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Push out bond strength between readymade and custom made fiber post in flared canal

Mohamed Ashraf Mahmoud Samy, Waled Abd ElGhafar AL-Zordk, Amal Abdelsamad Sakrana

Associate professor of Fixed Prosthodontics, Department, Fixed Prosthodontics Department, Faculty of Dentistry, Mansoura University

Professor of Fixed Prosthodontics Department, Head of Fixed Prosthodontics Department, Faculty of Dentistry, Mansoura University

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ABSTRACT

Aim of the study:

This study will evaluate Push – out bond strength of readymade fiber post and custom made fiber post in coronal part of the root.

Materials and Methods:

For this in vitro study, total forty extracted premolar teeth will be collected from oral surgery clinic Faculty of dentistry, Mansoura University then use universal test machine to evaluate the retention of 2 types of posts by push out test.

Conclusion:

Push out bond strength of custom made post is higher than readymade post and is recommended for flared canal.

Keywords: post and core, flared canal, fiber psot, push out test

I. INTRODUCTION

The likelihood of survival of a pulpless tooth is directly related to the quantity and quality of remaining dental tissue. A post is commonly placed in an attempt to strengthen the tooth. However, dentin must be removed during preparation of the post hole and the consequent reduction in fracture resistance may outweigh any likely gains. The post does not actually strengthen the root, but rather serves to improve retention of the core.[1]

The endodontically treated tooth with varying degrees of remaining tooth structure, the teeth must be able to withstand masticatory forces. To obtain a restoration with the most optimal results, the material used for post fabrication should have physical properties similar to those of dentin, should be bonded to the tooth structure, and must be biocompatible in the oral environment. Moreover, a good clinical outcome should be achieved if post materials are chosen that possess satisfactory modulus of elasticity, compressive strength, thermal expansion, and esthetics similar to those of dentin.[2]

Post and cores are commonly made from metals because of their superior physical properties; however, metallic posts may produce a gray discoloration of translucent all-ceramic crowns and the surrounding gingiva. If a metal post is desired, a post and core can be fabricated with dentin porcelain fused to a metal substructure. Growing demand for esthetic restorations in dentistry has led to the development of tooth colored, metal-free, post-and-core systems. There also is a trend toward the use of ceramic materials, attributed mainly to the improved properties of the porcelain bonding systems.[3]

Fiber-reinforced post systems contain a high volume percentage of continuous fibers embedded in polymer matrixes, which are commonly epoxy polymers with high degree of conversion and a highly cross-linked structure that binds the fibers.[4]

Prefabricated fiber-reinforced resin posts flex with the tooth structure, are easy to remove if retreatment is required, and have no negative effects on esthetics. However, the adaptation of the prefabricated post to the canal wall is important for retention, and in some cases, the canal must be enlarged to fit the configuration of the selected post, requiring removal of more tooth structure to achieve optimal adaptation. Therefore, these prefabricated posts have optimal adaptation and function in teeth with small circular canals.[5]

II. MATERIAL AND METHODS:

Using readymade Bioloren fiber post (fiber-reinforced composite) Bioloren, Saronno, Italy.

Using custom made fiber post by Trilor (Epoxy resin matrix (25% vol), multi directional glass fiber reinforcement (75% vol) Bioloren, Saronno, Italy.

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A total fifty six freshly extracted human mandibular premolar teeth were collected from Oral Surgery Department, Faculty of Dentistry, and Mansoura University with average similarity in size, shape and root morphology.

The tooth of each tooth was embedded vertically within epoxy resin blocks. Each tooth was mounted individually in special Teflon mold with epoxy resin (KEMAPOXY 150, CMB chemical, Egypt) with long axis parallel to the canter of the mold.

After endodontic treatment gutta percha removed from the canals by using Gates Glidden and the depth was limited to 10 mm using rubber stopper as reference. And to standardize post space preparation canals were prepared by size #1 post (RelyX™, 3M ESPE, S T.Paul, Minnesota, United State) of 1.3 mm diameter using matching stainless steel low-speed reamers. The preparation drill was changed after seven preparations so each group used four drills.

To stimulate flared root canal we used 2.6 mm diamond burs (#850, Intensive SA, Via al Molino, Montagnola, Switzerland) .using this diamond bur in high speed handpiece limited to 10 mm vertical length to achieve approximately 1 mm wide coronal root dentine wall.

After complete digital scanning by intra oral scanner post and core designed by Exocad system (Exocad Gmbh, Julius-Reiber-Straße 37, 64293 Darmstadt, Germany).The cores were standardized to 3mm in height with same anatomy of occlusal table, and the cement space was set at 20 µm for all custom made milled posts.

After milling Fiber post, readymade and custom made post are cemented using Rylex U200 (Rylex U200, 3M, Germany) dual cure resin cement used in room temperature 37℃.

All specimens embedded in acrylic blocks sectioned horizontally into 3 1-mm thick slices by a diamond cutter (Isomet 1000, Buehler, Ltd.) under water-cooling. Each post sectioned to 3 slices the first from cervical third, the second from middle third and third one from apical third.

Push-out forces were applied on each slice in an apical-coronal direction using 0.76 and 1.2-mm-diameter custom stainless-steel cylindrical plungers mounted on a universal testing machine (Triax Digital 50, Controls, Milan, Italy) at a crosshead speed of 0.5 mm/min. The sizes of the plungers were chosen to match the diameter of the post at the different root thirds. Each slice was oriented to ensure that the apical surface faced the plunger and the plunger was centralized to avoid contact with dentin. Push-out testing was applied along the bonded interfaces until failure occurred. The load of failure was recorded in Newton (N), and the bond strength was calculated in MPa, dividing the failure load by the surface of the bonded area.

III. RESULT

The highest push-out bond strength was reported in Custom made fiber post with a mean of 22.44±1.36 MPa in the coronal part of the root than readymade post10.71±0.64. There was a statistically significant difference between the readymade and custom made .The two-way ANOVA test also showed high significant difference in bond strength in the coronal part of the root between two groups. (Fig 1)

Figure (1): mean push out bond strength between Custom made and readymade post at coronal section

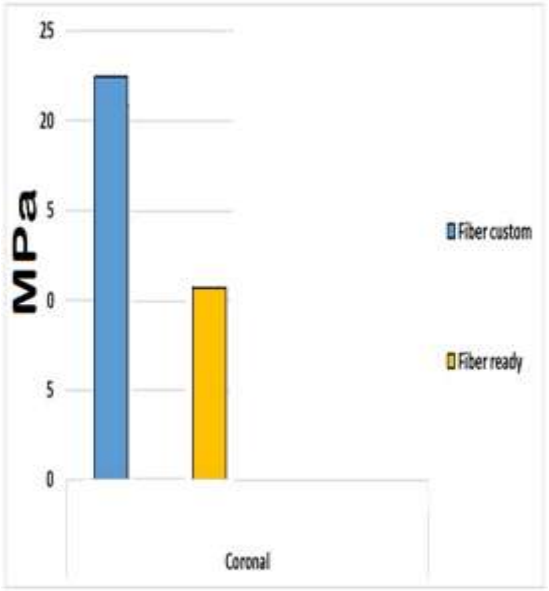

Fig 1

IV. DISCUSSION

Restoring weakened roots with post systems is a challenging process since the remaining dentin is thin and not very resistant to the physiological forces of occlusion and chewing. The large diameter of the root canals is also incompatible with the standardized geometry of prefabricated post systems. Thus; custom-made post systems with individual geometry for each root canal seem to be a promising restoration procedure for weakened roots, since they lead to greater retention due to their intimate contact with the dentin walls. They also reduce the thickness of the resin cement that, when compressed by the post

system prevents the formation of bubbles and voids that can predispose to post deboning.

Metal post and core systems, which were regularly utilized, demonstrated a higher incidence of vertical root fracture. However, because metal alloys and dentin have a significant difference in their elastic modulus (110 GPa for titanium, 95 GPa for gold, and 18.6 GPa for dentin), causing high stresses that are exerted at the dentin-post contact resulting in dentin cracking and in some cases dentin fracture. Thus, fiber glass posts with a resin core have been developed to address this disadvantage of metal. However, due to fiber's low elastic modulus (between 45.7 and 53.8 GPa), it is preferred over metal to minimize the risk of root fracture, a common issue related to the post and core systems. Due to the prefabricated nature of fiber posts, they cannot fit precisely to the geometry of the canal, and their usage has been commonly related with Debonding

Significantly higher push-out bond strength of the CAD/CAM posts compared with the prefabricated posts highlights the fact that anatomically adapted posts significantly increased the retentive strength of the post and cores in comparison with prefabricated posts. According to Da Costa et al, 21 CAD/CAM manufacturing of post and cores minimizes the cement film thickness and voids formation in the cement. The milling technique used in this study is known to produce around 110 µm cement thickness which is very close to what was found by Tsintsadze et al for the cast post and core cement space (106 µm).

This result may be attributed to the thinner and more regular layer of resin cement required with the custom fabricated posts, which would thus lessen the effect of polymerization shrinkage.

V. CONCLUSION

In flared canal it is very recommended to use custom made post than prefabricated one to enhance the retention of the post and cores in the root canal due to be mimetic to root anatomy in flared canal and decrees cement thickness.

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