

The evaluation of bond strength of glass fiber posts subjected to different surface treatments

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Abstract

Aim: The aim of the study is to investigate the effect of different surface treatments applied to the fiber reinforced composite post surface on post-dentin connection. In addition, bond strengths of post in cervical and apex regions have also been checked.

Material and Methods: Central upper teeth were used for the study, various surface treatments (50 µm aluminium particles, Er: YAG laser. Primer, Cojet) were conducted on the post surface except control group. Accordingly, samples were randomly divided into 5 groups (50 µm aluminium particles, Er: YAG laser. Primer, Cojet and control groups) as being 10 in each group. Following these treatments, dentin bonding agents were applied to root canal and light was practiced for 20 seconds. Next, resin composite was placed on the surfaces of posts and it was cured with light for 40 seconds from 2 mm away of post cavity.

Results: It was observed that there was high bond strength in Al₂O₃ group. A significant difference was not determined between push-out bond strength of apex regions of all groups.

Conclusion: It was seen that the samples in the group where aluminum particles were applied showed highest bond strength and laser group followed this. It was also seen that there was higher bond strength in cervical region compared to apex.

Keywords: Glass post; surface treatments; Er:YAG laser

INTRODUCTION

Restoring teeth with endodontics treatment through fibre posts is a widely used treatment method in dentistry (1). Glass fiber post has a different place when compared to other prefabricate posts because it generates a chemical bonding with resin cement and composite core. It thus enables to make a more conservative canal preparation due to this feature (1-3).

The length, design, diameter of post and surface treatments applied to post surface are ranked as factors affecting the retention of post in many in vitro studies. Uncovering monomers in polymer matrix of glass post can only be possible with surface treatments applied to surface of glass post. These treatments are in the form of sanding, silane application, abrasion with sanding and laser applications (3-5).

Laser applications are used in many areas of dentistry. Laser application is used as an alternative method to

produce suitable surfaces which would provide the bonding of adhesive resin cements. Various lasers in different wavelengths are used to increase the bond strength between restorative material and resin cement (6,7). Er:YAG lasers are a type of laser used to change the mechanical characteristics of restorative materials. Common characteristic of Erbium group lasers is their being absorbed well by water, hydroxyapatite and collagen. While absorbability of Erbium group lasers by water molecules is 10 times more than CO₂ laser, it is 20000 times more than Nd:YAG laser. Shear effectiveness of ablative lasers that are more effective in tissues with water based microbursts in solid tissues is more than the lasers that are effective through thermal vaporization (8-10).

The purpose of this in vitro study is to evaluate the push-out test of bond strength of different surface treatments applied glass posts. What is more, it has also been aimed

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to evaluate whether laser application created a significant difference compared to other applied surface treatments.

MATERIAL and METHODS

50 extracted central upper teeth were kept for disinfection in % 0.05 chloramine solution in 4 °C for 48 hours after surface remnants were cleaned with Scaler. They were later washed for 5 minutes under running water to eliminate the remnants of chloramine solution. Crowns of all teeth were removed with two-face diamond disc affixed to low-speed handpiece.

Root canal preparation of prepared teeth was performed with crown-down technique through endomotor (Endo Mate TC2, NSK, Japan) rotary tool as being 0,5 mm shorter from apical foramen (Figure 1). Root canal was washed with an injector filled with physiological saline solution in each file change. The root was then washed with distillate water after it was cleaned with 0.5% NaOCl for 1 minute. Root canals were filled with the technique of lateral condensation with AH26. Fiber posts (Snowpost, Carbotech, Ganges, France) were used with the same length and diameter in this study.



Figure 1. Application of canal treatment with endo motor

Canal expansion treatment applied canals were removed by using self-drill (Snow fiber post drill, size 1.0) of the post system as leaving approximately 4 mm in the apical of teeth, and post space in 10 mm was prepared. Prepared root canals were divided into 5 groups as each experimental group had 10 teeth.

Group 1: Control group 5ml of 17% EDTA and then 5.25% NaOCl was administered on the surface of canal dentin surface; it was later washed with 10 ml of water. No treatment was performed on the post surface.

Group 2: Posts were stored in 95% ethanol for 20 seconds; it was then washed with water and dried before applying

surface treatment to fiber posts. Following this, Al₂O₃ particles (CoJet, 3M ESPE, Seefeld, Germany) covered with silica in 30 µm diameters were carried out with 2.8 bar pressure for 20 seconds on snow post surface. It was paid attention that width among posts was kept between 2-10 mm with in-mouth sanding device during this application. After snow posts were covered with Al₂O₃ particles covered with silica, silan, a part of system, was applied on post surfaces by the help of brush (ESPE Sil, 3M ESPE, Seefeld, Germany) and waited for its dry for 5 minutes.

Group 3: Clearfil Ceramic Primer (Kuraray Medical, Okayama, Japan) was performed on snow post surface and waited for 5 minutes.

Group 4: Post surfaces were sandblasted with korox 50 (Bego, Germany) in dental laboratory in bar pressure from 10 mm distance for 15 seconds. Clearfil Ceramic Primer silane agent was administered on surfaces after they were cleaned with air freshener.

Group 5: 150mj/10Hz mj energy value was applied on post surface with Er:YAG laser working in 2.940 µm wavelength. Output power of the laser was determined as 1.5W. Er:YAG laser was conducted for 60 seconds (Figure 2).

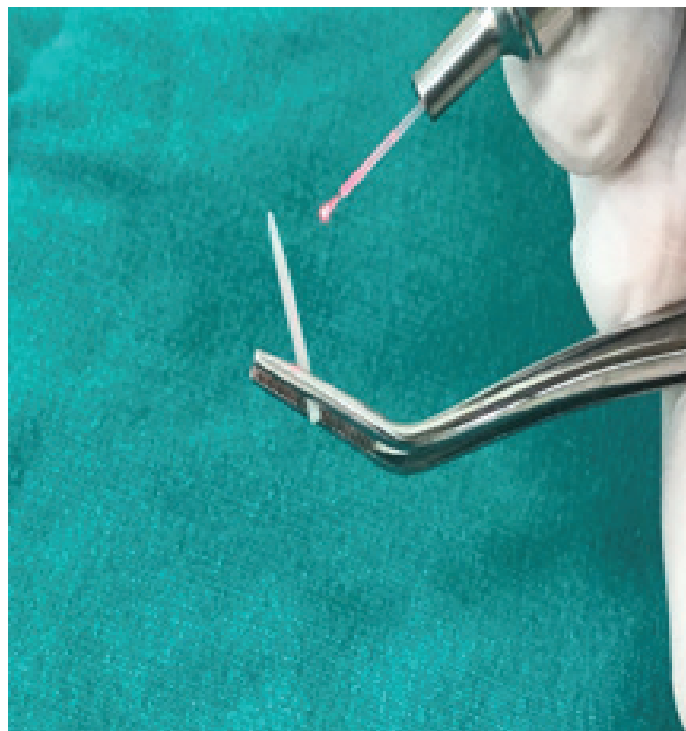


Figure 2. Er:YAG laser application

Surface treatment completed posts, Clearfil SA (Kuraray Medikal, Tokyo, Japan) were applied to post spaces by the help of cement special endodontic tips. Surface treated posts, were carefully placed into post space with a little finger pressure by being somewhat calibrated. Thus, extra cement was provided to overflow. While the finger pressure was applied in this way, Polymerization of resin cement was established with LED (L.E. Demetron I/Kerr Corporation, Orange, CA, USA) ray device for 40 seconds. All samples were kept in distilled water at 37 ° C for 24 hours.

Teeth were embedded into methacrylate resin molds. Embedding process into resin molds was performed thus: upper part one of the single hard bur box in 15x15x25 cm size was duplicated with silicon. Our sample was placed into lower part of hard bur box and it was then fixed. Vaseline was performed to lower part of hard bur box, and it was then embedded into transparent acrylics (Vertex Orthoplast, Netherlands). Sections were taken from each tooth by using shearing machine (Minitom, Struers, Copenhagen, Denmark) which was rotating slowly under distillate water cooling from acrylic blocks. Experiment of push-out was applied to prepared samples from apical to coronal with 0,5 mm/minute speed in universal testing machine (Lloyd LR 50K, Lloyd Instruments PIC, England).

Maximum failure value was determined as Newton (N), and this value was converted into Megapascal by dividing this value to post bonding surface area and it was then recorded. Obtained data were assessed by using paired samples t test and Bonferroni test

RESULTS

Mean push out bonding values of groups are seen in Table 1 in our study that evaluated push-out bond strength of snow posts which were subjected to different surface treatments.

Table 1. Minimum, Maximum, mean and standard deviation values of groups				
Groups	Minimum value	Maximum value	Mean	Standard Deviation
Control group	80.00	90.00	84.80	3.70
Cojet group	80.00	101.00	88.80	7.79
Al2O3 group	137.00	155.00	145.40	7.30
Laser group	105.00	124.00	114.00	5.32
Primer group	101.00	118.00	109.20	6.31

Significant difference was determined in terms of bond strength between aluminum particles applied groups and control group (P<0.05). The highest bond strength was observed in aluminum particles applied group.

Table 2. Mean push-out bond strength in MPa ±SD in experimental groups for each root canal cervical and apex region		
	Cervical	Maximum value
Control group	2.192 ±0.59aB	1.616 ±1.17bA
AL2O3	4.028 ±1.09aA	1.616 ±1.17bA
Laser	3.793 ±1.42aA	1.381 ±0.61aA
Primer	3.140 ±0.39aB	1.381 ±0.61aA
Cojet	2.192 ±0.59aB	1.616 ±1.17bA

Bond strength rank of groups is Al2O3 group>Laser group> Primer group>Cojet group>Control group according to Table 1. Push-out bond strength test results in cervical and apex regions of all groups are seen in Table 2. A significant difference has been observed between Al2O3 and push-out bond strength in cervical region of all groups (p<0.05). It was observed that there was high bond strength in Al2O3 group. A significant difference was not detected between cervical regions of cojet-control group (p>0.05). A significant difference was identified between cervical regions of Laser-Primer group (p<0.05). It was also observed that cojet group cervical region had lowest bond strength and similar results were obtained with control group (Table 2). A significant difference was not determined between push-out bond strength of apex regions of all groups (p>0.05) (Figure 3).

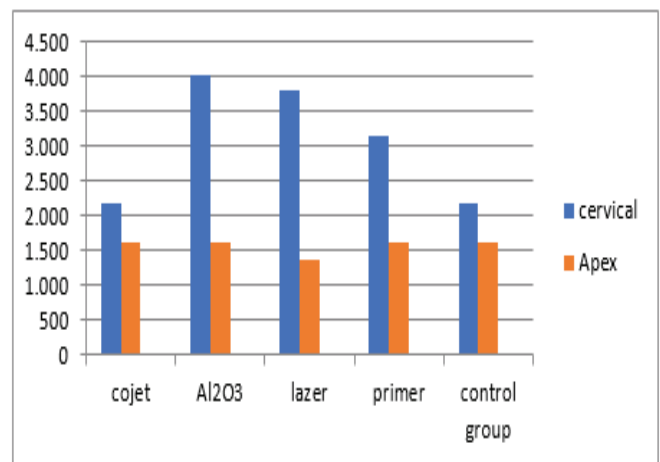


Figure 3. Mean push-out values of groups in cervical and apex regions

DISCUSSION

Bond strengths of snow post subjected to different surface treatments were evaluated in our study. In addition, bond strengths of these posts in their apex and cervical regions were investigated.

The treatments administrated to the surface of dental post are performed to increase wettability of post, to form a strong adhesion between post and cement, and to clean the post surface. Recently, laser applications have become popular in all areas of dentistry. Er:YAG laser, cojet, Al2O3, and primer applications have been administrated to post surfaces. The results of this study have supported the hypothesis of laser application would contribute to the retention of post (11,12).

Snow post systems have been used in this study as they do not contain metal and generate allergy and hypersensitivity reactions (1,2,8).

Monticelli et. all reported that abrasive particles applied to post surface led to increase in bond strength in post structure (3). Tuncdemir et. all indicated that bond strength

of sanding applied fibre posts increased significantly (10). It has been also observed in our study that an important increase occurred in bond strength of snow posts to which Al₂O₃ application was conducted ($p < 0.05$). Tuncdemir and his friends stated in one of their study that highest bond strength was in Al₂O₃ applied post group. These results support our study .

On the other hand, Sipahiet. all reported that primer, Cojet and Er:YAG laser applications administrated to glass post surfaces increased bond strength (12). It is also indicated in a similar study by Aslan and his friends that bond strength of Al₂O₃ administrated glass posts applications was higher than laser groups (14). This results support our study.

It has been observed that there are conflicting results regarding surface treatment studies conducted with Er:YAG laser. While some researchers urge that laser application to post surface increases bond strength, some others indicated similar results with primer application (11,15). According to our study; high bond strengths were observed in laser group than primer.

Kirmali et. al reported that laser irradiation with different intensities did not increase the bond strength of the fiber posts to the root canal dentin walls and the coronal and middle levels of the post space had significantly higher bond strength values compared with the apical level (17) .

CONCLUSION

Cervical regions bond strength has been determined higher than apex regions. It has also been observed that highest bond strength in cervical region was in Al₂O₃ applied snow posts. The low bond strength in the apex is attributed to the incomplete polymerization of the resin material. We also think that low value of laser-treated group is due to the unwanted surface properties that occur on the surface due to the glass nature of the hide. We believe that further research is needed on laser applied using different parameter or different glass post systems.

Competing interests: The authors found that the conflict of interest did not fully coincide.

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Ethical approval: We have ethics approve from Harran University.

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