ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)

IJDSIR : Dental Publication Service

Available Online at: www.ijdsir.com

Volume – 5, Issue – 2, March - 2022, Page No. : 514 - 529

Evaluation of push out bond strength of various surface treated fiber post, luted with different application technique - An Invitro study

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Citation of this Article: Dr. Deepthi.M., Dr. Ananthakrishna. S, Dr. Pradeep P. R., Dr. Sumayah Salma Muneer, Dr. Syam Prasad T., "Evaluation of push out bond strength of various surface treated fiber post, luted with different application technique - An Invitro study", IJDSIR- March - 2022, Vol. – 5, Issue - 2, P. No. 514 – 529.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background And Objectives: The aim of this in vitro study was to evaluate the effect of various surface treatments i.e, sand blasting, sand blasting + silane on fiber posts luted using different application techniques i.e, on the post surface only, using lentulo spirals and using injection technique (specific composite gun), on the bond strength of fiber post to root dentin using UTM and to evaluate the failure modes of fiber posts under stereomicroscope.

Methods: Seventy two single rooted premolars were endodontically treated and post spaces were prepared. The specimens were randomly assigned to 3 groups based on the surface treatment done on the surface of the posts. Group I – no surface treatment, Group II – surface treatment with Al_2O_3 particles, Group III – surface treatment with Al_2O_3 particles followed by silane application. Then each group was sub divided into 3 sub-groups depending on the different technique of luting into the post space; subgroup A- over the post surface only, subgroup B- using lentulo spiral instrument and subgroup C- using specific composite gun with appropriate plug. Self-adhesive resin cement was used to lute the fiber posts and to test the adhesion of a glass fiber post to the root dentin through a push out test using universal testing machine. The failure mode of fiber posts were assessed using stereomicroscope.

Results: Both sand blasting and sand blasting + silane showed highest push out bond strength compared to control group with no statistically significant difference between them. And also results showed that using lentulo spirals and injection technique to lute the posts into the root canal increased the push out bond strength of fiber post to the root canal. Most common failures were seen as adhesive type of failures between the resin cement and dentin.

Interpretation And Conclusion: There is an increase in the bond strength of the resin cement with fiber posts after various surface treatments and when the luting agent was brought into the post space with lentulo spirals or specific syringes.

Keywords: Sand Blasting, Silane, Push out Bond Strength, Stereomicroscope.

Introduction

The endodontically treated tooth is a unique subset of teeth requiring restoration because of several factors such as dehydrated dentin, decreased structural integrity and impaired neurosensory feedback mechanism when compared to a vital tooth.

It often require partial or complete coverage restorations according to the amount of remaining tooth structure.[1]

Various reinforcement materials have contributed for the success of the restorations. Endodontic posts are one of the most widely used materials for the restoration of endodontically treated teeth when there is an insufficient coronal tooth structure to retain a core for the definitive restoration.

The various posts available are custom cast posts, prefabricated posts, carbon fibre posts, silica fibre posts, light transmitting posts, ribbon fibre posts, ceramic posts, zirconia posts etc.[2]

Among these fibre posts are most widely used due to their excellent biocompatibility, aesthetic and mechanical properties. And they have similar modulus of elasticity to root dentin, thus reducing the risk of root fracture.[3] It also eliminates potential hazards of corrosion and allergic hypersensitivity. In addition, the fibre post can be easily removed if endodontic retreatment is required.[4]

Many in vitro studies have investigated various factors that affect the retention of a post.

These factors composed of length, design, diameter, shape, surface treatment of the post, luting agent, luting method, canal region and so on.[5]

Numerous pre-treatment methods are present which alter the post surface and modify their morphological characteristics such as etching, silanization and air abrasion.[6]

Air abrasion enhances the surface roughness of fibre post, increases the surface area for bonding and creates Monoblock interlocking, resulting in a strong bond between resin and fibre post.[7]

Some studies, showed that air abrasion on the surface of the fibre post, increased the bond strength of posts adhesively luted with dual cure resin cement, especially in combination of air abrasion followed by post silanization.[8],[9]

Silanization has the advantage of being a convenient chairside operation. Several studies concluded that the bond strength between the post and resin cement can be improved by silanizing the post in advance.[10],[11]

Nowadays, fibre posts in conjunction with dual cured resin cement are preferred, due to extended working time, which is capable of polymerization by both chemical and light activation.[12]

Carvalho et al and Alfredo et al reported that the success in retention of cores and intracanal posts cemented with adhesive agents depend on the factors including root canal preparation, operative procedures and specially the various application method of the luting agent.[13],[14]

Cementation technique has important effect on the eventual retention and stress distribution of the post and is essential to achieve a uniform, bubble free layer of cement that distributes the stress evenly throughout the entire root canal.[15]

Retention of the fibre post to the root dentin is a function of interlocking, chemical bonding and the applied frictional force which can be reflected by the push-out test.[16]

Therefore, the purpose of this study was to assess the push out bond strength of various surface treated fibre reinforced posts cemented using self adhesive resin following different application techniques.

Materials and Methods

Total of Seventy two single rooted premolar teeth which were caries free were taken. The study samples were decoronated apical to the cement enamel junction with a diamond disc under water coolant mounted on a straight micromotor hand piece.

The canal patency was determined by passing a no. 15 K – file in root canals until the tip of the file was visible at the apical foramen. Working lengths were established by subtracting 1mm from the measurement obtained when a size 15 file was placed into the canal until its tip was visible at the apex.

The working length of the samples were 14mm-15mm. Initial negotiation of root canal space was performed using a size 15 manual K- file used in a watch winding motion to assure the presence of a glide path. 2ml of NaOCL (3%) was used as an irrigant intermittently during instrumentation of all canals.

All the samples were prepared up to size (F4) with ProTaper Universal rotary files (Dentsply-Maillefer, Ballaigues, Switzerland). When changing between instruments, the root canals were irrigated with 2 ml of 3% NaOCl. Then, the root canals were dried with absorbent paper points and filled with gutta-percha and AH-plus sealer by single cone technique. The samples were now removed from the wax mounting and the coronal regions of the roots were temporarily sealed with Glass ionomer cement and stored in 100% humidity in labelled containers for 7 days at 37°C.

Subsequently, the coronal seals were removed and the roots were prepared for post placement by removing the gutta-percha from the canal using the Peeso reamers till size 5. The length of the post space was standardized to a length of 9mm. To preserve the apical seal, 4 to 5 mm of the gutta percha was retained at the apical level.The samples were randomly divided into three groups (n =24) corresponding to the surface treatment done on the surface of the posts.

Group I (control): No surface treatment.

Group II: Surface treatment with aluminium oxide particles.

Group III: surface treatment with aluminium oxide particles followed by silane application.

In GROUP I (control) the posts were cleaned with surgical spirit and dried . Later cement using resin cement. In GROUP II the posts were cleaned and abraded with 50µm Aluminium oxide particles in an extra oral sandblasting device at 2.5 bar pressure for 5 sec at a distance of 2cm from the tip of sandblasting unit. In GROUP III the posts were cleaned and abraded with Aluminium oxide particles and followed by application of silane coupling agent. Each group was randomly divided into three subgroups (n=8) according to the technique used to place the luting agent (self-adhesive resin cement) into root canal: subgroup A: applying only on the post surface.

Subgroup B: Using lentulo spiral instrument for 4s before setting the post.

Subgroup C: by injecting the material with a tube and the appropriate plug using a specific composite gun (Kerr Hawe SA).

All the posts were then placed to the entire depth in the prepared spaces using finger pressure. Excess of luting agent was removed immediately with the small brush. After initial set, the resin luting cement was polymerized with a curing light for 40sec, with a tip of the light unit in direct contact with the coronal end of the post. After the cementation procedures, the coronal part of the exposed dentin was completely covered with composite resin. Finally, the roots were stored at 100 percent humidity in labelled containers for 7 days at 37 degree C.

Push out test

After 1 week, the specimens were sectioned perpendicular to the long axis using low speed diamond-disc under water cooling. Three slices per each root, containing cross-section of coronal, middle and apical part of the bonded fibre posts were obtained. The sections were 2.0± 0.1mm in width. Each slice was marked on its apical side with an indelible marker. The thickness of each specimen was measured and recorded by a digital caliper with an accuracy of 0.01mm. .Then the specimens were subjected to push out bond strength tests using a universal testing machine. Punch pin is positioned in order to contact only the post, without stressing the surrounding root canal walls. The load was applied to the apical side of the root slice and in an apico coronal direction. Loading was performed at a cross head speed of 0.5 mm/min until the post segment dislodges from the root slice. A maximum failure load value was recorded (N) and converted into Mpa, considering the bonding area (mm^2) of the post segments. Post diameter was measured on each surface of the post/dentin section using the digital caliper and the total bonding area for each post segment was calculated using formula,

$\Pi (R+ r) [h^2 + (R - r)^2]^{0.5}$

Where, $\pi = 3.14$

R= coronal post radius in mm

r=apical post radius in mm

h=thickness of the slice in mm

After the push out tests, the failure mode was assessed under a stereomicroscope at magnification of ×10 and ×30.

The mode of failure was classified into four types (according to cecchin et al).

Type 1 – adhesive failure between resin cement and dentin

Type 2 – adhesive failure between resin cement and post

Type 3 – mixed failure

Type 4 – cohesive in dentin.

Results

One-way ANOVA test followed by Tukey's post hoc test was used to compare the mean Pushout bond strength between 3 groups for each adapted luting technique in different regions. Similarly comparison of the mean Pushout bond strength between 3 adapted luting techniques in different regions in each group was performed using the same test.Chi square test was used to compare the failure mode between 3 groups with each adapted luting technique in different regions.The level of significance [P-Value] was set at $P<0.05$.

Table 1:

Comparison of mean Pushout Bond strength between groups adapting various Techniques in different regions using One-way ANOVA Test followed by Tukey's Post hoc Test

Techniques	Region	Group 1		Group 2		Group 3		P-Value	Tukey's Post hoc Test		
		Mean	SD	Mean	SD	Mean	SD		G1 vs G2	G1 vs G3	G2 vs G3
Technique 1	Coronal	1.786	0.775	5.761	1.957	6.099	1.621	<0.001*	<0.001*	<0.001*	0.90
	Middle	1.596	0.612	4.521	1.779	4.798	0.993	<0.001*	<0.001*	<0.001*	0.90
	Apical	1.341	0.216	2.848	0.984	3.476	0.825	<0.001*	0.002*	<0.001*	0.24
Technique 2	Coronal	2.424	0.459	8.118	1.858	7.108	2.123	<0.001*	<0.001*	<0.001*	0.45
	Middle	1.983	0.334	6.178	1.412	5.671	2.083	<0.001*	<0.001*	<0.001*	0.77
	Apical	1.581	0.366	4.779	0.894	4.830	1.758	<0.001*	<0.001*	<0.001*	0.99
Technique 3	Coronal	2.770	0.543	8.703	2.120	7.243	2.466	<0.001*	<0.001*	<0.001*	0.30
	Middle	2.471	0.500	7.549	1.595	7.123	2.091	<0.001*	<0.001*	<0.001*	0.85
	Apical	2.370	0.320	6.689	1.598	5.910	1.691	<0.001*	<0.001*	<0.001*	0.50

* - Statistically Significant Note: G1 - Group 1; G2 - Group 2; G3 - Group 3

Table 2:

Comparison of mean Pushout Bond strength between various Techniques in different regions of each study group using One-way ANOVA Test followed by Tukey's Post hoc Test

Groups	Region	Technique 1		Technique 2		Technique 3		P-Value	Tukey's Post hoc Test		
		Mean	SD	Mean	SD	Mean	SD		T1 vs T2	T1 vs T3	T2 vs T3
Group 1	Coronal	1.786	0.775	2.424	0.459	2.770	0.543	0.01*	0.04*	0.01*	0.50
	Middle	1.596	0.612	1.983	0.334	2.471	0.500	0.007*	0.07	0.005*	0.14
	Apical	1.341	0.216	1.581	0.366	2.370	0.320	<0.001*	0.04*	<0.001*	<0.001*
Group 2	Coronal	5.761	1.957	8.118	1.858	8.703	2.120	0.02*	0.04*	0.02*	0.83
	Middle	4.521	1.779	6.178	1.412	7.549	1.595	0.004*	0.08	0.003*	0.22
	Apical	2.848	0.984	4.779	0.894	6.689	1.598	<0.001*	0.01*	<0.001*	0.01*
Group 3	Coronal	6.099	1.621	7.108	2.123	7.243	2.466	0.02*	0.04*	0.04*	0.46
	Middle	4.798	0.993	5.671	2.083	7.123	2.091	0.004*	0.04*	0.03*	0.003*
	Apical	3.476	0.825	4.830	1.758	5.910	1.691	0.01*	0.09	0.01*	0.33

* - Statistically Significant   Note: T1 - Technique 1; T2 - Technique 2 & T3 - Technique 3

Table 3:

Comparison of Failure Mode between groups adapting various Techniques in different regions using Chi Square Test										
Techniques	Scores	Coronal			Middle			Apical		
		Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Tech. 1	Score 1	6 (75)	6 (75)	5 (62.5)	5 (62.5)	6 (75)	4 (50)	5 (62.5)	3 (37.5)	5 (62.5)
	Score 2	2 (25)	2 (25)	2 (25)	3 (37.5)	1 (12.5)	0 (0)	3 (37.5)	5 (62.5)	2 (25)
	Score 3	0 (0)	0 (0)	1 (12.5)	0 (0)	1 (12.5)	0 (0)	0 (0)	0 (0)	1 (12.5)
	p-value	0.71			0.39			0.40		
Tech. 2	Score 1	5 (62.5)	3 (37.5)	5 (62.5)	5 (62.5)	4 (50)	4 (50)	5 (62.5)	4 (50)	4 (50)
	Score 2	2 (25)	4 (50)	2 (25)	3 (37.5)	4 (50)	2 (25)	3 (37.5)	3 (37.5)	4 (50)
	Score 3	1 (12.5)	1 (12.5)	1 (12.5)	0 (0)	0 (0)	2 (25)	0 (0)	1 (12.5)	0 (0)
	p-value	0.81			0.31			0.67		
Tech. 3	Score 1	6 (75)	5 (62.5)	3 (37.5)	7 (87.5)	4 (50)	3 (37.5)	6 (75)	4 (50)	6 (75)
	Score 2	2 (25)	3 (37.5)	3 (37.5)	1 (12.5)	3 (37.5)	5 (62.5)	2 (25)	2 (25)	2 (25)
	Score 3	0 (0)	0 (0)	2 (25)	0 (0)	1 (12.5)	0 (0)	0 (0)	2 (25)	0 (0)
	p-value	0.26			0.16			0.34		

Figure 1:

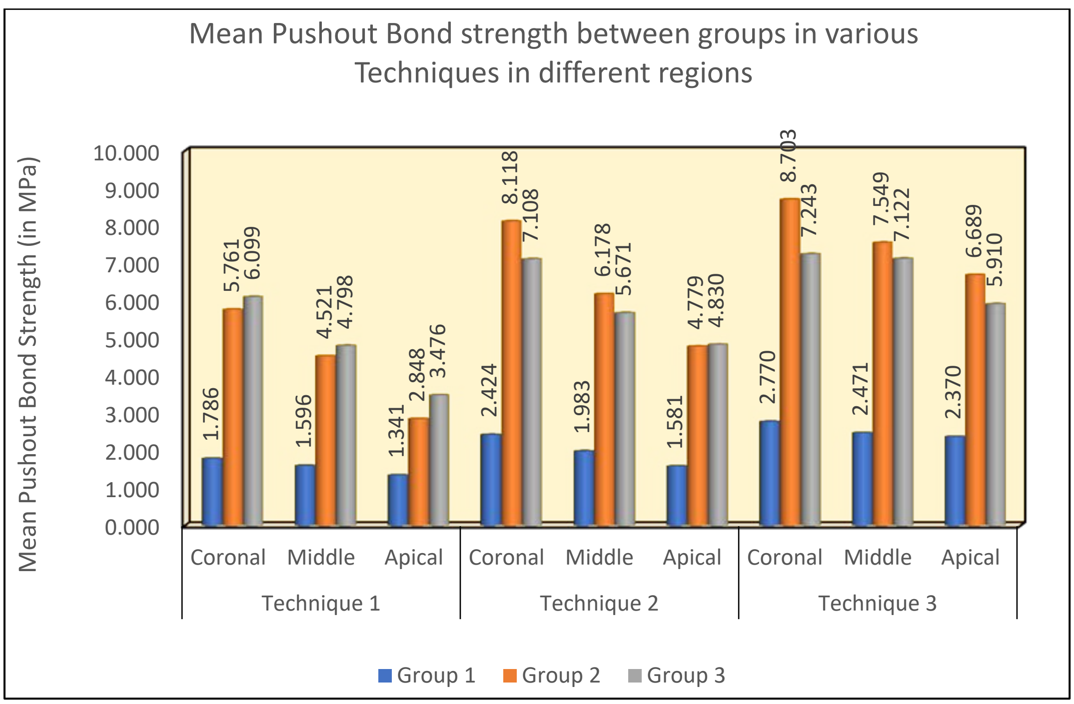

Figure 2:

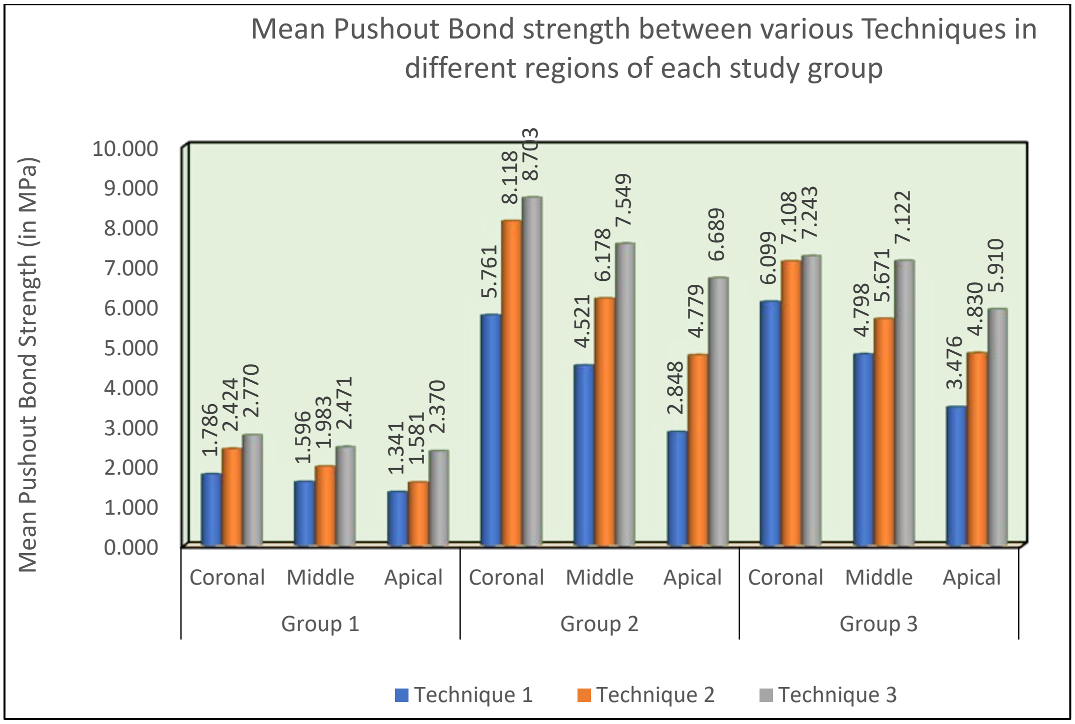

Figure 3:

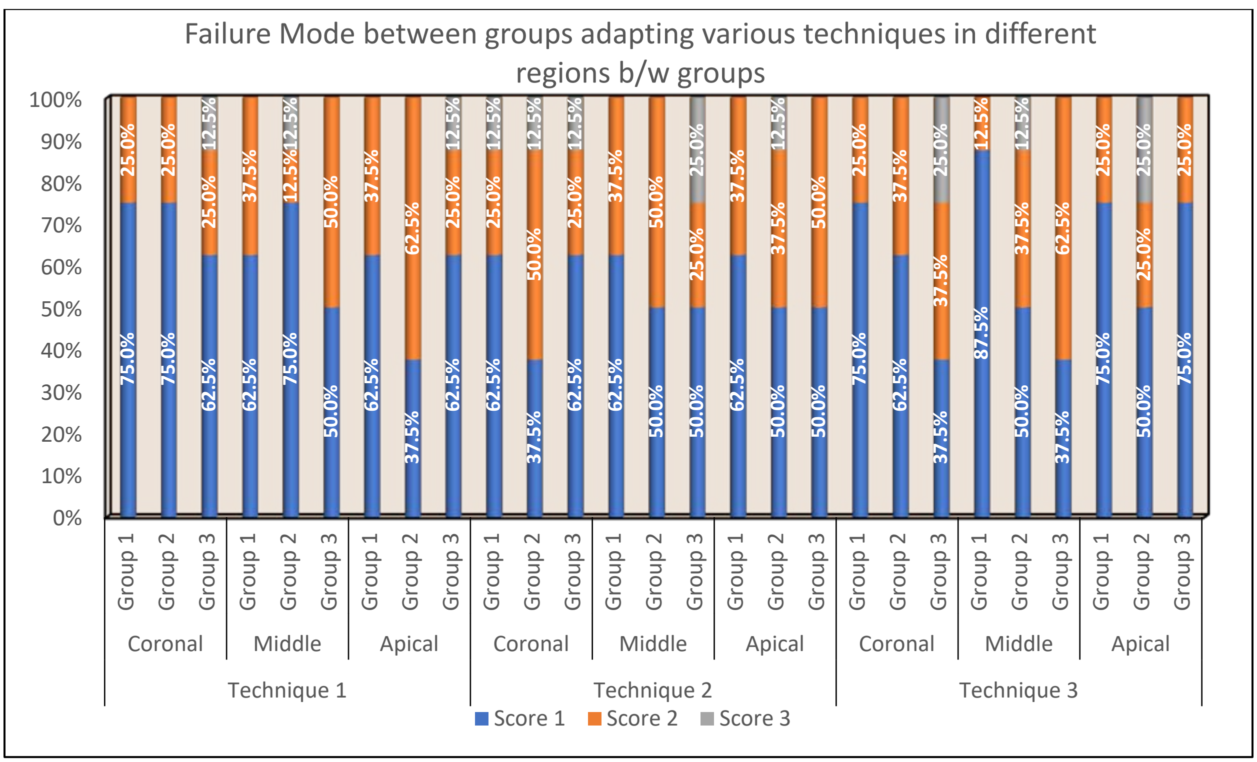

Figure 4: Type 1 Failure Mode At 10x

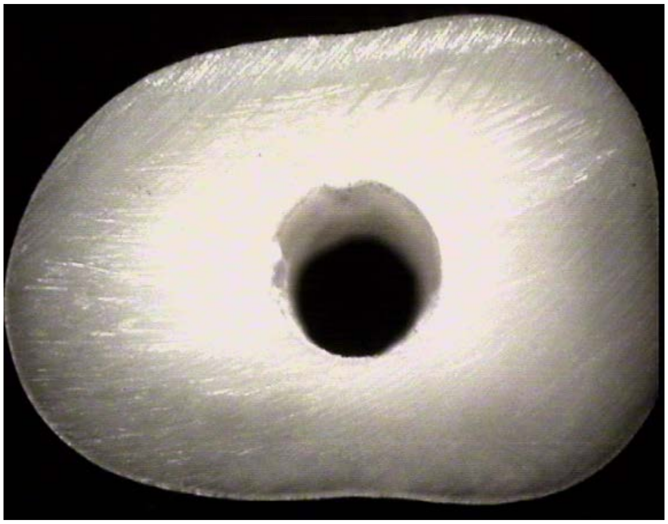

Figure 5: Type 2 Failure Mode At 10x

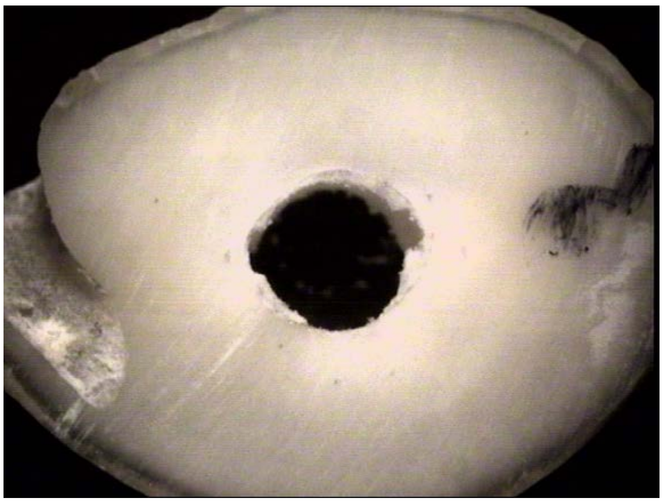

Figure 6: Type 3 Failure Mode At 10x

Discussion

The restoration of endodontically treated tooth is complicated by the fact that much or all of the coronal tooth structure which normally would be used in the retention of the restoration has been destroyed by caries, previous restorations, trauma, and the endodontic access preparation itself.

A tooth with large structural loss usually requires the use of an intra-radicular post preferably with a core or coping for improving the retention of additional restoration.[17]

There is a increasing demand for aesthetic posts and core systems.These new posts have been developed to improve the optical effects of aesthetic restorations. In fiber posts, fibers are pre stressed and subsequently resin, as a filler, is injected under pressure to fill the spaces between the fibers, giving them solid cohesion.[18] Fibre posts are composed of unidirectional glass fibers embedded in a resin matrix. Matrix polymers are commonly epoxy polymers with a high degree of monomer conversion and a highly cross-linked structure.[19]

Fibre posts were closely match the modulus of elasticity of sound root dentin, thus distributing occlusal stress more evenly in the root dentin and providing higher fracture resistance to weakened root.[20],[21]

In the present study glass fiber posts (Reforpost, Angelus), was used.

An optimal bond between a post and cement, and between cement and dentin, is necessary to restore endodontically treated teeth.[22] Generally, retention is affected by the post type, the properties of the cement, and bonding of the cement to the post and the dentin in the root canal.[23]

Surface treatments are commonly recommended to improve bonding properties by facilitating chemical and micromechanical adhesion. Such strategies include adhesive treatment, tribomechanical treatment, sandblasting as well as combination of these methods.[24],[25]

The airborne particle abrasion of fiber-reinforced posts would significantly affect the mechanical properties of fiber posts and the bond between the posts and resin cement.

Mechanical interlock is an important factor on the bonding interface; the clean surface of fiber posts formed by air abrasion can significantly improve the contact angle of the polymer surface and reduce the interfacial energy of the bonding interface. These effects greatly enhance the bond strength. The sandblasted rough surface of fiber posts exposed more fiber, increasing the bonding area and forming a good micromechanical interlocking at the same time.[26]

The silanization procedure has been described as an important pretreatment to increase the bond strength to resin cements. Silanes have a dual reactivity, because the organic functional part (vinyl, allyl, amino and isocyanato) can polymerise with an organic matrix, while the alkoxy groups (methoxy and ethoxy) reacts with an inorganic substrate. Thus, this procedure has been recommended as a pre-treatment for the fibre-post surface.[27]

Some studies showed that air abrasion on the surface of fiber posts increased the bond strength of posts adhesively luted with dual cure resin cement, especially the combination of air abrasion followed by post silanization.[9],[28]

Therefore in this study, the surfaces of the posts were airborne – particle abraded with 50µm alumina oxide particles in an extra oral sandblasting device at 2.5 bar pressure for 5 sec at a distance of 2 cm from the tip of the sand blasting unit.[9] and air abrasion followed by silane coupling agent were used as surface treatment for fibre post.

The adhesive cement type used in the present study is RelyX U200 (3M ESPE, St Paul, MN, USA) for the cementation of fiber post to the root dentin.

Self adhesive resin cements have been recently developed and do not require surface pre - treatment, which significantly simplifies the clinical implementation and possibly prevents side effects caused by pre – applied adhesives on dentin.[29]

Rodrigues and others, suggested that self-adhesive resin cements (SARC) are equally effective alternatives to conventional resin cement.[30]

The distribution of resin cement into the post space during the luting procedure and the anatomical and histological characteristics of the root dentin seemed to influence bond strength between resin luting agent and the root canal regions.[31],[32]

Fonseca et al, reported that when the luting agent was placed into the root canal using a lentulo spiral or injection technique with lentulo spirals or specific syringes increased the post retention.[33]

Therefore, in the present study, three different luting agent application techniques were compared, i.e; cement applied only on the post surface, cement applied into the root canal using lentulo spiral instrument for 5 sec before seating the post and injecting the luting material into the root canal with a tube and the appropriate plug using a specific composite gun.

A resin luting agent may create polymerization shrinkage stresses within the post space. [34] These shrinkage stresses contribute to what has been defined as the C factor, the ratio of bonded to unbounded surface areas in root canal dentin.[35]

The retentive strength of a bonded post can be considered as the combined result of micromechanical interlocking, chemical bonding and sliding friction. The push-out test is therefore clinically relevant when evaluating the retentive strength of fiber posts. Owing to a thin slice design, the stress distribution within each specimen is uniform and the regional differences in retention strength inside the root canal can also be tested. [36]

The adhesive bond between fiber post and resin cement provides a short term strengthening effect, theoretically creating an endodontic monoblock. Nevertheless, bonding posts to root canal dentin can be compromised.[37]

The stability of the resin – root dentin interface is also affected by the presence of the endogenous enzymes activated during etching procedures. These are in part responsible for the hybrid layer degradation and reduction of the longevity of post – endodontists restorations performed with the use of root canal posts.[38],[39]

The present study was carried out to evaluate the push out bond strength of various surface treated fiber posts using different application techniques. Push out bond strength was done using universal testing machine. Failure mode was assessed using stereomicroscope after the push out bond strength test.

Results of the present study showed that, when the mean push out bond strength was compared between groups adapting various Techniques in different regions of the root, control group showed significantly lesser mean push out bond strength as compared to group II and group III. However there was no significant difference observed between group II and group III.

In the control group, a failure probably occurred between smooth surface and the low surface energy of the untreated post and resin cement as no bonding is expected to occur between the methacrylate based resin cement and the glass fiber post's epoxy resin matrix.[9]

Sand blasting with aluminium oxide particles was meant to provide plastic deformation and roughening of a treated surface, resulting in an increased surface area for bonding and this helps in increasing the contact angle of polymer surface. This procedure has been shown to improve the retention of glass fiber posts in root canals.[40]

In present study, surfaces of the posts were airborne-particle abraded with 50µm alumina particles at 2.5 bar pressure for only 5 sec from a distance of 20mm. This regimen did not produce visible changes in the form of the posts. Nevertheless, this mild form of the posts abrasion resulted in a statistically significant increase in retention of the posts. This result is consistent with those previous studies reported that airborne-particle abrasion with alumina particles increased the surface area and enhanced the mechanical interlocking between the cement and the roughened surface of a post.[9]

According to manufacturer, the sandblasting time was adjusted, as the post surface was smaller than 1cm^2.The reduction of the sandblasting time in order to obtain the milder effects on the blasted substrate was previously described[41] and has been recently reported to be one of the effective adjustments of the sandblasting conditions in order to avoid overly pronounced dimensional changes, when the procedure was applied on fiber posts.[42]

The mechanical action of blasting probably determined removal of the superficial layer of the resinous matrix, creating micro retentive spaces on the post surface.

In the present study, sandblasting the fiber posts with aluminium oxide particles prior to the cementation increased the retention of the fiber post. The results of the present study were in accordance to the study by Balbosh and Kern et al.[9]

Silane coupling agents are commonly used in dental practice in order to improve the adhesion of resin – based materials to prosthodontic substrates. Silanes have been reported to enhance the surface wettebility and the chemical union between resin based materials and glass fibers[43] and to increase the interfacial strength between fiber posts and resin core materials.[10] Silanization alone does not produce a significant difference in bond strength. As the fiber posts contain epoxy resin as the matrix connecting the individual fibers, which has no functional groups to react with a silane coupling agent.[44]

Sahafi et al, reported that silanization did not improve bond strength between fiber reinforced posts and resin cement unless it was preceeded by airborne-particle abrasion, a finding that is consistent with results of the current study.[23]

The surface of the fiber-reinforced post is primarily covered with epoxy resin, and it can be assumed that prior surface treatment with air abrasion, which could expose the fibers, would increase the surface area available for chemical bonding with the alcoxy groups of the silane molecules. This would therefore increase the bond strength between the post and the cement.

In this study, sandblasting with aluminium oxide particles followed by silane application to the fiber posts showed significantly highest push out bond strength. The results of the study were in accordance with the study done by Ruttonji et al.[2]

The results obtained in this study for bond strength showed higher values in the coronal region than in the middle and apical regions for all groups. Results were in accordance with the study done by Andrea Dolores et al.[45]

It could attributed to the presence of smear layer, generated during endodontic treatment and post space preparation, which are deposited on the root canal walls. The presence of such a layer impairs a proper contact between the acidic methacrylates of self adhesive resin cements and the underlying dentin during adhesive procedures interfering with its bond strength to dentin.[46]

In present study, regardless the technique used to lute the fiber post into the root canal, both group II and group III showed highest push out bond strength with no statistically significant difference between them.

When the mean push out bond strength was compared between the various techniques in different regions of each study group, technique 1 showed significantly lesser mean push out bond strength as compared to technique 2 and technique 3. However, no significant difference was observed between technique 2 and technique 3.

An earlier investigation found bubble formation and incomplete luting, when cement was not previously placed into the root canal space but only applied to the post. This could interfere with the effective interaction between the cement and intracanal dentin walls.[33]

It was reported that the application of luting agent with a lentulo spiral instrument permits a favourable distribution of resin cement throughout the post space and a formation of uniform continuous cement layer.[47]The lentulo drills might heat up the resin cement and speed up polymerization, reducing the cement working time. Therefore in the present study, the application time was limited to 5 sec for luting the post using lentulo spiral to avoid partial polymerization before the adequate post seating.

In injection method, the material was injected with a tube with needle and the appropriate plug (KerrHawe SA) using a specific composite gun (KerrHawe SA).

This technique used for application of resin cement is an effective technique for reducing voids and bubbles within the luting agent. A uniform, bubble free cement layer is likely to result in greater retention.[17] The results of this study were in accordance with the study done by Camillo D Arcangelo et al.[47]

The present study also showed that, bond strength was substantially higher in the coronal than the apical region of the tooth. The results were in accordance with the study done by Ivana Purcina Amizic et al, they evaluated the micro push out bond strength between 2 types of fiber posts which were cemented with 3 different types of cements.[48]

A higher density of dentinal tubules in the coronal region may explain such results. Apical root dentin is indeed less favourable for bonding procedures, due to the prevalence of tubule free areas, the presence of irregular secondary dentin, accessory canals and cementum like tissues on the root canal wall. A strength reduction in the apical region might also be caused by traces of gutta percha and sealer after post space preparation[48]

After the push out bond strength tests, failure modes were assessed under stereomicroscope. Failure mode analysis revealed different types of failures were observed in all the different regions of the root canal system with respect to different surface treatments and luting techniques. Most of the failures observed were adhesive failure between the resin cement and dentin. There were no cohesive failures in dentin observed in all the groups. The results were in consistent with the study done by Valandro et al[49] and Bergoli et al.[50]

The adhesive failure between the resin cement and dentin could be explained by the difficulty of controlling moisture inside the root, high C – factor of the cavity, decreased intensity of light transmission through the root and the polymerization stresses generated by the cement.[50]

With the above mentioned findings and results, it was suggested that the bond between the luting material and the fiber post improved due to the effects of different surface treatments on the posts. In this study which used sand blasting and sand blasting + silane as a surface treatments on fiber posts is effective in increasing the interfacial micro-mechanical interlocking and chemical adhesion between the post and resin cement, thereby increasing the push out bond strength of the fiber post to the root canal. The results of this study also reported that using lentulo spirals and injection technique to lute the posts into the root canal influenced the push out bond strength of fiber posts to the root canal.

Conclusion

Within the limitations of the present study, there is an increase in the bond strength of the resin cement with fiber posts after various surface treatments. The best results with the push out test were obtained when the luting agent was brought into the post space with lentulo spirals or specific syringes.

Further studies are required to evaluate the clinical efficacy of these surface treatments on the fiber posts.

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