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Comparing the Effect of Self-adhesive Resin Cements and Self-etching Bonding System on Retentive Strength of DT light Fiber Post: an in-vitro study

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ABSTRCAT

Background and Aim: Loss of bond strength is the most common reason for failure of fiber posts. The aim of this study was to compare the effect of self adhesive resin cements (Bifix SE, Clearfil SA luting) and self-etch adhesive systems (Panavia F.2, Bifix QM) on bond strength of DT light fiber post.
Materials and Methods: This experimental study was performed on 40 single-rooted human premolars. After being endodontically treated and preparing post spaces for DT light fiber posts, the samples were randomly divided into 4 groups of 10 based on the resin cement type, and were submitted to 4000 thermal cycles (5-55c). Then three 2mm thick segments from coronal, middle and apical thirds of roots were prepared and push out test was performed on them. Then all root segments were assessed for failure mode using stereomicroscope. From the coronal slices of each group based on dominant failure mode, one slice was randomly selected to be observed under SEM. Data were analyzed using T-test, two way ANOVA and Tukey test.
Results: : No significant difference was found between the self adhesive cements and self-etch adhesive system. ($p<0.4$) The highest and the lowest bond strength values were observed respectively in Bifix SE and Clearfil SA luting, which was statistically significant. ($p<0.05$) In the studied cements, there was no significant difference between the different regions of root; ($p>0.05$) however the interaction between the luting cement and different root regions was significant. ($p<0.001$) The most common failure mode was type 4 (adhesive between the cement and dentin).
Conclusion:the type of cement used and interaction between the luting cement and different root regions influenced the bond strength value, but different root regions per se could not influence the bond strength.
Key words: Fiber post; Resin cements; Bond strength

INTRODUCTION

Loss of bond strength of fiber posts that are widely used in endodontically treated teeth with vast destruction is among the most important defects of their usage.[1] A retrospective study after 4 and 5 years has reported the clinical success of fiber posts to be respectively 45.71 and 32.56%. [2] Loss of bond strength of fiber posts can result recurrent caries, root or crown fractures, as well as periapical and periodontal lesions. [2, 3]
Since the retention of fiber posts are non-resistant inside the root canal, their resistance against movement and fracture depends totally on cementing technique. [1] Among other factors that can influence the bond strength are C-factor, the sealer type in endodontic treatments, anatomical differences and quantity of dentinal tubules in different root regions, troubles in light reach-

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ing of the light cure device and moisture control and application of adhesive material in apical part of the root. [3]

Regarding the higher strength of resin cements in comparison to conventional cements [1], recently self-adhesive resin cements have been suggested with self-etch bonding system because of their advantages and fewer clinical steps and simplicity of bonding of fiber post.[4] Based on the recent studies, self adhesive cements provide more bond strength. [4-8]

On the other side, some researchers propose self-etch resin cements for higher bond strength [9], while some others have reported no difference in bond strength between various groups[3,10]. Considering the controversies in this regard, the current in-vitro study was carried out to compare the effect of self-adhesive resin cements (Clearfil SA luting and Biifx SE) and self-etch bonding system resin cements (Bifix QM+Futurabond DC and Panavia F.2+ED Primer) on the bond strength of DT Light fiber post in different root regions, using Push-out test.

Materials and Methods:

In this experimental study, a number of single-canal single rooted premolars [1, 4, 11,12] were collected with closed apex and without previous endodontic treatment that were extracted due to orthodontic treatment in patients aged 16-25 [4,5]. Teeth dimensions were measured in coronal, middle and apical sections using digital caliper (Insize, Iran). They were assessed for caries and fracture in root surface by an ophthalmic lens with a magnification of 4, and 40. qualified teeth were selected with 14-17mm root length.

Teeth were disinfected with 0.2% thymol solution [13] for 48 hours at 4°C, then were rinsed and stored in normal saline solution [11]. The coronal part of the teeth were removed 3mm above CEJ of proximal perpendicular to the long axis of the tooth, with Cylinder-L diamond bur (Dia, Italy) [8]accompanied with turbine and cooling water. All teeth were cleansed and shaped to the working length 1mm shorter than the radiographic apex by step-back technique using K file (Mani, Japan) and 3-2Gates (Mani, Japan). Master file was 35 for all samples [3, 4 ,14] sodium hypochlorite was used for rinsing throughout the procedure.

At the end, the inside of canals were rinsed with normal saline, dried with paper point and filled with lateral condensation technique using Gutta-percha (Ariadent, Iran) and sealer (AH26 DENTSPLY, Konstanz, Germany) [4,5,12]. Endodontic treatment of all teeth was done by the same operator. After filling canals, the orifice point was temporarily sealed with dressing material (Golchay, Iran) [3,5,14,15], and teeth were stored in incubator for 48 hours at 37°C with 100% humidity until the complete hardening of the sealer. [1, 4, 7 , 9]

Afterwards, the dressing was removed by round angle bur; Gutta-percha was removed using heat carrier plugger. 12mm post space was prepared from 3mm above the CEJ using size 2 drill (coronal diameter 1.8mm, apical diameter 1mm) specified for DT Light post (RTD Illusion, ST Egreve, France). Then inside of the canal was rinsed with physiological serum and dried with paper point. The post space was controlled through radiography [3] to make sure of complete removal of Gutta-percha from the walls of canal. The teeth were randomly divided into four groups of 10 based on the cement used. The resin cements used in group 1 and 2 were self-etch bonding system.

1.Panavia F.2+ED primer(Kuraray, Okayama, Japan)
2.Bifix QM+Futurabond DC (Voco, Cuxhaven, Germany)
3.Clearfil SA luting cement (Kuraray, Okayama, Japan)
4.Bifix SE (Voco, Cuxhaven, Germany)

All the cements in this study were dual-cure and were used based upon the manufacturer's instruction (Table A). Prior to using the cement, the root surface was wax-coated all over (Cavex, Holland).[9] Each fiber post was once tried inside the canal to make sure of its proper seating. With use of a double-sided diamond disc (Diatec, Germany), they were cut down to 3mm above the CEJ, cleansed with alcohol [3, 4, 14, 16] and dried. The self-cure bonding was applied to groups 1 and 2 with use of a microbrush specified for canal; the extra amount was removed with paper point, and a bit of bonding was placed over the post.

All cements were applied into the canal by Lentulo instrument (Dentsply, Maillefer). [4, 5, 12-14] Each time a bit of cement was added over the post. The post was inserted into the canal and kept there with finger pressure for 60 seconds and the extra amount of cement was removed with microbrush. [4,16]. Demetron light-cure (Kerr, USA) set at 800mwW/cm2 was used. When curing, the tip of the unit was directly in touch with the end of the fiber post. Then the exposed dentinal part of the crown and the bottom of the fibers were covered by Fuji IX (GC, Tokyo, Japan) to make it more similar to clinical conditions.

On completion of polymerization of the resin cements, the teeth were incubated within a dark container of distilled water for 24 hours at 37°C [4, 8, 9, 15 , 17]. Then the root surface was covered with Speedex silicone (Coltene, Swiss), and all samples were submitted to 4000 thermal cycle from 5 to 55°C in thermocycling device (Dorsa, Iran). The storage time in each bath and the transfer time between the two baths was 20 seconds. Then the samples were mounted within the plastic experiment tubes [5] containing self-cure transparent acrylic resin (Acropars, Iran).

Each sample was attached to the plate of high-speed cutting machine accompanied by cooling water and was cut from 1mm below the CEJ perpendicular to the longitudinal axis of the post. Three slices of 2±0.1mm [5, 8 ,12] was prepared of each coronal, middle and apical regions of the post along with the root. The blade of the device was 0.5mm thick. The relating regions of the sections were marked on the apical side of them using waterproof marker. Then a digital caliper with 0.01mm accuracy (Insize, Iran) was used to measure the thickness and diameter of coronal and apical surface of each section.

To perform the push-out test, each specimen was placed in its place on the moving plate in such a way that the post in the root section be located on the center of the cavitational generator. With use of a load compressing pin which was made suitable to the sections [6, 11] (coronal 1mm, middle 0.9mm, apical 0.8mm) and was attached to the upper part of the device, a force of 0.5mm/min from apical to coronal sides was applied [1, 3-6, 9, 15 , 18] to the center of the sample on the post until the post dislodgement occurred.

The bond strength was calculated by the formula of Debond stress=debond force (F)/A in Mpa, in which A was the lateral surface area and F was the maximum force needed for post dislodgement recorded by the device. The lateral surface area was calculated by the following formula: A=∏[(r1=r2)[(r1+r2)2+h2] ½ [3-6, 8, 14-16.]

After the push-out test, the failure mode of each sample was evaluated in the 3 sections of coronal, middle and apical, using stereomicroscope at ×10, ×20, and ×30 magnifications from both coronal and apical areas[16], and the failure mode was analyzed based on the specified category.

Type 1: Adhesive between the post and the cement (no cement should be observed around the post)

Type 2: Mix (0-50% of the post surface must be covered by cement)

Type 3: Mix (50-100% of the post surface must be covered by cement)

Type 4: Adhesive between cement and the crown (the post must be enveloped by the cement)

Type 5: Cohesive [7, 13,15]

A sample was randomly selected from the coronal sections of each cement type with respect to the predominant failure mode. The samples were immersed in ethanol solution and were dried afterwards. Then they were mounted in metallic stubs and gold coated, and were finally observed under SEM (Phillips, Holland). Two-way ANOVA, T-test and Tukey tests were used as appropriated.

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The chemical compound, manufacturer, and instructions used

Instruction	Bonding chemical compound	Cement chemical compound	Bonding Type	Cement Type
Mix equal amounts of ED primer A&B, wait 30s Gently air dry, dispense equal amounts of paste A&B, mix paste A&B for 20s, light cure 2-3s, remove the excess, light cure 20s	**Primer A:** 2HEMA,MDP, NM-aminosalicylic acid, diethanol-p-toluidine, water **Primer B:** NM-aminosalicylic acid,T-is opropylic benzenic sodium sulfinate, water, Diethanolptoluidine,	**Paste A:** 10MDP,Hydrophobic& Hydrophilic dimethacrylate, Benzoylperoxide, Camphorquinon colloidal silica **paste B:** sodium fluoride, Hydrophobic&Hydrophilic dimethacrylate, Diethanol-p-toluidine, t-isopropylic benzenic sodiumsulfinate, barium glass, titanium dioxide, colloidal silica	EDprimer	**panaviaF.$_2$ (Kuraray)**
Futurabond DC Mix equal amounts of liquid1&2,apply 20s,air dry 5s,light cure10s **BifiX QM:** The automix delivery system mixes pasteA&B through the mixing tip to render a single paste,apply directly ,remove excess, light cure 20S	**Liquid A:** polyfunctional adhesivemonomers, dimethacrylates, sio_2, nanoparticles, initiators **LiquidB:**ethanol, water,fluorides, DCcatalyst	HEDMA(10-25%)BisGMA(10-25%) catalyst≤2.5%	Futurabond DC	**Bifix QM (Voco)**
The automix delivery system mixes pasteA&B through the mixing tip to render a single paste,apply directly, light cure for2-5s,leave it for3-5min,remove excess paste,light cure 20s	-	**Filler** load:66%wt(45%vol)mean **PasteA:**10MDP,BisGMA, TEGDMA,hydrophobic aromatic dimethacrylate, dI-camphorquinone, Benzoylperoxide Initiator, Silanated barium glass filler, Silanated colloidal silica **Paste B:** BisGMA,hydrophobic aromatic dimethacrylate, hydrophobic aliphatic dimethacrylate accelerators,pigments, surface treated sodium fluoride, Silanated barium glass filler, Silanated colloidal silica	-	**Clearfil SA luting (kuraray)**
The automix delivery system mixes pasteA&B through the mixing tip to render a single paste,apply directly,light cure1-2S,45s waiting before excess removal,40s light cure	-	**Base**:dimethacrylates(BisGMA,UDMA, GlyDMA),filler:glass (70%Wt),coinitiator,photoinitiator, polyfunctional adhesive monomers (phosphate monomers),stabilizers **Catalyst :**dimethacrylates,fillers, SC initiator	-	**Bifix SE (voco)**
Select the post corresponding to its drill size provided.for trimming of the post,use diamond bur or disk for desired length.	-	**Fiber:**quartz **Matrix:**Epoxy resin **Shape:**double tapered Radioopaque,translucent **Composition:**unidirectional,quartz fibers bound in a resin matrix	-	**DT light post**

Results:

The current study was done on 40 teeth (four groups of 10) using Self-etch bonding system resin cements of Panavia F.2+ED Primer and Bifix QM+Futurabond DC and the self-adhesives of Bifix SE and Clearfil SA luting.

Regardless of root region, the bond strength in self-etch bonding resin cements was 11.63±6.2Mpa and in self-adhesive resin cements was 10.62±4.36 Mpa; T-test proved this difference not to be statistically significant (P<0.4).

As presented in table 1, the highest and the lowest bond strength was respectively detected in Bifix SE self-adhesive cement (13.12±5.25Mpa) and Clearfil SA luting resin cement (8.13±3.47Mpa). Tukey multi-comparison test revealed this difference to be statistically significant (P<0.05).

Table 1- Pairwise comparison of bond strength (Mpa) in the studied cements

Bond Strength / Cement	Mean±SD	P.Value
Bifix SE	13.12±5.25	P<0.05
clearfil SA luting	8.13±3.47	
Bifix SE	13.12±5.25	P>0.9
PanaviaF.2+ED primer	12.3±6.68	
Bifix SE	13.12±5.25	P<0.5
BifixQM+futurabond DC	10.94±5.71	
clearfil SA luting	8.13±3.47	P>0.09
PanaviaF.2+ED primer	12.3±6.68	
clearfil SA luting	8.13±3.47	P>0.3
BifixQM+futurabond DC	10.94±5.71	
PanaviaF.2+ED primer	12.3±6.68	P>0.8
BifixQM+futurabond DC	10.84±5.71	

According to table 2, ANOVA test showed the studied cements to have no significant difference in bond strength in coronal, middle and apical sections (P>0.5). However, the interaction between the cement and the different root regions was significant (P<0.05), i.e. the highest bond strength was observed in the middle and apical area of Bifix SE self-adhesive cement (13.49±4.2 and 14.7±6.41Mpa, respectively) and the lowest value was related to the middle and apical sections of Clearfil SA luting self-adhesive (7.20±2.59 and 7.19±3.63Mpa, respectively). Also Tukey test showed that significant difference existed only between the middle and apical regions of Bifix SE and Clearfil SA luting cements (P<0.001 and P<0.0001).

Table 2- Bond strength (Mpa) in different root regions in studied cements

Cement	Bond Strength / Root regions	Mean±SD	C.V	P.Value
Panavia F.2+ED primer	Coronal	13.14±6.23	47.41	P>0.5
	Middle	12.06±7.93	65.75	
	Apical	11.7±5.88	50.25	
Bifix QM+futurabond DC	Coronal	11.75±7.51	63.91	P>0.5
	Middle	8.29±3.79	45.71	
	Apical	12.77±5.83	45.65	
clearfil SA luting	Coronal	10±4.18	41.8	P>0.5
	Middle	7.19±3.63*	50.48	
	Apical	7.20±2.59**	35.97	
Bifix SE	Coronal	11.16±5.13	45.96	P>0.5
	Middle	14.7±6.41*	43.60	
	Apical	13.49±4.2**	31.13	

By observing the failure mode by Stereomicroscope at ×10, ×20 and ×30, it was found that type 4 mode (adhesive between the cement and crown – post be enveloped by the cement) was the most recurrent failure mode in the 4 studied cement groups.

Failure mode of type 3 (Mix, 50-100% of post surface be covered with cement) was detected only in 1 Bifix SE specimen in apical area, 1 sample of Bifix QM in middle area, 1 Clearfil SA luting sample in coronal area and 2 samples

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in middle area. In samples of Panavia F.2 cement, it was detected in 5 samples in coronal area, 2 samples in middle and 1 in apical area.

As mentioned before, in Panavia F.2 cement, 5 samples had mix failure mode (type 3) and 5 samples had adhesive cement – dentin failure mode (type 4). Among 5 mix samples one sample was selected randomly and inspected with SEM and it became clear that void in cement had caused cohesive fracture in cement itself which extended to cement-post junction. (figure2)

Also, in one sample of coronal area section of Panavia F.2 cement, fiber post was completely dislodged which was inspected with SEM. In some areas in canal wall pieces of cement were seen which indicates surface tension with dentinal wall of canal. (Figures 3 and 4) furthermore, in a part of dislodged fiber post cohesive fracture and exposure of quarts fibers was detected which could have happened during cutting of sections. (Figure 5)

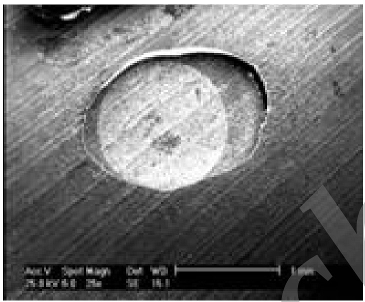

Figure 1- Type 4 failure mode (adhesive failure between the cement and dentin)

Figure2- Type 3 failure mode (Mix). The arrow shows the cohesive failure in Panavia F.2 cement.

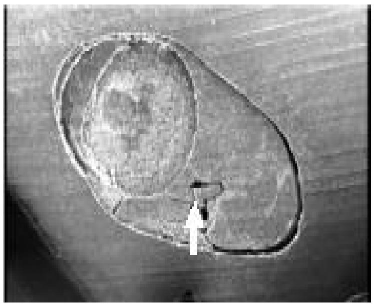

Figure2: Type 3 failure mode (Mix). The arrow shows the cohesive failure in Panavia F.2 cement.

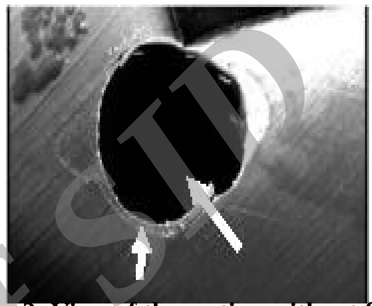

Figure 3: View of the section without fiber post. The arrow shows Panavia F.2 cement attached to the dentinal wall

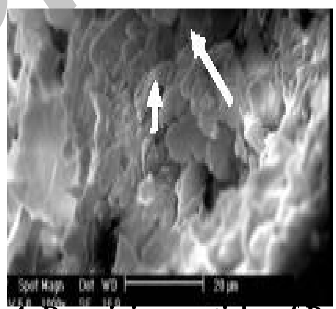

Figure 4: Remaining particles of Panavia F.2 cement in the inner canal wall without fiber post

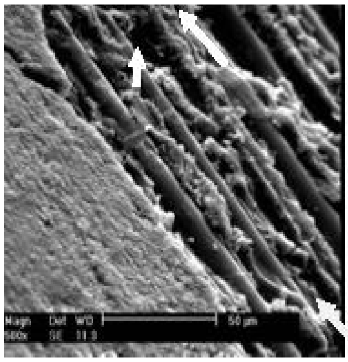

Figure 5: Figure 8 at ×500 magnification (the arrow shows the cohesive failure of the fiber post and exposure of quarts fibers

Discussion:

The present study revealed that there is no significant difference between the bond strength value of resin cements of self-etch bonding system and self-adhesive system. Hence, the first hypothesis of the research claiming the shear bond strength of fiber posts attached by self-etch bonding system resin cements to be higher than self-adhesive cements would be rejected.

The same result was achieved in the studies enrolled by Mumcu [3] and Alizadeh et al [10]; but Calixto [9] reported the bond strength of Rely X U100 self-adhesive cement to be significantly less than Panavia F.2 and Multilink with self-etch bonding systems. Also in the study by Bitter [6], Rely X Unicem self-adhesive cement was detected to have higher bond strength than Panavia F.2 and Variolink II cements. The probable reason for this difference with the present study can be attributed to the different methods of performing these two studies.

There are various methods for measuring the bond strength [12]; Push-out test is a practical method to measure the factors that affect the bond strength of fiber posts [1]. Uneven stress distribution in thick samples is one of its deficiencies that has been solved through providing thinner samples, which is called micro-Push-out test [12.] Based on the above mentioned reasons, the current study relied on Push-out test to compare the bond strength in three different root regions and 2mm thick samples were used so that the stress would be distributed uniformly.

Generally, bonding to the structure of the root dentin is influenced by various factors, one of which is the type of primer and the mechanism of adhesion (self-adhesive or pre-etching)[12]Bonding to the canal can be associated with omission or presence of smear layer[3]10MDP is a phosphate containing functional monomer in the composition of ED primer and paste A of Panavia F.2 and Clearfil SA luting cements. This molecule does not dissolve the smear layer and would lead to demineralization of dental tissue [14, 19 ,20]. It also creates chemical bond to the calcium remaining of the hydroxyl apatite that surrounds the collagen in hybrid layer. Ca-MPD salt is slightly soluble in water and is able to protect the bond against hydrolytic degeneration (3). Also Bifix SE cement and Futurabond DC bond consists of phosphoric acid multi-functional monomers that can demineralize the teeth structure; consequently they have micromechanical and chemical retention to hydroxyl apatite [21, 22]. Although the self-adhesive cements are believed to have limited penetration and cause less demineralization in dentine [1], both self-adhesive and self-etch bonding systems have similar functional mechanism which was confirmed by the present study.

In the current study, the highest and the lowest bond strength was respectively related to Bifix SE self-adhesive cement and Clearfil SA luting self-adhesive cement, and there was a significant difference between these two. But no significant difference between Bifix SE and other studied cements was recorded, and it was concluded that the bond strength is affected by the used cement. Majority of the studies found similar results as the above mentioned results. However, in the study performed by Mumcu [3], no significant difference was found between Panavia F.2 self-etch bonding and Rely X Unicem, Maxem self-adhesive cements. Also in Mosharraf's study [16], the difference between Panavia F.2 and Variolink (TotalTech) cements was not significant. The probable reason of this difference might be attributed to the different cements used and the experimental conditions.

Presence of considerable difference between Bifix SE and Clearfil SA luting self-adhesive cements can be due to the difference in structure and chemical composition of the cements in a system [4]; in such a way that degeneration of self-adhesive cements seems to be dependent on the composition of the substance [18] Besides, based on the manufacturer's claim regarding the strength of bonding to root dentin, Bifix SE was calculated to have higher bonding strength than Bifix QM+Futurabond DC which was approved by the current study [21, 22].

The current study found no considerable difference between the coronal, middle and apical

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one-third regions of the root in the studied cements and it was concluded that the different root regions do not have any impact on the bond strength. Hence, the second hypothesis of this study that the shear bond strength in the coronal and middle one-third is more than apical third of the root was rejected.

Similar to current study, Cantoro [11] found that root sections made no significant difference in study groups; nevertheless, most studies concluded that bond strength is influenced by different root regions. In the studies by Mumcu[3]Al-jaff [5], Alizadeh Oskoee [10], Aminsalehi [12], Mosharraf [16] and Noukar [23], the bond strength in coronal 1/3rd area was higher than the apical 1/3rd, and the conclusion was drawn that bond strength reduces from coronal to apical area. This bond strength reduction was attributed to the difficulty in reaching the apical region, decrease in the light received to this section and consequently decreased polymerization of the cement, as well as the difference in distribution and density of dentinal tubules in various root regions [3].

The highest bond strength was observed in middle and apical area of Bifix SE self-adhesive cement and the least in the middle and apical area of Clearfil SA luting self-adhesive cement samples with a statistically significant difference. It leaded to the conclusion that the bond strength is influenced by the interaction between the cement and different root regions. Some researchers found similar results regarding the interaction between cement and root regions. [4, 13]Kahnamouei [4] claimed the self-adhesive systems to have lower sensitivity to dentin depth and density of tubules.

In the present study, this statement is true in the case of Bifix SE cement, while it was rejected for Clearfil SA luting cement in which increasing the depth resulted in decreased bond strength. It can be caused by the higher stability of Bifix SE cement in moist environment, since moisture control in deeper parts of the canal is more difficult, or it can be attributed to the fact that polymerization of Clearfil SA luting cement is more influenced by its light-cure reaction.

In Panavia F.2 cement, the bond strength reduced from coronal area to apical area. In the study by Kahnamouei [4], the claim was made that the difficulty in delivering the adequate amount of self-etch bonding to the apical area of the canal caused lower bond strength in this area, but it was not the case for Bifix QM cement that had the highest bond strength in apical area. The reason can be the better adaptation of post in apical area and consequently the decreased amount of cement.

To reconstruct the clinical conditions and to evaluate the bond strength of fiber posts over time in the current study, 24 hours after posts were cemented and the root surface were covered with Speedex silicon, all samples were subjected to thermal cycling in water (5/55°C, 4000 cycles).

Mazzitelli [1] evaluated the bond strength before and after thermocycling and found that the bond strength was significantly affected by thermocycling and the interaction between the cement type and thermocycling. Bitter 6 carried out a study aiming to assess the effect of thermomechanical loading (TML) on the bond strength and reported that TML significantly decreased the bond strength of all studied cements. Also Rely X self-adhesive cement was found to have significantly higher bond strength before and after TML. Also in the study by Noukar [23]all samples were subjected to thermocycling 24 hours after the posts were cemented, without covering the root surfaces.

Unlike the present study, in all the above mentioned studies, the samples were directly subjected to thermal changes; this issue can have impacts on bond strength.

The most predominant failure mode in this study was of the type of adhesion between the cement and dentin, which was in agreement with the results of most former studies [1, 3, 11, 13, 15, 18]. This might be because all samples were subjected to thermocycling prior to Push-out test. In the study by Mazzitelli et al. [1] that was done on Rely X Unicem, Breez, and G-Cem self-adhesive cements, the most common failure mode before and after thermocycling was adhesive between the cement and the dentin. Also in the study by Bitter et al. [6], it was concluded that TML significantly affects the failure mode in Rely X Unicem and Panavia F.2 cements; however, it does not have any impact on failure mode of Varolink II. Before adapting TML, the most common adhesive failure mode was between the post and the cement, but after applying TML it was changed to adhesive failure between dentin and the cement.

Calixto [9] reported the mix mode as the dominant failure mode. Farina's study announced the most common failure mode in Rely X Unicem to be the cohesive in the cement, and in cement post the failure occurred most in the adhesive between the dentin and the cement, as well as in mix mode. [7] a study focusing on three types of posts revealed that the main failures in DT White post was in the adhesive between the post and the cement; Mix mode was the prevalent failure mode in the other two types.[19]

Assessing the coronal section of the studied samples using SEM based on the predominant failure mode, adhesive failure between the cement and the dentin (type 4) was observed and the obtained results was approved by stereomicroscope. As mentioned previously, 5 samples in Panavia F.2 cement had type 3 failure mode (Mix) and 5 others had type 4 (adhesive failure between cement and dentin). One out of the 5 mix samples was selected randomly and observed by SEM; it was detected that the void in the cement had led to cohesive failure in the cement in such a way that the failure had progressed up to the junction of cement-post.

In one of the coronal samples of Panavia F.2, the fiber post was completely detached from the dentin of inner wall of the canal. Both the section and the fiber post were removed and observed by SEM. Remaining particles of cement was observed on some parts of the inner wall of the canal, indicating surface interaction with the inner wall of the canal. Cohesive failure and exposure of quarts fibers was observed in some parts of the dislodged fiber post that could have occurred while cutting the sections.

Regarding the different results obtained in various studies, and the limitations of experimental conditions, In-vivo studies seem to be essential to evaluate the clinical application of fiber posts.

Conclusion:

It seems that bond strength is influenced by cement type and interaction between cement and different root regions but is not influenced by different root regions per se.

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