The Effect of Different Bonding Protocols on Push-out Bond Strength of Fiber Reinforced Composite Post to Radicular Dentin using Two Flowable Core Build-up Resin Composites

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DEDICATION

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Introduction

The restoration of endodontically treated teeth has been a challenge for clinicians and posed a dilemma for many years. However, with the evolution of adhesive dental technology, more promising outcomes have become in handy and it greatly had an influence upon modern restorative dentistry.

For retention of coronal restoration in endodontically treated teeth, posts were widely used, especially with massive loss of coronal tooth structure[1,2]. Prefabricated fiber posts gained more popularity, as they had the advantage of simplifying the restorative procedure, where the dentist could perform all the procedural steps in one visit. Thus, they gained more compliance of the patient[3,4], through time-saving and reduced cost, meanwhile providing satisfactory results[4,5].

Posts made from tooth-colored materials have gained recently so much popularity[6]. Fiber posts being used in endodontically treated teeth increased the survival rate of such teeth, which showed great loss in their coronal portion that hindered their capability to withstand more stresses[7]. It achieved the concept of the "monoblock theory" being in combination with the resin cement and radicular dentin as one unit. The "monoblock" concept was reported to be beneficial in increasing the strength of the tooth by fulfilling equal distribution of stresses, hence decreasing liability to mechanical failure[8–12]. Moreover, being a homogenous complex with the resin cement and radicular dentin decreased the probability of microleakage[13,14].

The advantages of the "glass-fiber posts" were high biocompatibility, with high esthetics and favorable mechanical properties[7,15,16]. Esthetically, they solved the esthetic problem of metallic posts and could be used whenever esthetic demand is a concern[15,17,18].

Mechanically, they had modulus of elasticity similar to that of the natural teeth, thus creating a stress field similar to that of the natural tooth, decreasing risk of root fractures[19–22]. It was reported that most of the failures related to fiber post and core restorations were commonly de-bonding rather than root fracture[23–26].

The type of cement used, either resin cement or flowable core build-up resin composite, greatly affected the bond strength outcomes, the retention of the fiber post to root canal dentin and the fracture resistance of the tooth[20,27]. However, bond strength depended on many factors, among them, the geometric features of the root canal, the high C-factor[28,29], the variation in the bond strength through different root canal regions, the difficulty of light penetration[30,31], moisture control[32] and adhesive application[33–35]. Another factor that influenced the bond strength outcomes, was the curing protocol of the adhesive resin and the resin cement, it greatly affected the quality of cement/post and cement/dentin interfaces. Many operative techniques aimed to enhance the curing of both resin cement[36,37] and adhesive[38–41].

Accordingly, it was shown that studying the effect of different bonding protocols of fiber reinforced composite post to root canal dentin using two types of flowable core build-up acted as resin cements and their mode of curing might be of good concern for restorative field.

REVIEW OF LITERATURE

It was known for a long time ago that teeth with root canal treatment were weaker than vital ones[9,42–47]. The main reason behind this, was the amount of tooth structure lost either due to carious decay, trauma or removal of tooth structure during root canal treatment (RCT) procedure[8,31-37]. It has been also suggested that teeth with RCT dry out over-time and other changes occurred in the collagen cross-linking of the dentin[39–41], which rendered these teeth to be more brittle and more susceptible to fracture than vital ones[21,50,52,53]. Endodontically treated teeth, especially those with great loss of coronal tooth structure, usually required the use of posts to retain the coronal restorations[54,55]. The main determinant factors for the selection of the type of post and coronal restoration were esthetic demands, mechanical properties of post/core system and functional requirements[56,57]. A tooth with massive destruction of its coronal part with esthetic display in the oral cavity greatly favored the use of glass-fiber post together with a tooth colored core material[56,58].

Current concepts for the use of fiber posts

Restoring endodontically treated teeth with great loss of coronal tooth structure with posts was mistaken to be for strengthening reasons[59,60], however posts were mainly used for the retention of coronal restorations[22,61–63]. The amount of remaining tooth structure after caries removal and root canal treatment was a great influencing factor in the liability of tooth to fracture and the probability of failure[55,56]. That factor, in addition to the position of the teeth in the dental arches, the functional or para-functional load and esthetics were all influencing factors that determined the type of post/core system planned for use[56,64–67]. Generally, posts were used to provide anchorage of coronal restorations to the tooth,

so, whenever the remaining coronal structure was insufficient for retention, posts were indicated for use[8,59].

The glass-fiber posts (GFPs) were developed to overcome the drawbacks of metallic and non-metallic carbon or zirconia posts[15]. Metallic custom-made posts, although provided good adaptation to root canal space[68] with perfect connection between the post and the core with minimal possibility of separation, they possessed low esthetics. Due to their metallic nature, they did not have the ability of transmitting light and were liable to corrosion, which caused the risk tooth and gingival discoloration[69]. In addition, these corrosive products accumulated at the interface between the posts and the root canal walls, that could lead to weakening of the of the dentin. On the contrary, fiber posts were non-corroding, so they were more biocompatible compared to their metal counterparts[55,70] . Mechanically, metallic posts had good mechanical properties but with no benefit for restoring teeth, as they had an elastic modulus mismatching that of the tooth being several times higher[71]. So, upon repetitive stresses, these stresses concentrated in isolated points, so possibility of unfavorable tooth fracture occurred[72]. In addition, metallic posts required more aggressive preparation of the tooth to be restored, which dis-obeyed the concept of conservative dentistry. Regarding carbon fiber posts, they did not gain the familiarity of using it, due to low esthetic outcomes[16], stiffness and its radiolucency[19,73].

Thus, the development of glass fiber posts (GFPs) gained more acceptance for clinicians as they overwhelmed the major drawbacks of the metallic and carbon posts. They had better physical[74], mechanical[75] and esthetic properties[18]. White and translucent posts had good esthetics, translucent ones also physically had the ability to transmit light allowing

the photo-activation of luting materials within the confine of the root canal[74]. Mechanically, their elastic modulus was closely similar to that of the tooth, the core material and the luting agent; allowing for homogenous stress distribution among the bonding assembly, by allowing more balanced stress distribution along the root confines, thus, decreasing the risk of unfavorable root fracture[18,71,75–77]. This potential risk was also reduced by the chemical bonding between the post and the luting cement[74]. So, it did make sense that this property of well-balanced stress distribution, in turn would also provide a strengthening factor to the tooth to a certain extent, this was also supported by previous studies[78,79], reporting that the strengthening effect was immediately presented after post adhesive procedure. It was also suggested that better bonding along with less removal of dentin, decreased the wedging effect in the root canal, decreasing the susceptibility of tooth fracture, which was the main influencing factor for failure[50]. Retrievability, was an additional important factor in the selection of type of post, as in case of endodontic failures requiring re-treatment, easy removal of the glass-fiber posts could be accomplished without either trauma or excessive tooth structure removal[15,50,55].

In some studies that evaluated the restoration of endodontically treated teeth with metal and fiber posts, they found that the failures of fiber posts including, loss of marginal integrity, crown/root fractures and teeth mobility, were less than that were reported accompanying metal post[70,80,81]. It was concluded that using fiber posts for the restoration of endodontically treated teeth decreased the chances of failure compared to using metal posts.