Durability of Different Types of Cement on the Bonding Strength of Medicinal Biomaterial Fiber Post, In Vitro Study

Abstract

Objectives: The purpose of this study was to investigate the bond strength of medicinal biomaterial fiber post with canal wall using different types of cement.

Methods: Thirty sound maxillary canines, each canal was prepared using #55 K-file and was obturated according to manufacturer instruction. After that, fiber post was cemented in the canal for each one. Specimens were divided into three groups according to types of the cements that were used for cementation: [(G1:Relay X U200), (G2:RelyX Luting), and G3:(GC lining cement)]. After cementation, all roots were stored at 100% humidity till testing. Each Sample was investigated using push-out test by placed them in a universal testing machine at a crosshead speed of 0.5 mm/min.

Results: The highest bonding strength was shown in G2 cervical level, while the lowest was shown in G3 in middle level. Results: the highest bond strength was shown in cervical level for all cements type, while the lowest was shown in the middle level.

Conclusion: The highest bonding strength was observed in Rely XU 200 while the lowest was seen in lining cement G3. G1 has higher bonding strength than Conventional G3 due to micromechanical retention.

Keywords: Bond strength; Fiber post; Cement; Durability; Medicinal material

Introduction

Dentists were using the medicinal biomaterial cast post and cores for restoring badly destructive endodontic treated teeth. In cases that coronal tooth structure was lost during the root canal therapy using of either direct or indirect restoration is indicated. Now, biocompatible non-metal posts are used as an alternative to casts post because they are nearby to the elastic modulus of dentine, in addition they are more esthetic than metal ones. Therefore, they present higher longevity and high fracture resistance [1]. Furthermore, biomedical fiber posts have several advantages as preserving the root structure by less dentine removal, fiber optic post has higher esthetic due to increase esthetic client demand [2] and less dental procedure so that less chair time [3,4].

Several studies analyzed the main causes of fiber post’s failure, they have shown that it was because of de-bonding between the post and intra-radicular dentin [5,6]. With the addition bonding strength of cementation is directly faced by C factor which is affected by polymerization shrinkage that creates gaps between cement and dentin, which will lead to reducing bonding strength [7-9]. Researchers showed that de-bonding between post and cement is less than between cement and intra-radicular dentin [10]. The adhesion mechanism of the cementation post to root canal dentin is mostly.

Ferrari et al. [11] presented that, when the filler load is increased, the polymerization stress will increase due to decrease in the bonding strength. The tooth/restoration interface can suffer long-term degradation due to the action of water, temperature changes, and mechanical loading [12-14] which lead to failure over time [13,15,16]. On the other hand, using of G1 and resin modified glass ionomer have been used as an alternative to resin based cement [17-19]. Researchers showed that resin-modified glass ionomer cements have stronger bonding when compared to conventional glass ionomer bonding [20,21].
There is a huge controversy between dentists about the proper cement material in fiber post therapy, so that this study tried to investigate the bond strength of biomaterial fiber post with canal wall using different types of cement.

**Material and Methods**

Thirty maxillary canine human teeth were endodontically treated using K files (Dentsply, Maillefer, USA). The working lengths were measured by reducing 1 mm from their measures under radiographic image. Canals were prepared till 55 K-file to get standardization. Roots were irrigated using saline then dried with paper points. The roots were obturated with size 55 gutta-percha points (Dentsply, Maillefer, USA) and AH-plus sealer (Dentsply, Detrey of MbH Germany) using the cold lateral compaction technique. Later, they were stored at 37°C for one week to permit the sealers to set.

Two third of the root canal length was removed using a gate-glider bur, and next prepared space for the post according to manufacturer instruction (Dentsply, Maillefer, USA). Then canals were irrigated with normal saline to remove debris and remnant of gutta-percha and sealer. Then, the fiber posts were cleaned using 95% ethyl alcohol and dried with air spray.

The specimens were randomly divided into three groups (n=10) according to types of the cement used: RelyX U200 (3M ESPE, USA); Luting & Lining Cement (3M, ESPE, USA) and Lining Cement (GC, Japan) (Table 1).

All cements were used according to the manufacturer’s instructions and placed on the post then inserted in the canal for each tooth. Later excess cement was removed using micro brush. Samples were stored for 10 days in humid environment.

Root of each sample was sectioned below the cement-enamel junction, perpendicularly to the long axis using sectioning machine (Isomet 1000, Buehler, Lake Bluff, USA). Three sectioning with thickness (1 mm) slices were obtained per root at 1 mm, 5 mm, and 9 mm from their cervical portion. Thus, each slice represents different post level in the same root (cervical, medium, and apical). Then, each specimen was attached with acrylate-based adhesive be adapted them in the device, which was carried out on a universal testing machine (EMIC, Curitiba, SC, Brazil). A compressive load was affected using diameter cylindrical plunger (0.8 mm) at a constant speed of 0.5 mm/min until the post was dislodged. The plunger was positioned in the center of each specimen. Bond strength values were measured by the amount of maximum force required to dislodge the post (N) by area (A).

**Statistical Analysis**

The statistical analysis was performed using the Analysis of Variance (ANOVA). Three readings were evaluated according to position of slice (cervical, middle and apical). The multiple comparisons were performed using the Tukey HSD test (Figures 1-3).

**Results**

The two-way ANOVA shown that there is significant change in the cement variable affected the push-out bond strength values (P<0.005). The post level, in turn, did not influence the bond strength of fiber posts to root dentin (P=0.148). The highest Bonding strength was shown in G2 cervical level, while the lowest was shown in G3 in middle level. It was evaluated that the highest bond strength was shown in cervical level in all cement types, while the lowest was shown in the middle level for all tested samples (Table 2).

**Discussion**

Different types of cement have different adhesion strength and different protocol. G3, G1 and G2 are contemporary different in setting reactions. Fluoride ions that are released from polyacrylic acid during setting reaction to form cross links with dentinal wall; in addition, setting reaction is moisture and time dependent [21]. While G1 and G2, their setting reaction is by micromechanical bonding.

**Table 1** Illustrate the luting cements that were used in this study.

| Product              | Manufacture         | Composition                                                                 |
|----------------------|---------------------|------------------------------------------------------------------------------|
| RelyX U200           | 3M ESPE, USA        | **Powder:** Glass fillers, silica, calcium hydroxide, Self-cure initiators,  |
|                      |                     | **Liquid:** Methacrylated phosphoric esters, dimethacrylates, acetate,       |
|                      |                     | stabilisers, self-curing initiators                                           |
| RelyX Luting         | 3M ESPE, USA        | **Pasta A:** Fluoroaluminosilicate (FAS) glass, Proprietary reducing agent,  |
| (Luting cement)      |                     | HEMA, Water, Opacifying agent                                                 |
|                      |                     | **Pasta B:** Methacrylated Polycarboxylic acid, BisGMA, HEMA, Water,         |
|                      |                     | Potassium persulfate, Zirconia silica flier                                   |
| Lining Cement        | GC, Japan           | **Powder:** Fluoro Alumino-silicate glass (amorphous)                         |
| (Glass ionomer cement)|                    | **Liquid:** Distilled water, Polyacrylic acid, 2-Hydroxyethylmethacrylate    |
|                      |                     | (HEMA), Urethane dimethacrylate (UDMA).                                        |
|                      |                     | **Conditioner:** Citric Acid, Distilled water, Iron chloride (Ferric chloride),|
|                      |                     | Food additive Blue                                                            |

**Figure 1** Showed the bond strength for all groups in apical portion.
The monomer is set to form hybrid layers that penetrate the collagen fiber and form bonding between dentine surface and cement [17]. The cement has a very low pH, allowing the hydrophilic properties of the material to provide a good adaptation to the root walls. In the course of the reaction, acidic monomers interact with the filler components of the cement and the hydroxyapatite content in dentin, neutralizing the reaction and increasing.

Studies were shown that bond strengths of endodontic posts and root canal dentine are affected according to different types of cement [22]. Others showed that the conditioning of dentine is effective in the enhancement of the bond strength of cements to dentin [19,23].

The region of the root canal significantly affects the interface strength with the highest values for the coronal third and lowest for the middle and apical thirds [24].

Ferrari et al. [25] reported that there was direct relation between bonding strength and dentinal tubule, which explained the higher adhesion strength, was shown in the coronal part than apical or middle part of root canal dentine. Cardoso et al. [17] showed decreases in the bond strength of G1 to dentin if they did not use cavity conditioners. In this study the highest bonding strength was observed in RelyX U200 cement, while the lowest significant change was observed with Lining Cement G3.

Resin cements may need to improve in the apical portion in the portion that is difficult for complete dryness from dentinal fluid and modifying of smear layer [18]. According to limitation of this study, types of light cure device and different procedure of resin cement that was used may affect to the result of this study.

**Conclusion**

We concluded that types of cement have significant differences in bonding strength of the fiber optic post to root dentine. The higher bonding strength was observed in Unicem U 200 while the lowest was seen in Conventional G3. G1 has higher bonding strength than Conventional G1 due to micromechanical retention.
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