INFLUENCE OF FIBREGLASS POST DESIGN AND LENGTHS ON THE BOND STRENGTH

ABSTRACT

Post retention in root canal is an important factor on the clinical success of restorations in endodontically treated teeth. **AIM**: To evaluate the effect of luting agent, fibreglass post design and lengths on the bond strength of posts. **MATERIALS AND METHOD**: One hundred eighty single-rooted teeth were root filled and prepared to receive either a parallel-sided and serrated fibreglass post or a tapered and smooth fibreglass post (n=90). The posts were cemented with the following resin cements: dual-cured resin cement (RelyX ARC), self-adhesive resin cement (RelyX Unicem) and a self-cured resin cement (RelyX ARC Luting) (n=30). The posts were luting in different depths: 5.0 mm; 7.5 mm; 10.0 mm (n=10). The posts were submitted to a traction test at a speed of 0.5 mm/min and the bond strength values (MPa) were submitted to anova in a split-plot arrangement and Tukey's test ($\alpha < 0.05$). **RESULTS**: The analyses of bond strenght values revealed that post length (depths of luting), resin cement and post design was statistically significant ($\alpha < 0.05$). The highest values of retention were observed in the smooth posts. No difference of retention values was observed in the posts cemented into 5 or 7.5 mm. The highest values were obtained cementation depth of 10 mm. The RelyX ARC and RelyX Unicem showed the highest values of retention. **CONCLUSION**: Greater depths of cementing provide greater retention. Dual-cured resin cement and self-adhesives had the highest retention values especially when the post format used is smooth and tapered.

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KEYWORDS

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INTRODUCTION

Despite glass fibrepost has your used enlarged in recent years with high rates of clinical success,[1] some doubts about the best protocol to achieve sufficient adhesion to withstand the mastigatory forces without losing adhesion the root, still remain. Manufacturers provide posts with different formats. Moreover, currently, different types of cement are available for cementation of posts. This creates doubt in the dentist about which post or cement used. Added to this, authors have attempted to explain the ideal depth removal of gutta percha for a reliable cementing of posts.[2]

Two formats of post prefabricated commonly used are smooth and tapered (conical) or serrated and parallel-sided. The tapered feature better adaptation to the root canal and require less amount of wear in the apex region, since your anatomical shape is similar to the root.[3] The serrated posts were developed in order to obtain best values of adhesion to root through the serrations. However, their use has been questioned because they form a line of cement thick and not uniform and therefore less adhesion.[4]

One of the advantages of using glass fibre post is its ability to be retained adhesively in the root canal.[5] For this, different cements with different types of cure are utilized.[6] The resin cements are composite resins with viscosity suitable for this purpose. May have cure for chemistry, photopolymerizable or both (dual). Due to the difficulty of the irradiation of light at great depths using dual-cure cements or chemical cure are the most suitable.6 The dual cements the base glass ionomer are, also, used due to their biocompatibility, ability to release fluoride and chemical interaction with the dentin[7]. Recently, trying to simplify the step of cementing, were developed self-adhesive cements[8].

Some reports suggest that the correct post length should be the length of the crown or two-thirds the length of the remaining root. [2,9-11] These statements were related to cast metal posts, which have a high elastic modulus and only frictional retention in the root canal. However, these statements have been transferred to the use of prefabricated metal posts and fibre posts, without taking into consideration the different mechanical properties, and the capacity shown by some of these intra-radicular posts of bonding to dentine, with the use of adhesive systems and resin cements.[2]

Thus the aim of this study was to analyze the null hypothesis that post design, lengths and cement no influence on the values of adhesion in the root canal.

MATERIAL AND METHODS

Ninety bovine roots of similar size and shape were selected for this study. The teeth were

stored in 0.2% thymol solution (Pharmacia Biopharma Ltda.,Uberlândia, Brazil). The soft tissue deposits were removed with a hand scaler (SS White Duflex, Rio de Janeiro, Brazil), and the teeth were cleaned using a rubber cup and fine pumice water slurry. The coronal portion of each tooth was sectioned 15.0 mm coronally from the root apex, using a diamond double-faced disk (KG Sorensen, Barueri, SP, Brazil) in a slow-speed handpiece, cooled with air/water spray.

Root canals were prepared throughout their length with Gates–Glidden burs (Dentsply Maillefer, Ballaigues, Switzerland) burs 2 and 3, with 4 being used only in the cervical third of the root canal. The canals were irrigated with 1% sodium hypochlorite solution (Asfer, Industrial Química, São Paulo, Brazil). Each canal was filled by lateral compaction using gutta-percha points (Dentsply Maillefer) and sealer (Sealer 26; Dentsply, Imp. Indústria e Comércio Ltda, Petrópolis, RJ, Brazil). One hundred eighty single-rooted teeth were root filled and prepared to receive either a parallel-sided and serrated fibreglass post (Reforpost n°. 3) or a tapered and smooth fibreglass post (Exato Cônico) (n = 90). The preparations using a heated instrument (GP heater; Dentsply Maill efer, Ballaigues, Switzerland) to remove gutta-percha; post preparations were completed with a bur 5 (GS Brasil, São Paulo, Brazil), 1.5 mm in diameter, for the cylindrical fibreglass posts, with conical apical ends and circumferential mechanical retainers (Reforpost N °. 3; Angelus, Londrina, Brazil). Meanwhile, for the smooth conical fibreglass posts (Exato Cônico; Angelus, Londrina, Brazil), the canal was prepared using the N°. 3 rotary cutting instrument present in the post kit. Access to the canals of the specimens was immediately sealed with glass–ionomer cement (Vidrion R, SS White, Rio de Janeiro, Brazil); thereafter, the roots were stored in distilled water at 37°C for 7 days. The post preparations was realized in three depth (n = 30): 5.0 mm; 7.5 mm; 10.0 mm. The post was luting with three cements (n=10): dual-cured resin cement (Rely X ARC, 3M Espe, St Paul, MI, USA); self-adhesive resin cements (Rely X Unicem, 3M Espe, St Paul, MI, USA); dual-cured ionomer of glass cement (Rely X Luting, 3M Espe, St Paul, MI, USA). The roots were covered with embedded in a polystyrene resin (Cristal, Piracicaba, Sao Paulo, Brazil) up to 4 mm below the cervical limit to simulate the alveolar bone. The post was cleaned with 70% alcohol in a single application using a microbrush, and after drying a silane agent was applied (Silano, Ângelus). All roots were covered externally with wax to avoid lateral polymerization, and each canal was treated according to the luting agent used.

For the groups of posts cemented with RelyX ARC, the canal was etched with 37% phosphoric acid (Adper Etching, 3M-ESPE; St. Paul, USA) for 15 s, washed and dried with paper points, followed by the application of the all-etching two-bottles adhesive system (Adper ScothBond Multi-Purpose, 3M-ESPE; St. Paul, MN, USA). The adhesive application followed the procedure of Dong et al. (2003),12 in which two consecutive layers of primer were applied using a thin microbrush, 13 after 20 s, the bond was applied and polymerized from the coronal portion of the canal for 20 s using a halogen unit of 750 mW cm-2 (XL 3000, 3M-ESPE; St. Paul, MN, USA).

For those posts cemented with RelyX Unicem and RelyX Luting, the internal root dentine was washed only with water and dried with paper points. The luting agents were manipulated according to the manufacturer's instructions and

inserted into the canal. For groups cemented with RelyX ARC e Unicem, 3 min after post insertion, photoactivation was performed for 40 s each on the cervical face of the root, in the direction of the long axis and then oblique to the buccal and palatal surfaces, totaling 120 s. The groups cemented with RelyX Luting was awaited the cure time of the cement recommended by the manufacturer. A composite resin core (Filtek Z250, 3M ESPE) was standardized using an acetate matrix constructed in a vacuum plasticizer using a polycarbonate pattern for built of to standardize the location and position that the tensile device would exert force. After polymerization, the samples were stored in distilled water at 37 ° C for 24 h. The tensile tests were executed with device developed specifically for this study. The specimen was positioned on the test machine (EMIC DL 2000, EMIC Equipamentos e Sistemas de Ensaios, São José dos Pinhais, Brazil) and were subjected the vertical force with speed of 0.5 mm/min until fracture by displacement of the post. The force required (N) to cause fracture was recorded by a load cell hardwired to software (TESC; EMIC DL 2000), which was able to detect any sudden load drop during the test.

The data of tensile resistance were analyzed by ANOVA and Tukey's HSD tests were employed to compare the cement agents and posts. Were considered significantly statistically different at α=0.05 (SPSS software; SPSS Inc., Chicago, IL, USA).

RESULTS

Means and standard deviations for each variable are inserted in tables 1, 2, 3. The highest values retention were observed for the post smooth, cemented with 10 mm deep and cements RelyX ARC and RelyX Unicem. The lowest values were observed serrated for luting posts in depths less than 10 mm and glass ionomer cement.

Table 1: Mean values and standard deviation for design of post. Tukey categories with different letters are statistically significant from each other (α < 0.05).

Serrated Post		Smooth Post	
Mean	Standard deviation	Mean	Standard deviation
138,10 **B**	60,76	175,89 **A**	72,11

Table 2: Mean values and standard deviation for type of cement. Tukey categories with same letters are not statistically significant from each other (α < 0.05).

RelyX-ARC		RelyX-Unicem		RelyX-Luting	
Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
194,86 **A**	70,57	185,81 **A**	66,74	115,20 **B**	50,12

Table 3: Mean values and standard deviation for depths of luting. Tukey categories with same letters are not statistically significant from each other (α < 0.05).

5,0 mm		7,5 mm		10,0 mm	
Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
117,43 **B**	45,43	117,95 **B**	56,60	209,56 **A**	60,22

DISCUSSION

Fibreglass post are the newest option for reconstruction of endodontically treated teeth since they have sufficient strength to withstand masticatory forces, modulus of

young and stiffness similar to that of dentin and, also, ability to adhere to the resin cement and dentin.[1,14] Furthermore, fibreglass posts can establish the pattern of stress distribution similar to the sound tooth.[15]

Some factors, such as length and format of the post and the choice of cement can affect the retention of the post and determine the clinical success of the procedure.[9,16] Therefore, each of these factors was evaluated in this study.

The null hypothesis was rejected. The results indicated that the retention of the fibreglass post into the root canal represented by the bond strength of fibreglass posts to internal root dentine was influenced by the luting agents, lenghts of post (depth of luting) and the post design.

Regarding the cementing agents, dual-resin cements have been recommended to luting of fibreglass posts to ensure adequate polymerization in depths areas of the root canal.[17] In the current study, the deficiency of luting caused by inappropriate polymerization of cement in the root apex, was not a problem. The post cemented with 10 mm of deep showed the highest values of retention. Soares et al (2012) showed the adequate polymerization in the cervical third of root, probably this adequate polymerization obtained in the cement close the light source, is capable of ensuring the retention post. Despite it was not observed difference between retention values of cements the RelyX ARC and RelyX Unicem, the option for this last seems to be more practical for clinical. The RelyX Unicem is composed of bifunctional methacrylate groups, whose acid nature allows for tooth demineralization and posterior infiltration by means of the adhesive system, resulting in micromechanical retention.[18] This cement eliminates acid etching[19] and and, therefore, makes the cementing more quick and easy for the dentist. The RelyX Luting showed the lowest values of retention. The Rely X Luting is a glass ionomer cement resin modified. It is composed of different monomers, the main Bis-GMA and HEMA. This material not present polymerization by light and therefore its cure is only by chemical reaction. Even without problems of polymerization inappropriately this cement, he had the lowest retention values. Studies show that this cement has low cohesive strength, this may justify the lower retention values found.[14]

Bonfante et al. [14] (2007) observed the failure mode of RelyX Luting and found a high number of cohesive failures and presence of larger numbers of bubbles in the cement. The posts cemented with resin cements showed only adhesive failures and not cohesive failures as the groups with glass ionomer cement.

These results also may be used to explain the low retention values in the current study.

Santos-Filho et al (2008) showed that post of fibreglass cemented with 5, 7.5 mm and 10 mm of depths showed low fracture risk of cause fracture in the root. Other authors no found difference in fracture pattern and fracture strenght in roots restored with different lengths of posts.[20] However, none of these authors evaluated if reduction of the depth of cementing would lead to a loss of retention that could compromise the clinical success. The post cemented with 10 mm of depth showed the highest values of retention. Any difference was observed between the 5 mm and 7.5 mm. Despite that the higher retention values were obtained with 10 mm deep, high retention values are obtained at the depth of 5.0 mm and 7.5 mm. This agrees with other studies.[21] Clinically should choose, whenever possible, cement the post in greater depths, but when the tooth to be restored has a root curve, short or calcified, the luting in lowest depths can be performed with substantial retention values.

The major cause of fibrepost failure is loss of retention.[22-24] It is known that the design of the posts have much influence on the retention of the root canal and cement.[25] So, the serrated post was development with objective of increase the retention of the post. However, these serration may increase stress concentration on fibres that were sectioned during post fabrication.[26] This could lead to a weakening of the post and facilitate the fracture of post. Tapered posts has the advantage the less removal of tooth structure in apice[3] and the best adaption in the root canal. Despite of other authors showed that the format of fibreglass post not affect the retention,[6,27] the present study observed results contrary. The highest values for smooth post can be explained by way of canal preparation. Only kits of tapered posts have a cutting instrument for the preparation of the root canal which corresponds to the diameter of the post utilized. The root canal preparation for cementation of posts serrated was conducted only with burn Largo. Thus, the tapered posts are better adapted to the root canal than the serrated posts. The authors of this study believe the cement line more uniform and thin ensures better retention values and less chance of cohesive failure of the cement. Another advantage mentioned by authors[28,29] is that the use of tapered post induces a less removal of tooth structure in the apical regions. Thus more healthy tooth structure is preserved.

Finally, this study highlights that the success of a restorative procedure with post intraradiculares depends on many factors. The use of tapered post and resin cements seems the best option. The length of the post is directly related to retention, i. e., the post should be as long as possible.[21] A gutta-percha remaining of 4 mm should be kept in the apical third to prevent contamination via root canal.

Studies, also, highlights that other care as perform root canal preparation and post cementation immediately after the finish of endodontic treatment can reduce, considerably, the chance of contamination of the root canal.[30]

Future study using fatigue and aging of samples will be performed in order to contribute to define a secure protocol for the restoration of endodontically treated teeth, specially, faced a situation it is not possible to cement the post at great depths.

CONCLUSION

• The smooth post showed higher values of tensile strength than the serrated posts

• Post cemented with 10 mm had the highest values of tensile strength than 5 mm and 7.5 mm.

• Post cemented with 5 mm and 7.5 mm no showed statistically significant difference

• The cemented with resin cement to dual cure RelyX ARC and RelyX Unicem showed the highest values of tensile strength than the cement base of glass ionomer (RelyX Luting).

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