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# Influence of 2% chlorhexidine digluconate on bond strength of a glass-fibre post luted with resin or glass-ionomer based cement

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ABSTRACT

*Objectives:* This study evaluated the influence of 2% chlorhexidine digluconate (CHX) on the bond strength (BS) of a glass-fibre post to the root canal, regarding the cements (dual-cured resin or resin-modified glass-ionomer cement), the root thirds and the time of storage.
*Method:* Eighty bovine roots were selected and endodontically treated, before being randomly assigned to the following groups according to the luting protocol: ARC (RelyX ARC); ARC + CHX; RL (RelyX Luting 2); and RL + CHX. After 24 h of luting, the roots were sliced to obtain 1 mm-thick slices. Half of each group was submitted to either 7-day or 6-month storage in artificial saliva ($n = 10$). The specimens were subjected to push-out tests with a crosshead speed of 0.5 mm/min. The data were analysed with four-way ANOVA and Tukey's test ($P \leq 0.05$). The failure modes were analysed with a digital microscope (50× and 200×).
*Results:* ARC yielded a significantly higher BS compared to RL ($P < 0.001$). Despite CHX exerted a significant effect; it depends on the interaction with the luting cement and time ($P < 0.001$). Thus, CHX decreased the values of BS to those of ARC after 6 months ($P < 0.001$). On the 7th day of storage, the ARC + CHX presented higher BS to the cervical and middle thirds compared to RL + CHX ($P = 0.012$). Time solely was not a significant factor ($P = 0.081$). Adhesive cement-dentine type and mixed failures were predominant modes for the ARC groups. For the RL groups, the main failures were adhesive cement-post and mixed modes.
*Conclusions:* Glass-fibre posts luted with RelyX ARC dual-cure resin cement exhibited higher BS than those luted with RelyX Luting 2 resin-modified glass-ionomer cement. Furthermore, CHX was not effective to improve the BS and negatively affected the BS of RelyX ARC after 6 months of storage.
*Clinical significance:* The use of chlorhexidine solution seems not to improve the bond strength of fibre posts to root canals, disregarding the composition of the luting cement.


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## 1. Introduction

Glass-fibre posts are indicated for endodontically treated teeth when additional retention of the core build-up is necessary.[1] At the same time, the evolution of adhesive luting agents has been equally relevant for their successful application.[2–4] Adjunctively, these options have been favoured on the basis of their interesting biomechanical properties that can minimize catastrophic failures.[1]

Dual-cure resin cements offer appropriate optical and physical mechanical properties and longer working time. Their chemical polymerization reaction allows for optimal rates of monomer conversion in the absence of light, which results in satisfactory performance, especially in apical regions.[5] Due to difficulty in accessing this region, shortcomings related to the cavity geometry of the canal can contribute to incomplete penetration and polymerization of the adhesive systems used, which exacerbates their high cavity configuration.[6–9]

Alternatives to resin-based luting cements that have been advocated include glass-ionomer cement (GIC) and resin-modified glass-ionomer cement (RMGIC), especially due to their chemical adhesion ability to tooth structures.[10–12] These materials have been recommended mainly when an adhesive technique is hampered by any condition of the procedure. However, there has been a lack of scientifically established protocols for glass-ionomer-based cements used with glass-fibre posts.[11,13,14]

Over time, degradation of the bonding interface can compromise the longevity of the material, and this degradation can be attributed not only to the hydrolytic susceptibility of the resin components[6] but also to the action of proteolytic enzymes, among which are the metalloproteinases (MMPs) and cathepsins (CTs) that are reactivated during the bonding procedure to dentine.[15,16]

In this context, chlorhexidine (CHX) has been employed as a non-specific inhibitor of dentine's intrinsic proteolytic enzymes, in an attempt to retard the degradation of the bonding interface.[17,18] Evidence for the activity of MMPs in the root canal[15] has also encouraged the use of CHX during luting procedures.[9,19]

Based on this scenario, this study aimed to investigate the influence of 2% chlorhexidine digluconate on the bond strength of glass-fibre posts to root dentine using two luting agents, a dual-cure resin cement and a RMGIC, in root thirds submitted to different storage times. The null hypothesis tested was that there would be no differences in BS according to luting agent, use of chlorhexidine, root third or time of storage.

## 2. Methods and materials

This *in vitro* study involved the analysis of four factors: type of cement (two types); dentine pre-treatment using CHX (yes or no); root thirds (at three levels); and storage times (two durations).

### 2.1. Specimen preparation

Eighty straight bovine roots were selected and stored in 0.1% thymol-supersaturated saline solution at 4 °C, which was renewed weekly. Roots that presented either ample-diameter canals or ample-apical foramen were excluded. The teeth were cut at the cementoenamel junction with a low-speed saw (Isomet, Buehler, Lake Bluff, IL, USA) under constant irrigation with deionized water to obtain 17-mm-long roots. Endodontic access was obtained, with working length established at 16 mm. The step-back technique was used to prepare all of the root canals with K-files (Maillefer-Dentsply, Ballaigues, Switzerland) up to ISO size 45. Preceding the use of each instrument, the canals were irrigated with deionized water to avoid obliteration of the dentinal tubules. Hypochlorite-based products were avoided to minimize interference with the stated problem raised in this study. After instrumentation, irrigation was performed with ethylenediamine tetraacetic acid (EDTA) (Biodinâmica, Ibiporã, PR, Brazil), followed by rinsing with deionized water and drying with absorbent paper cones (Tanari, Manacapuru, AM, Brazil). The roots were filled with gutta-percha points (Tanari, Manacapuru, AM, Brazil) associated with a calcium-hydroxide-based sealer (Sealer 26 – Dentsply, Rio de Janeiro, RJ, Brazil), using the cold lateral compaction technique.

After 7 days of storage in artificial saliva at 37 °C and 100% humidity, the root canal sealing material was removed with a #2 Gates-Glidden drill (Dentsply/Maillefer, Rio de Janeiro, RJ, Brazil). Each root canal was enlarged with the low-speed drill provided by the post system's manufacturer. The post space was 13 mm from the CEJ in depth and 1.5 mm in diameter, resulting in 3 mm of apical sealing.

After selection and standard preparation of the roots, they were distributed into 8 groups ($n = 10$), based on the parameter of diameter of the canal to allow an equal distribution among them. For this purpose, Microsoft Excel computer program was employed following the ''randomization function'' available in the programme. Then, these groups were divided according to the luting agent, dentine pre-treatment and time of storage (Table 1).

Before cementation, all of the samples were wrapped with aluminium foil to minimize external light interference. The glass-fibre posts (#2 Exacto posts, Ângelus, Londrina, PR, Brazil) were cleaned with alcohol, and silane-coupler (Primer Silano – Ângelus, Londrina, PR, Brazil) was applied with a microbrush for 1 min, followed by drying with air jets. The luting protocols are described in Table 2. Dentine treatment was performed, followed by luting of the fibre posts. For ARC, the cement was inserted into the root canal manually with a lentulo drill. For the RL groups, cementation was performed with K-files due to the material's higher viscosity, allowing for better distribution of the cement.

After 24 h, the specimens were attached to the arm of a low-speed saw and were sectioned perpendicularly to the long axis under water-cooling (Isomet, Buehler, Lake Bluff, IL, USA), using deionized water. Nine 1-mm-thick specimens were obtained from each root: 3 coronal, 3 middle and 3 apical (Fig. 1). The slices were identified on the coronal surface. The specimens were stored in artificial saliva at 37 °C for 7 days or 6 months ($n = 10$).

### 2.2. Push-out test and failure mode analysis

Push-out tests were performed using a universal testing machine (Instron 3342 – Instron Corporation, Canton, MA, USA). The coronal surface of the slice faced the device, and the