

COMPARATIVE *IN VITRO* STUDY OF FOUR DENTAL MATERIALS USED IN RETROGRADE APICAL FILLING

Estudo comparativo in vitro de quatro materiais odontológicos utilizados em retroobturações apicais

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Abstract

OBJECTIVES: The objectives of this study were to evaluate the apical sealing ability of four dental materials used in retrograde fillings. **MATERIAL AND METHODS:** Eighty human maxillary canines were selected and treated endodontically. The apical ends were sectioned and root-end cavities were prepared. The sample was randomly divided in four groups of 20 specimens each. In each group, root-end cavities were filled with one of the following materials: ethyl cyanoacrylate (EC); silver zinc free amalgam (AM); resin-modified glass-ionomer cement (GIC); or resin-modified glass-ionomer cement and light curing (GIC+light). Specimens were immersed in 0.2% methylene blue for 24 hours at 37° C and then sectioned longitudinally. The analysis of dye penetration was conducted by means of visual inspection of the buccal and lingual sections of the roots. **RESULTS:** Analysis of variance was used to compare results. The least marginal leakage was found in the EC group, followed by the GIC+light, GIC and AM groups, which had the greatest leakage. **CONCLUSION:** In the conditions of this work, the use of GIC+light and EC provided the best apical sealing.

Keywords: Apicoectomy; Retrograde filling; Dental Materials; Oral Surgery; Endodontics.

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Resumo

OBJETIVO: Os objetivos deste estudo foram avaliar a capacidade de vedamento apical de quatro materiais odontológicos utilizados em retroobturações. **MATERIAL E MÉTODO:** 80 dentes humanos (caninos superiores) foram selecionados. Os ápices foram seccionados, seguindo-se preparo de cavidades apicais. A amostra foi dividida aleatoriamente em quatro grupos. Cada grupo teve o ápice obturado com um dos seguintes materiais: cianoacrilato de etila (CE); amálgama de Prata sem Zinco (AM); cimento de ionômero de vidro modificado por resina (CIVr); cimento de ionômero de vidro modificado por resina associado à fotopolimerização do material (CIVr+foto). A infiltração foi avaliada pela imersão dos espécimes em azul de metileno 0,2% por 24h, na temperatura de 37°C. Após, foram seccionados longitudinalmente. A análise dos níveis de infiltração do corante foi realizada por meio da visualização das superfícies vestibular e palatina/lingual das raízes dentárias. **RESULTADOS:** Os resultados foram submetidos à análise de variância SANES. A infiltração marginal foi menor no G2 (CE), seguida por G4 (CIVr+foto), G3 (CIVr) e G1 (AM), o qual apresentou o maior nível de infiltração. **CONCLUSÃO:** O CIVr+foto e CE apresentaram as melhores condições de vedamento apical.

Palavras-chave: Apicetomia; Obturação retrógrada; Cirurgia bucal; Endodontia; Materiais dentários.

Introduction

The aim of the search for isolation between the periapical tissue and the root canal is to prevent the passage of microorganisms or microbial toxins from the root canal to the periapex (1, 2). However, no ideal material has yet been found to seal the root tip (3, 4, 5).

Silver amalgam has been the most commonly used material. Its importance is still recognized, although its use has been prohibited in some countries (6, 7).

Studies have shown that the main advantages of resin-modified glass-ionomer cement (GIC) (adhesion to dental structure, fluoride liberation and biocompatibility) demonstrate its suitability as a root-end filling material (8, 9, 10, 11). Bruyne and Moor (12) note that the use of dual polymerized (chemical and photo-activated) GIC combines the advantages of conventional GIC with improved bonding time. The indication of GIC as a root-end filling material is based on its chemical adhesion to enamel and dentin, which inhibits marginal leakage (11, 12, 13).

Other studies indicate ethyl cyanoacrylate (EC) as an ideal alternative for sealing the root tip because of its rapid autopolymerization, biocompatibility and good adhesion properties (14,15). Studies of marginal sealing capacity in root fillings indicate that cyanoacrylates form strong bonds with both dentin and enamel (16).

Methods

Eighty healthy maxillary human canines were used. The teeth were washed for 24 hours in running water to neutralize the 10% formaldehyde in which they had been stored. The specimens were then stored in 0.9% sodium chloride solution at room temperature.

The crowns were removed at the cemento-enamel junction and samples were standardized to a length of 16 mm using a diamond disc (KG Sorensen Ltda, São Paulo). The root canals were then cleaned, shaped and filled. The apical 3 mm of each root was resected perpendicular to the long axis using a n° 4138 diamond drill (KG Sorensen Ltda, São Paulo), at high speed under constant irrigation with sodium chloride solution. Root-end preparations were made following the long axis to a depth of 2 mm using n° 56 cylindrical drill (KG Sorensen Ltda, São Paulo). For purposes of isolation, two coats of nail enamel (Impala®, São Paulo) were applied to the entire tooth structure, except to the apical section.

The root end cavities were filled following the manufacturers' instructions. The study groups were as follows:

- group 1 – silver amalgam not containing zinc (AM) (Dispersaloy®);
- group 2 – ethyl cyanoacrylate (EC) (Super Bonder® - Loctite S.A.);
- group 3 – resin-modified glass-ionomer cement (GIC) (Vitremar®);
- group 4 – resin-modified glass-ionomer cement with light curing (GIC+light) (Vitremar®).

After filling, specimens were immersed in 0.2% methylene blue for 24 hours and kept at 37° (17). They were then washed for 12 hours in running water and sectioned longitudinally in a mesiodistal direction using a 0.1 mm double-faced diamond disc (KG Sorensen Ltda, São Paulo), under constant irrigation. Dye penetration was analyzed by visual inspection of the buccal and lingual sections of the roots.

Specimens were examined using stereoscopic lens. Three levels of leakage were

defined, assigning the value 1 for no leakage, 2 for moderate leakage and 3 for generalized leakage. Results were compared using analysis of variance.

Results

Group G2 (EC) showed the lowest marginal leakage index, followed by group G4 (GIC+light). Groups G3 (GIC) and G1 (AM) showed higher levels of marginal leakage (Tables 1 and 2).

Table 1 - Leakage index frequency by material

GROUP	MATERIAL	LEAKAGE INDEX		
		1	2	3
G1	AM	13	1	6
G2	EC	19	1	0
G3	GIC	14	2	4
G4	GIC+light	19	0	1

Source – Study data (PUCRS, 2005).

Table 2 - Leakage index mean and standard deviation by material

GROUP	MATERIAL	MEAN	STANDARD DEVIATION
G1	AM	1.65	0.93
G2	EC	1.05	0.22
G3	GIC	1.5	0.83
G4	GIC+light	1.1	0.45

Source – Study data (PUCRS, 2005).

Discussion

The biocompatibility of dental materials is one of the most important and most studied factors in endodontic surgery, but the hermetic sealing of the canal is no less important for the success of root canal fillings (13, 18). Failure of apical surgery can generally be attributed to poor marginal sealing of the root ends, characterized by inadequate contact between the filling material and the tooth surface (3, 4, 5, 7).

Apical sealing should prevent leakage of interstitial fluid into the root canal, as such fluid may carry microorganisms into the canal. Apicectomy and retrograde preparation increase the capacity for leakage of the remaining root, reinforcing the need for retrofilling (11).

In general, it is desirable that the retrofilling material should bond as soon as it is inserted into the cavity, favoring dimensional stability and reducing contact with apical fluids when the material is in its most vulnerable state (12, 15). These suggestions are confirmed by the results obtained, with EC showing lower marginal leakage than the other materials.

Some studies have reported incomplete sealing with GIC, suggesting that it may be sensitive to contamination by saliva and blood, thereby suffering some disintegration (4, 19). The present study found GIC to have a higher leakage index when not photopolymerized, perhaps as a result of being exposed to oral fluids in its most vulnerable state.

Conclusions

On the basis of the methodology used and the results obtained, it can be concluded that GIC and EC offer better apical sealing than the other materials studied.

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