reduction in the bond strength from
coronal to apical direction. Some of these factors are inherited to the root dentin composition, and others are related to the restoration techniques used[14].

2. The effect of type of cements on bond strength of fiber post to the root canal:

The result of this study showed higher bond strength gain when resin cement was used to cement fiber post to the canal walls Adhesive resin cement has been advocated for cementation of the post because they bond the post to tooth structure with greater strength than other cements[15] . it is generally accepted that resin cement produce lower shrinkage stresses due to their lower curing rates that allow more stress relief by polymer flow[16].

3- The effect of storage period on bond strength of fiber post to the root canal:

The result of this study showed that there was increase in push out bond strength for the two types of dental cements used to cement the fiber post to the root canal after one and two months this may be related to complete setting reaction of dental cement providing better resistance to dislodging forces[17].

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