Introduction

The restoration of endodontically treated teeth, despite the high technical and scientific advance, is considered a challenge when comes to the oral rehabilitation, once the retention of the restorative material is compromised by the loss of coronal dentinal structure.[1,2,3] Thus, the use of intracanal posts is required in teeth with partial or total destruction of the crown and need prosthetic rehabilitation treatment.[2,4]

Retention and stability of intracanal posts depends on the anatomical features, intracanal post preparation, which will limit post length and width, and the physicochemical features of the used cement.[1,5,6] Therefore, the adhesion ability of the used cement, linking the intracanal post to the dentin, is essential to the rehabilitation treatment success.[7,8]

The main cause of failure of restorations with intracanal posts is loss of the post adhesion.[9] Therefore, the cement type is a decisive factor to the treatment success. The zinc phosphate cement has been widely used to cementation of intracanal posts.[10] However, this material does not present chemical bond to dentin. The development of resinous cements introduced a new perspective to enhance retention, since these cements adhere to both the retention material and dentin.[11]

Another determinant factor for the rehabilitation of endodontically treated teeth is the type of endodontic cement used for root canal filling, which could interfere in the adhesion of the intracanal post to dentin, especially zinc oxide and eugenol based sealers. The eugenol seems to modify the resinous cement polymerization, which could result in bond failure on the intracanal post cementation.[10,12,13]

Thereby, the present study had the aim to verify the influence of the eugenol on the bond strength of cast intracanal posts using resinous cement.

Material and Methods

This study was approved by the Research Ethics Committee (protocol 149/09) of the Lauro Wanderley University Hospital.

The sample was constituted of 33 human maxillary central incisors, with similar dimensions and root without curvature, and without previous endodontic treatment. After extraction, the teeth were stored in sodium hypochlorite 1% (Dilecta, João Pessoa, PB, Brazil) for 30 seconds to disinfection and were submitted to prophylaxis with pumice (SS White, Rio de Janeiro, RJ, Brazil), using Robinson's brush (KG Sorensen, Cotia, SP, Brazil). Later, the teeth were cleaned in running water and stored in saline solution renewed weekly, under refrigeration until the experiment period, which had not exceeded a maximum period of six months, according to the standardization ISO / TR 11405:2003.[14]

The selected teeth were identified by number and standardized in size after the removal of coronal portion, keeping 15 mm length, measured in the apex-crown axis using a digital caliper with resolution of 0.01 mm (Mitutoyo MTI Corporation, Tokyo, Japan). The sectioning was performed using a double face diamond disk (Discoflex, KG Sorensen, Cotia, SP, Brazil), under constant water irrigation.

The endodontic treatment of the samples was performed by one professional, with the apical preparation standardized 1 mm below the apical foramen, using the crown-down technique, as described by Estrela.[15] The tooth length determination was performed by visual method, standardized 14 mm length, 1 mm below the apical foramen.

The root cervical portion was prepared with a LA Axxess bur (SybronEndo, Orange, CA, USA) and the cervical and middle portions were enlarged by Gates-Glidden burs (Dentsply Maillefer, Ballaigues, Swiss) #3 and #4 until 10 mm. Sodium hypochlorite 1% was used for the irrigation of root canals during the preparation. The apical shaping was performed until K-file #55 (Dentsply Maillefer, Ballaigues, Swiss). After biomechanical preparation, the root canals were dried with paper points (Dentsply, Petrópolis, RJ, Brazil) and, posteriorly, irrigated with 10 ml of EDTA 17% (Dilecta, João Pessoa, PB, Brazil) for 3 minutes and followed by 10 ml of sodium hypochlorite 1% and 10 ml of distilled water.

The teeth were randomly allocated to 4 groups: 3 experimental with 10 teeth each and 1 control group with 3 teeth. The groups were divided accordingly to the used cement: Group I (control) – without root canal sealer; Group II – epoxy resin based cement AH Plus (Dentsply, De Tray, Konstanz, Germany); Group III – calcium hydroxide based sealer Sealapex (SybronEndo, Orange, CA, USA); Group IV – zinc oxide and eugenol based sealer Endofill (Dentsply, Petrópolis, RJ, Brazil).

The root canal fillings were performed by the lateral condensation recommended by Estrela.[15] After confirmation of master gutta-percha cone #55 (Dentsply, Petrópolis, RJ, Brazil) clamping, the root canal sealers were manipulated according to the manufacturer's instructions, except for Group I, which did not used root canal sealer, and the condensation was performed with spreaders (Dentsply Maillefer, Ballaigues, Swiss) and pluggers (Odous de Deus, Belo Horizonte, MG, Brazil).

Following, the root canal post space was prepared using hot pluggers properly delimited at 10 mm, intercalated by cold plugger condensation, as recommended by the Schilder's technique. The presence of 4 mm reminiscent of root canal filling was confirmed radiographically.

After this procedure, root canal modeling was performed with pinjet (Angelus Soluções Odontológicas, Londrina, PR, Brazil) and Duralay resin (Reliance Dental Mfg., Worth, IL, USA) with the root canal space properly isolated with topic anesthetics (DFL, Rio de Janeiro, RJ, Brazil). After the modeling of the posts, they were sent for foundry with NiCr alloy. The root cavities were sealed with temporary restorative material (Coltosol, Vigodent, Rio de Janeiro, RJ, Brazil), and the teeth were stored in a chamber at 37°C for 48 hours.

The posts cementation was performed by the sequence: 1 – Verification of post adaptation in the root canal; 2 – The posts were cleaned with alcohol and left to dry for 1 minute; 3 – The internal root canal walls were cleaned using a microbrush (Vigodent, Rio de Janeiro, RJ, Brazil); 4 – The root canals were dried with paper points and conditioning with phosphoric acid 37% was performed for 15 seconds and then removed using water spray. After, the root canals were dried with aspiration cannula and paper points #50, preventing dentin dehydration; 5 – Single Bond (3M ESPE, St. Paul, MN, USA) adhesive system was applied to the root canal walls using a microbrush. After 15 seconds, and the excesses were removed using a paper point. This procedure was followed by photo polymerization for 40 seconds; 6 – The cement RelyX ARC (3M ESPE, St. Paul, MN, USA) base and catalyzer were manipulated under the same lengths according to the manufacturers specifications; 7 – After manipulated, the cement was applied to the surface of the metallic post and then placed in the pre-prosthetic space, kept initially by compression; 8 – The cements excesses were removed with a microbrush; 9 – The cement was photo polymerized according to the manufacturer's specifications.

Subsequently, the specimens were properly identified and kept in a chamber until their inclusion.

PVC tubes (Tigre, Joinville, SC, Brazil) with internal diameter of 21 mm were cut with 22 mm height, according to the mechanical test machine. The exact location of the PVC tube was standardized in the analyzing basis of a delineator (Bio-Art, São Carlos, SP, Brazil),determining that superior and inferior parts of the delineator were in the exact position for the specimens tests. The superior edge of the posts was fixed in the superior rod of the delineator (Bio-Art) using wax #9 (Lysanda, São Paulo, SP, Brazil), such that the long axis was perpendicular to the basis. Then, they were positioned in the center of the PVC tube, cut with 22 mm height.

After this procedure, the inclusion of the root and the post in acrylic resin (Vipi Flash, São Paulo, SP, Brazil), inside the PVC tube, 2 mm below the cementum-enamel junction.

The specimens, properly individualized according to the group, were submitted to the push-out test in the Universal Testing Machine Kratos 5002 (Kratos, Cotia, SP, Brazil). The specimens were positioned vertically, to minimize lateral forces and keep the tension in the tooth long axis. An increasing tensile strength was applied to the post, with ascent speed of 0,5 mm/min, until the post was dislocated from the root canal.

The strengths values needed to dislocate the posts were recorded in Kgf/cm^2. The values were submitted to statistical tests ANOVA and Tukey, with significance level of 5%, by the software Assistat 7.6 (UFCG, Campina Grande, PB, Brazil).

Results

The results found by the push-out test showed that the control group (G1) presented higher bond strength (M=598,05) and the specimens which received obturation by Endofill (G4) had the lower resistance (M=213,70). The Tukey test showed statistical significant difference between control and AH Plus groups (G1 and G2, respectively) and the Endofill group (G4). The results are described in Table 1.

Discussion

The retention of intracanal post is a frequent cause of failure in the rehabilitation treatment. Ferrari et al[16] evaluated retrospectively 985 treatments with intracanal posts, verifying failure in 79 cases. Twenty one of these cases were caused by the loss of post adhesion to root dentin. The main factors that influence retention are length and diameter of the post, root canal shaping and the type of cement used to fix the post.[5,17-21] Thus, a sealer that provide adhesion to dentin and post material may favor the retention and directly influence the rehabilitation success.[7,8]

Table 1. Mean and standard deviation values of bond strength of root canal posts, in Kgf/cm^2, and the results of the Tukey test.

Groups	Mean (SD)	Tukey Test
G1 (Control)	598.05 ± 153.38	A
G2 (AH Plus)	475.42 ± 156.20	A
G3 (Sealapex)	358.03 ± 149.17	AB
G4 (Endofill)	213.70 ± 152.53	B

However, one of the main problems from cementation resinous systems is the polymerization. This may not occur in the complete extension of the root canal, especially the apical region. This problem could be enhanced by the use of cast posts, which do not allow the penetration of light to the apical portions of the root. Therefore, the use of post that allow the penetration of light could be a determinant factor to the durability of the prosthetic treatment.[22] Although, one criterion for the use of fiber posts is that these are applied to teeth that have at least 50% of coronal reminiscent, a rare fact in endodontically treated teeth.[21]

Santana et al[23] showed that the use of cast posts failure is more associated the dental fracture, while fiber posts are more prone the post fracture failure. However, Veloso et al[21] showed that most cast posts are cemented without the properly requirements, which could cause a higher number of fractures, once most studies do not report the real condition of the cast posts, only report the fractures.

Moreover, the insufficient polymerization of the apical region could cause, beyond the physical problems related to retention, biological problems. The infiltration of monomers to the periapical region could cause inflammatory reaction and necrosis of the periodontal tissues, resulting in endodontic treatment failure.[24,25] Thus, the maintenance of a root canal filling reminiscent of at least 3 mm is essential to prevent infiltration not only of microorganisms, but also of cytotoxic substances from the restorative materials.[26,27,28]

In addition to the penetration of light, another factor could be decisive for the polymerization of resinous cements is the use of substances in the root canal filling that interfere this process. A highly studied root canal filling material related to the polymerization is the root canal sealer, especially containing eugenol.[10,12,13,29-33] This is a substance known for the interference in the polymerization process of resinous material, due to its phenolic components that interact with free radicals.[10]

This study verified that the use Endofill, a zinc oxide and eugenol based root canal sealer, resulted in lower levels of bond strengths in comparison to the other cements. These results were similar to those found by several studies that associated the use eugenol containing root canal sealer to lower bond strength of the posts.[12,13,30,31,32] However, there are some divergences between authors concerning to the influence of the root canal sealer type on the bond strength of intracanal posts, which there was no statistical significant difference in some studies when zinc oxide and eugenol based root canal sealers were compared other sealers.[10,29]

Hagge et al[34] also evaluated the influence of the eugenol containing root canal sealer in the retention of posts at different times (immediate, 1 week, 4 weeks). The authors observed that the presence of eugenol for 4 weeks showed the lower results. This fact could be due to the penetration of eugenol in the dentinal tubules, impairing its removal. This fact agrees with the results from this study, which found influence of eugenol in the adhesion of posts to root canal walls, placing the eugenol containing root canal sealers as decisive factor for the rehabilitation failure. However, Dias et al[10] did not verified the influence of time (immediate, 72 hours, 4 months) in the retention of posts in teeth filled with eugenol containing root canal sealer.

Conclusion

The eugenol influenced the bond strength of intracanal cast posts using resinous cement decreasing tensile resistance.

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Efficiency of different concentrations of sodium hypochlorite during endodontic treatment. Literature review

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ABSTRACT

The aim of this study is to evaluate, through a literature review, the effectiveness of various concentrations of sodium hypochlorite during endodontic treatment. It was possible to verify that the 0.5% sodium hypochlorite concentration needs more time to dissolve organic tissue while causing less irritation to periapical tissues. The 1% concentration showed lower loss of chlorine due to the presence of stabilizer, making the solution more reliable for long periods after open. The 2.5% concentration showed better bactericidal action and a good tissue dissolution time; the 5.25% concentration showed higher solvent potential and bactericidal effect, with lower surface tension and consequently better root canal decontamination. However, the highest concentration was also more toxic to periapical tissues, promoting greater irritation. Based on the literature review it can be said that the 2.5% sodium hypochlorite concentration, due to its less cytotoxic properties, is the most suitable for endodontic treatment of root canals.

Keywords: Sodium hypochlorite. Antimicrobial activity. Organic solvent. Irrigation solutions.

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