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Effect of different surface treatments of luted fiber posts on push out bond strength to root dentin

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Abstract

Purpose: The purpose of this in vitro study was to evaluate the influence of different post surface treatments on the micro push out bond strength of a luting agent to a fiber post.

Materials and methods: Sixty freshly extracted single rooted upper central incisor teeth were selected, cut perpendicular to the long axis at the labial cemento-enamel junction. All root canals were instrumented, obturated, the post spaces were prepared to a depth of 11 mm. The specimens were classified into five groups according to the surface treatment performed to the post. Group 1:- no surface treatments (control group), Group 2:-surface treatment with chloroform, Group 3:-surface treatment as in group 2 in addition to the application of silane coupling agent (Calibra), Group 4:-surface treatment by sandblasting using 50 μm alumina particles, Group 5:-surface treatment as in group 4 in addition to the application of silane coupling agent (Calibra), A dual-polymerizing resin luting agent (Calibra) was used for cementation of posts. Three segments (1 mm each) from the cervical 1/3 of each root were obtained. Micro push out test was performed on a universal testing machine at a cross-head speed of 1.0 mm/min until bond failure occurred. Data were analyzed with 1-way ANOVA.

Results: Micro push out bond strength of the luting agent to the post was significantly affected by surface treatment ($P < 0.05$). Treating the surface of the post with airborne-particle abrasion followed by silanization resulted in the highest bond strength compared with other treatments. There was no significant difference in bond strength between the chloroform group before and after silanization.

Conclusions: Airborne-particle abrasion in addition to silanization provided the highest increase in bond strength between the fiber post and the resin luting agent evaluated.

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Keywords: Fiber posts; Surface treatments; Sandblasting; Silane; Chloroform; Micro push out bond strength

1. Introduction

Endodontically treated teeth may be damaged by decay, excessive wear, or previous restorations, resulting in a lack of coronal tooth structure.

The restoration of these teeth may require the placement of a post to ensure adequate retention of a core foundation [1–3]. Cast metal posts and cores have been traditionally used in these situations to provide

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the necessary retention for the subsequent prosthodontic restoration [3]. Many dentists prefer to use prefabricated post systems because they are more practical, less expensive, and, in some situations, less invasive than cast metal post and core system [4].

Recently, the use of esthetic (tooth colored) posts such as fiber and zirconia posts in the restoration of endodontically treated teeth has increased in popularity [5,6]. Fiber posts are currently perceived as promising alternatives to cast metal posts, as their elastic moduli are similar to that of dentin, producing a favorable stress distribution [5]. These posts, also, increase the light transmission within the root and overlying gingival tissues, thereby, eliminating or reducing the dark appearance often associated with non-vital teeth and metal posts and cores [7].

A choice must be made between different types of fiber posts based on their light-transmitting capacities, non-translucent posts block light passage, therefore, light-polymerizing luting materials must be substituted with auto polymerizing resin composites, and these materials are typically fluid and have a long polymerization time [8].

Selecting an appropriate adhesive and luting procedure for bonding posts to root dentin is another challenge. Sealing is expected to be strong due to recent improvements in the sealing ability of adhesive resin luting agents [8]. Moreover, various types of bonding systems can be used in combination with different luting resin [8,9]. In a recent investigation, carbon fiber post and core foundations cemented with dentin bonding and resin luting agents showed less microleakage than those luted with glass-ionomer and zinc–phosphate cements [10]. Resin luting agents may be polymerized through a chemical reaction, a light-polymerization process, or a combination of both mechanisms [11]. Most current resin luting agents polymerize using a dual-polymerizing process that requires light exposure to initiate the reaction [11,12].

Failure of fiber post-and-core restorations often occurs because of de bonding between the resin luting agent (-fiber post and/or -root canal dentin) as a result of inadequate bond strength [1,5,13,14].

One difficulty with some of the available prefabricated fiber posts is that the polymer matrix between the post material fibers is highly cross-linked and, therefore, less reactive. This makes it difficult for these posts to bond to resin luting agents and tooth structure [2,15].

Although the adhesion in the root canal represents the weakest point of the post-endodontic restoration, the post/composite adhesion needs to be considered. Bonding of fiber posts to composite materials relies only on the chemical interaction between the post surface and the resin material used for luting or building-up the core. In an attempt to maximize resin bonding to fiber posts several surface treatments have been recently suggested [16].

2. Materials & methods

Sixty freshly extracted human periodontally involved, single straight rooted upper central incisor teeth with single canal were selected. To standardize the root canal length for this study, the roots were cut (from the coronal end) to a uniform length of 16 mm. The root canals were instrumented to a working length of 1 mm from the apex up to #55 Master apical file. All root canals were instrumented by the same operator using a step-back technique with stainless steel K-files. The canals were obturated with gutta-percha cones (*Dentsply-Maillefer, Ballaigues, Switzerland*) and sealer (*AH-26, Dentsply DeTrey GmbH, Konstanz, Germany*) using lateral condensation technique. After complete endodontic treatment, the cervical root canal openings were filled with an eugenol free provisional restorative material (*Orafil G*, *Prevest Denpro Limited, India*). The roots were then fixed in standardized self-cured cylindrical acrylic blocks to facilitate handling of specimens. The temporary restorations were removed and the cavities were cleaned. The post spaces were prepared to a depth of 11 mm with special preparation drills supplied from the manufacturer of the Easy Post systems (*Dentsply-Maillefer, Switzerland*) using a low speed straight hand piece attached to bench drilling machine.

Number 3 Easy Posts with 1.6 mm diameter at the coronal end and 20 mm length were used. The specimens were randomly classified into five equal groups ($n = 12$) according to the type of treatment performed to the post surface:-

- **Group I:-**No post surface treatments, considered as a control group.
- **Group II:-**Post surface treatment with chloroform, the post was immersed in the solvent (chloroform) for 1 h and then wiped with a chloroform impregnated tissue for 1 min.
- **Group III:-**Post surface treatment as in group II in addition to the application of silane coupling agent using a brush then left undisturbed for 1 min and gently air-dried.
- **Group IV:-**Post surface treatment by extra oral sandblasting device using 50 μm alumina particles at 2 Mpa air pressure for 10 s with the posts held perpendicular to the incoming particle stream at 20 mm distance. The sandblasted post is then cleaned

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