Influence of the application of Chlorhexidine at 2% in the Adhesive Protocol on the Tensile Bond Strength of Glass Fiber Post

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Abstract

The decementation of glass fiber post can be attributed to the degradation of collagen fibers by matrix metalloproteinases (MMP) at the level of the intra radicular hybrid layer. The objective of the research was to compare the tensile bond strength of glass fiber posts that were cemented with previous treatment of the radicular dentine with chlorhexidine at 2% inside the adhesive protocol. Thirty eight bovine incisives were employed. The specimens were then divided into two groups (n=19): control group (it were realized the conventional procedure) and experimental group (it were realized the application of chlorhexidine at 2% inside the adhesive protocol). The tensile bond strength was measured with an Amsler universal tester machine. The data were statistically process with the T Student test for establish important differences in the two groups (p-value < 0.05). We obtained a great increases in the values to the tensile bond strength to the glass fiber posts when apply chlorhexidine at 2% as an additional step between the acid etching and the application of adhesive system.

Keywords: Orthognathic surgery, Condylar atrophy, Complications.

INTRODUCTION

The rehabilitation of endodontically treated teeth with a great structural loss is associated with the use of intra radicular retention elements called posts that help retain the final restorative material and preserve the remaining tooth [1]. These devices have evolved vertiginously in the last decades from the cast metal post to the prefabricated systems being the glass fiber post a good option because exhibit better physical and esthetical properties closer to the tooth [2-3]. In spite of their excellent biomechanical behavior they present a high index of decementation that is associated to intra radicular hybrid layer failure due to the degradation of the collagen fibers by endopeptidases enzymes known as matrix metalloproteinases (MMP) [5,6].

Several studies claim that the use of 2% chlorhexidine can inhibit the collagenolytic activity of matrix metalloproteinases a long term and thus preserve the intra radicular hybrid layer to ensure the retention of the glass fiber post [7-13].

MATERIALS AND METHODS

The methodology used for this study was based on the technical standards ISO / TS 11405 of "Dental Materials - evaluation of adherence to dental structures". In addition, the materials used in this study, their composition and manufacturers are shown in Table 1.

Specimen Preparation

Thirty-eight freshly extracted bovine lower lateral incisors were used with an average age of 36 months, with straight roots, shape and similar sizes [14-16]. The teeth were cleaned with periodontal curettes and No. 15 scalpel blades to remove the remnants of the periodontal ligament, washed in tap water and examined with magnifying glasses with a 3X magnification for discarding teeth with cracks or fractures [14]. All pieces were submerged in distilled water for 1 day.
The specimens were then stored in 2% Glutaraldehyde for 48 days for disinfection and preservation. Subsequently, they were washed in tap water and kept in distilled water until the time of experimentation, with distilled water being replenished every 24 hours. The teeth were embedded in condensed silicone (Speedex, Colten Whaledent, Ohio, EE UU) matrices with a rectangular negative shape of 16 x 10 x 10 mm and filled with transparent acrylic resin, ensuring that roots previously measured at 1-4 mm of the third apical to coronal will be centered in this. All roots were also varnished with clear nail polish and allowed to dry for 1 minute. The crowns of all specimens were then removed by covering the exposed root canals with the temporary sealing material to subsequently submerge all specimens in distilled water, finishing with metallographic polishing with water sanding and final polishing thereof with a paste fine abrasive abrasive (Diamond Excel, FGM, Joinville, Brazil) and a felt disc. The sample was then randomly into 2 groups of 19 specimens for both the control group and the experimental group, labeling them and identifying them respectively. Then all specimens were stored in distilled water at room temperature [14].

Endodontic Procedure

All endodontic treatments were performed with rotary instruments. During the preparation, all conduct were irrigated with 1% sodium hypochlorite (Zonident, Proquident - Colombia), 17% EDTA (Trisodium EDTA, Biodynamic - Brazil) and distilled water, and the conduct were dried with paper cones. The conduct were sealed with gutta-percha cones and calcium hydroxide cement (Apexit Plus, Ivoclar Vivadent - Liechtenstein) using the lateral condensation technique, then the entries were sealed with Colsosol to store the pieces in distilled water for 48 hours [14].

Adhesives Procedures

The 38 teeth were prepared employing Peeso drill Nº2 (Mailefer – Denstply, Brazil) and the proper drill of the glass fiber post system at the same length and under constant irrigation [14]. Next, the selected posts (White Post DC Nº2, FGM, Joinville, Brazil) were prepared, it were immersed in 70% alcohol for 20 seconds, it were blown, a layer of silane was applied, 1 minute was waited for the drying thereof and as a last step a layer of adhesive was applied that was blown for 10 seconds and light cured for 20 seconds [14].

The conduct were then conditioned with phosphoric acid at 37 per cent in a lapse for 15 seconds and were rinsed with water. Conducts drying was performed with absorbent paper cones to avoid excessive dentin dehydration due to drying [14,15]. In the experimental group, 2% chlorhexidine was applied to the conduct for 1 minute, after which the conduct was not rinsed, only excess moisture was removed with paper cones. Then the etch and rinse adhesive system selected (Excite, Ivoclar Vivadent, AG - Liechtenstein) was applied to the interior of the conduct, scrubbing against the walls of the dentin for 15 seconds, it was blowing for a lapse of 10 seconds and for remove the excess of adhesive we employ endodontic paper cones, finally it was light cured for 40 seconds.

Cementation Procedure

The dual resinous cement agent was prepared according to the manufacturer’s instructions and the posts were cemented removing the excesses and then each specimen was light cured on each of its surfaces for 30 seconds making a total of 120 seconds [14,15]. To finish, the excess of the external surface of the test bodies were eliminated using polishing discs (Soft Lex, 3MESPE - USA) in a sequential and decreasing way until leaving the polished surface, after the external surface of the test bodies was varnished and the projecting end of the posts, was drying for 1 minute and stored in distilled water for 24 hours [14,15].

Thermocycling Procedure

After 24 hours the specimens were subjected to thermocycling at extreme temperatures of 5 °C to 55 °C for 30 seconds at each temperature, with a change interval of 10 seconds to fatigue the adhesive interface with a total repetition of 10,000 cycles to simulate 1 year of function [14]. Finally all the specimens were submerged in distilled water for 1 day before the tensile test. (Figure 1)

Table 1: Materials used in the study with the composition of materials according to information obtained from the manufacturers.

| MATERIAL     | COMPOSITION                                                                 | MANUFACTURER            | Lot No. |
|--------------|-----------------------------------------------------------------------------|-------------------------|---------|
| White Post   | Fiberglass composite and epoxy resin of high mechanical resistance.          | FGM, Joinville – Brazil.| 24031   |
| Prosil       | Is a 3 methacryloxypropyltrimethoxysilane hydrolyzate ethanolic solution.   | FGM, Joinville – Brazil.| 130411  |
| Condac       | Is an water-based gel containing phosphoric acid at 37%.                      | FGM, Joinville – Brazil.| 140111  |
| Excite       | Phosphonic acid acrylate, Hydroxethyl dimethacrylate, Methacrylate, Highly Dispersible silicon dioxide, Ethanol (solvent), Catalysts and stabilizers. | Ivoclar Vivadent, AG - Liechtenstein. | M66605 |
| Clorhexidina S | Chlorhexidine Digluconate at 2%, deionized water and volatile Surfactant.     | FGM, Joinville – Brazil.| 160311  |
| All Cem Trans | TEGDMA, Bis EMA, Bis GMA, camphoroquinone, barium-aluminum-silicate micro glass, silica nano particles, methacrylic monomers, di benzoyl peroxide and stabilizers, barium-aluminum-silicate micro particles. | FGM, Joinville – Brazil. | 261110  |

Fig 1: Specimens completed and stored before experimentation.
Tensile Bond Strength Test

The specimens were placed in the Amsler universal testing machine (Mitutoyo brand), the test conditions were environmental, through a load cell of 500 kg, with a minimum reading unit of 1 kg, each sample was subjected it to a tensile load, at a speed of 1 mm/minute, until the dislocation of the fiberglass post of the root canal [14]. (Figure 2)

Fig 2: Specimen subjected to traction in the Amsler Universal testing machine.

Statistical Analysis

For statistical analysis, Student's T test was employed using a level of statistical significance of 5% (p value = 0.05). The differences among groups were analyzed using the statistical software SPSS v21.

RESULTS

In this study it was found that the value of the T- Student test $T_c = -3.64$ is less than $T_c = 2.03$, resulting in sufficient statistical evidence to reject the null hypothesis ($H_0$). Therefore, there will be an influence of the application of 2% Chlorhexidine in the adhesive protocol over the values of the tensile bond strength of glass fiber posts, at 95% confidence. Additionally, it was found that the average value of the tensile bond strength of glass fiber posts when 2% chlorhexidine was applied in the adhesive protocol was 35.47 Kg-f being higher than in the control group, as well it was found that the median value in the group with 2% chlorhexidine application was 38.00 Kg – f, being higher than that found in the control group as shown in the table 2 and figure 1.

Table 2: Comparison of the tensile bond strength of glass fiber posts when applying and not applying 2% chlorhexidine in the adhesive protocol.

| GROUP          | CONTROL          | EXPERIMENTAL       |
|----------------|------------------|--------------------|
| Mean           | 29.53            | 35.47              |
| Median         | 30.00            | 38.00              |
| Mode           | 30.00            | 38.00              |
| Standard Deviation | 5.12            | 4.96               |

Note: $n = 19$

DISCUSSION

The incorporation of 2% chlorhexidine within the application protocol of etch and rinse adhesives in the intra-radicular dentin is a valid clinical resource with the intention of avoiding the enzymatic degradation to the collagen fibers that occurs at the level of the hybrid layer thus increasing the longevity to the adhesive joint post - cement - adhesive - dentine [17-21].

In this study, significant differences were found over the values of the tensile bond strength in both groups where the intra-radicular dentin was re wetting with 2% chlorhexidine after etching with phosphoric acid and rinse it and before the application of the system adhesive to preserve the long-term adhesive interface.

The findings of this study coincide with the results obtained in previous studies [22], which evaluated the effect of various irrigating substances and endodontic medications on the bond strength to the dentin of the root canal, where it was found that the application of chlorhexidine for 60 seconds showed the values of bond strength higher in relation to the other substances, concluding that chlorhexidine is an appropriate irrigating solution for the treatment of the root canal before the application of adhesive posts.

Da Silva et al [23], evaluated the bond strength between radicular dentine and a resin cement it was employ to cement carbon fiber posts, they employing several irrigating agents to were used in the preparation for insert the posts. Based on the results obtained, they concluded that the 2% chlorhexidine gel is a suitable substance for the preparation of space for the posts; in addition it has the advantage of antimicrobial activity and low toxicity.

Lindblad et al [24-25] evaluated the effect of chlorhexidine at 2% on the retention of posts based on fiber reinforced composites (FRC) to dentin cemented with resin cement. Based on the results obtained, they concluded that chlorhexidine did not negatively affect the bonding of the cemented posts with any evaluated resin cement / adhesive, on the contrary there were improvements in the bonding [26-27].

It is important to note that our study not only demonstrated the effectiveness of 2% chlorhexidine by optimizing the intra-radicular bonding of fiber glass posts immediately after the clinical procedures were completed and to undergo the various mechanical tests of the test bodies as all the previous [22-25], but also showed the preservation of the adhesive interface over time, because the thermal fatigue of the adhesive interface was performed at 10000 cycles to simulate 1 year of clinical performance in the mouth [28,29], simultaneously improving the tensile bond strength of glass fiber posts over time [30], very important not only for clinicians but also for patients seeking more durable restorative treatments [28-30].

CONCLUSIONS

Under the experimental conditions of this in vitro study and based on the results obtained, we can concluded that: the experimental group obtained an average value of tensile bond strength of glass fiber posts to 35.47 kg-f compared to the control group obtained an average value of
We as the authors to the present research declare to there is not conflicts of interests in relation to the publication of this paper.

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