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ORIGINAL ARTICLE

Effect of viscosity of dual-cure luting resin composite core materials on bond strength to fiber posts with various surface treatments

Juthatip Aksornmuang [a*], Masatoshi Nakajima [b], Junji Tagami [b,c]

[a] *Department of Prosthetic Dentistry, Faculty of Dentistry, Prince of Songkla University, Hat Yai, Songkhla, Thailand*
[b] *Cariology and Operative Dentistry, Department of Restorative Science, Tokyo Medical and Dental University, Tokyo, Japan*
[c] *Global Center of Excellence Program, International Research Center for Molecular Science in Tooth and Bone Diseases, Tokyo Medical and Dental University, Tokyo, Japan*

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bond strength;
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Abstract *Background/purpose:* The objective of this study was to evaluate the viscosity of two dual-cure resin composite core materials and their bond strength to fiber posts treated with various surface treatments.
Materials and methods: Viscosity at 60—90 seconds after mixing two resin composite core materials, Clearfil DC Core (DC) and Build-It FR (BI), was tested by a rheometer. Eighteen fiber posts (FibreKor) were divided into three groups according to the following post surface treatments: (1) no surface treatment; (2) application of silane coupling agent (Silane); and (3) application of silane followed by Bond-1 adhesive resin (Silane + Bond-1). Treated posts were cemented into artificial post spaces using DC or BI. After 24-hour storage, each specimen was serially sliced into 12 beams for a microtensile bond strength test. The data were divided into upper, middle, and bottom regions, and statistically analyzed ($\alpha = 0.05$). Failure modes were observed using a scanning electron microscope.
Results: The viscosity of BI at 60 seconds after mixing was lower than that of DC. Bond strengths were found to be affected by luting resin composites, surface treatment, and region. For DC, bond strength was significantly improved in the group of Silane + Bond-1 ($P < 0.05$).

* Corresponding author. Department of Prosthetic Dentistry, Faculty of Dentistry, Prince of Songkla University, Hat Yai, Songkhla 90112, Thailand.
E-mail address: juthatip.a@psu.ac.th (J. Aksornmuang).

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For BI, application of Silane significantly improved bond strength ($P < 0.05$), but application of Silane + Bond-1 had no advantageous effect on it.
Conclusion: Bond strengths between luting resin composites and fiber posts were affected by post surface treatments, depending on the resin composite used. Application of a low-viscosity adhesive resin to the post surface seemed to be beneficial for a high-viscosity luting resin composite.

Introduction

Currently, utilization of fiber posts to provide radicular retention for crown restoration is routinely recommended for the treatment of endodontically treated teeth. Several studies have accordingly supported the benefit of fiber posts in reducing the incidence of root fracture, due to their modulus elasticity, which is comparable to that of dentin.[1–3] Moreover, fiber posts provide superior aesthetics, easier removal, and shorter treatment visits compared to cast metal posts and cores.[4] In fiber post luting procedures, either a resin cement or a resin composite core material can be used as a luting medium. Dual-cure resin composite core materials have been introduced for the placement of fiber posts in post spaces because a resin composite has a modulus of elasticity close to that of dentin and fiber posts, and better mechanical properties than those of a resin cement.[5] A recent study revealed significantly higher bond strength when luting the fiber post with dual-cure core build-up materials than with resin cements.[6]

Even though the utilization of a fiber post can reduce the incidence of root fracture, failure can still occur through decementation of the fiber post from the canal. The flexibility of fiber posts allows them to consensually bend with dentin during function, resulting in debonding of the interface when bond strength is inadequate. Failure can occur either at the resin–dentin or at the resin–post interface. A previous study reported that debonding between fiber posts and a luting resin took place when the root canal dentin was efficiently bonded.[7] Various surface treatment methods have been proposed to improve the adhesion between post surfaces and the luting resin, either through mechanical interlocking or through chemical bonding at the interface.[8] Various techniques for increasing the roughness of post surfaces, by means of hydrogen peroxide etching,[9] hydrofluoric acid etching,[10] or airborne-particle abrasion with aluminum oxide,[11,12] have been reported to be effective for increasing bond strength between fiber posts and the luting resin. However, one study revealed that post surface abrasion produced undesirable surface changes.[13] Silane application to post surfaces was found to be a simple method for improving the bonding between post surfaces and the luting resin.[10,14] However, there have been conflicting research results in regard to the efficiency of silane as a coupling agent to fiber post surfaces.[8]

Various fiber posts are available in the dental market. According to manufacturers' instructions, several methods—such as no treatment needed, application of silane, or application of silane followed by an adhesive resin—have been suggested as post surface treatments before bonding posts in root canals. Application of these chemical agents to post surfaces has been recommended in order to improve the adhesion between fiber posts and the luting resin through the mechanisms of chemical interaction and increased wettability.

Low viscosity of an adhesive resin is important for good wettability of post surfaces.[15] However, if the luting resin itself has low viscosity, additional application of an adhesive resin may have a negligible effect. Dual-cure resin core materials of various viscosities have been developed. Lower-viscosity resin core materials would be easier to inject into the root canal; however, it would be more difficult to build up a core part without a matrix. By contrast, resin composites with higher viscosity may produce a gap at the surface, although they facilitate the construction of an abutment form. Only a limited number of studies have investigated the effect of viscosity of dual-cure luting resin composite core materials on bond strength. Moreover, the effect of surface treatments may be related to the viscosity of the luting medium, an assumption that has not yet been proved.

This study was performed to evaluate the viscosity of two dual-cured resin composite core materials used for luting fiber posts and their bond strength to fiber posts treated with various surface treatments. In addition, the correlation between viscosity and bond strength data would be described. The null hypotheses were that the viscosity of the luting agent, types of luting agent, post surface treatments, and regional differences do not affect the bonding between fiber posts and luting resin composite materials.

Materials and methods

Two dual-cure resin composite core materials were used for bonding fiber posts: Clearfil DC Core (DC; Kuraray Medical, Tokyo, Japan) and Build-It FR (BI; Pentron Clinical Technologies, Wallingford, CT, USA). After mixing, their viscosity was tested using a rheometer (HAAKE RheoStress RS75; Thermo Electron, Karlsruhe, Germany) at 25°C with a C20/4 (diameter = 20 mm, angle = 4°) sensor. Viscosity of each resin composite was determined twice; the viscosity values in Pa·second were reported at 60 seconds, 70 seconds, 80 seconds, and 90 seconds after mixing.

Eighteen 1.48-mm-diameter and 18-mm-length FibreKor nonserrated glass fiber-reinforced composite posts (Pentron