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Influence of the spatulation of two zinc oxide-eugenol-based sealers on the obturation of lateral canals

Influência da espatulação de dois cimentos à base de óxido de zinco e eugenol na obturação de canais laterais

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ABSTRACT: The objective of this research was to evaluate, *in vitro,* the importance of the correct manipulation of endodontic sealers, correlating it with flow rate and with the consequent obturation of root canals. Twenty-four human canines were prepared, 1 mm from the apex, with K-files up to size 50, by means of the step-back technique. Six lateral canals were then drilled in each tooth, with size 10 file fixed to a low-speed handpiece. The teeth were randomly divided into 4 groups, and root canals were obturated either with the Endométhasone® sealer or Grossman sealer, prepared at ideal or incorrect clinical consistency. After obturation by means of the lateral condensation technique, the teeth were radiographed and evaluated as to the number of sealed lateral canals. Statistical analysis revealed significant differences ($p < 0.001$) between the tested sealers, and indicated the higher capacity of the well-manipulated Grossman sealer to fill lateral canals. It can be concluded that the flow rate of a sealer and its correct manipulation are very important for the satisfactory obturation of lateral canals.

UNITERMS: Dental cements; Zinc oxide-eugenol cement; Physical properties; Endodontics.

RESUMO: O objetivo deste trabalho foi avaliar a importância da correta manipulação dos cimentos endodônticos à base de óxido de zinco-eugenol, correlacionando-a com o escoamento e a conseqüente obturação do sistema de canais radiculares. Vinte e quatro caninos humanos foram preparados a 1 mm do ápice anatômico com limas tipo K ("step-back", lima de memória número 50). Seis canais laterais artificiais foram confeccionados em cada dente, por meio de uma lima número 10 acoplada a um motor de baixa rotação. Os dentes foram divididos aleatoriamente em 4 grupos e obturados com Endométhasone® ou cimento de Grossman, em uma consistência clínica ideal e outra incorreta (excesso de eugenol). Após a obturação, pela técnica da condensação lateral, os dentes foram radiografados e avaliados quanto ao número de canais laterais obturados. A análise estatística revelou diferenças significantes ($p < 0,001$) entre os cimentos testados, indicando uma maior capacidade do cimento de Grossman bem manipulado em obturar canais laterais. Conclui-se que o escoamento de um cimento, bem como sua correta manipulação, são extremamente importantes para a obturação satisfatória do sistema de canais radiculares.

UNITERMOS: Cimentos dentários; Cimento de óxido de zinco e eugenol; Propriedades físicas; Endodontia.

INTRODUCTION

The root canal treatment is constituted of different, though connected, steps, and aims to restore the integrity of periodontal tissues in order to allow for the preservation of the tooth. The hermetic sealing of the root canal system is the last link of a therapeutic chain that, once broken, condemns the whole treatment to failure.

The removal of irritating agents during the biomechanical preparation favors the healing of periapical tissues, but it is necessary to avoid recontamination of the root canal by means of its complete and final obturation, which preserves the state of disinfection[13].

Endodontic lesions laterally positioned to the root are vivid reminders of the complexity of the root canal system[1]. Researchers are unanimous in stating that sealing the entire root canal system considerably increases the success rate of the endodontic treatment[8,14].

De Deus[2] (1975) reports that 27.4% of the teeth have some kind of ramification of the main canal. Sharma *et al.*[12] (1998), studying the internal anat-

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omy of human canines with two roots, found lateral canals in 68.9% of the cases.

Thus, the aim of several researches has been to develop and test materials and techniques that favor the filling of such canals. Those studies require the utilization of experimental models that allow for the evaluation of sealing in a standardized and controlled way, which is often not possible *in vivo*. One of the alternatives proposed is the utilization of simulated root canals drilled in blocks made of epoxy resin, comparing the efficacy of different obturation techniques[6,9]. The utilization of human teeth with simulated root canals is an attempt to make the experimental methodology even closer to clinical situations[7].

The objective of this research was to study, *in vitro*, the influence of the spatulation of two zinc oxide- and eugenol-based sealers on the obturation of lateral canals.

MATERIAL AND METHODS

Twenty-four mandibular human canines, obtained from the stock of the Laboratory of Endodontics, School of Dentistry of Ribeirão Preto, University of São Paulo, and kept in 0.1% aqueous thymol solution under refrigeration, were utilized. The teeth were washed under tap water for 4 hours prior to the experiment, in order to eliminate all traces of thymol.

Standard access to the pulp chamber was performed, and the teeth were instrumented with K-files (Dentsply-Maillefer), 1 mm from the anatomical apex, by means of the step back technique, up to a size 50 file. Irrigation with 3 ml of 1% sodium hypochlorite was carried out between instruments.

After instrumentation, simulated lateral canals were created following the technique used by Holland, Murata[7] (1995), with modifications. A size 10 K file, with its tip cut (diameter of 150 µm), was fixed to a low-speed handpiece and used as a drill. Six simulated lateral canals were drilled in each tooth. They were equally distributed among the radicular thirds, in the mesial and distal aspects.

The main canal was filled with 15% EDTA for 5 min and received a final flush with 3 ml of 1% sodium hypochlorite. The teeth were then randomly distributed in four groups of 6 specimens each.

The root canals were sealed by means of the lateral condensation technique. The type and consistency of the employed sealer varied according to the group. The utilized sealers were Grossman and Endométhasone®, which are both zinc oxide- and eugenol-based materials. However, the compositions of both sealers are not the same. The Grossman cement has in its composition hydrogenated resin, bismuth subcarbonate, zinc oxide, barium sulfate and sodium tetraborate. The Endométhasone® sealer is composed of dexamethasone, hydrocortisone acetate, diiodothymol, tryoxymethylene and radiopaque excipient. Group 1 was obturated with the Grossman root canal sealer at an ideal clinical consistency, whereas Group 2 was sealed with the same material, though with an excess of eugenol, which prevented the obtainment of the ideal consistency. Groups 3 and 4 were sealed with Endométhasone®, in an ideal consistency and with an excess of eugenol, respectively, as it was reported for Groups 1 and 2.

Immediately after sealing, the teeth were radiographed and the films were mounted in slide frames and properly identified. The X-ray images were projected on a white surface and magnified 20 times, so that they could be evaluated by three independent and previously calibrated evaluators. Scores were attributed to each simulated canal, according to the extension of obturation observed in the radiograph: 1 = totally sealed; 2 = partially sealed; 3 = unsealed. The most frequent score for each canal was adopted in case of discrepancy between evaluators.

RESULTS

Table 1 shows the number of totally sealed, partially sealed and unsealed simulated root canals, according to the type of obturation.

Due to the ordinal nature of the collected data, a non-parametric statistical test was necessary to analyze the results. The Kruskal-Wallis test was employed and it revealed significant differences ($p < 0.001$) between treatments. The Grossman root canal sealer, when correctly manipulated, showed superior capacity in sealing lateral canals when compared to the other tested treatments, which showed no differences between each other (Figure 1).

DISCUSSION AND CONCLUSIONS

The aim of the root canal treatment is to hermetically seal the root canal system and, thus, reestablish the normal conditions of periapical tissues. Consequently, the utilization of cements that pre-

TABLE 1 - Number of totally sealed, partially sealed and unsealed simulated root canals, according to the type of obturation.

Extension of obturation	Type of obturation			
	Grossman		Endométhasone®	
	Ideal consistency	Excess of eugenol	Ideal consistency	Excess of eugenol
Totally sealed	19 (52.78%)*	7 (19.44%)	9 (25.00%)	6 (16.67%)
Partially sealed	10 (27.78%)	11 (30.56%)	14 (38.89%)	9 (25.00%)
Unsealed	7 (19.44%)	18 (50.00%)	13 (36.11%)	21 (58.33%)

*p < 0.001 compared to other obturations.

sent good flow rate, among other requisites, and whose composition is based on inert materials, is necessary.

One of the main components of the Grossman root canal sealer is hydrogenated resin (27%)[3]. This compound provides the cement with flowability and plasticity, which allows for its penetration in all anatomical details of the root canal system[4]. Savioli *et al.*[10] (1994) evaluated the effect of all components of the Grossman cement and confirmed that its flow rate is due to the presence of hydrogenated resin and not of bismuth subcarbonate. The manipulation of a zinc oxide- and eugenol-based cement without hydrogenated resin leads to insufficient flow rate, as it occurs with Endométhasone®.

The ideal clinical consistency, which is characterized by the formation of a 2.5-centimeter-long thread between the spatula and the glass plate, is extremely important. Inadequate spatulation with excess of eugenol jeopardizes the physico-chemical properties of the material. With a decreased flow rate, the efficient sealing of the root canal system in all its extent will not be achieved.

The Endométhasone® root canal sealer, in ideal consistency or with an excess of eugenol, did not present the necessary flow rate to penetrate into the simulated root canals, differently from the ideally manipulated Grossman sealer. Statistically, the results obtained with Endométhasone® were similar to those obtained with poorly manipulated Grossman sealer. This can be explained by the lack of hydrogenated resin in the composition of Endométhasone®, which affects flow rate[5,10]. Savioli *et al.*[11] (2000) reported that Endométhasone® does not meet the minimum flow rate standards required by the American Dental Association for root canal sealers.

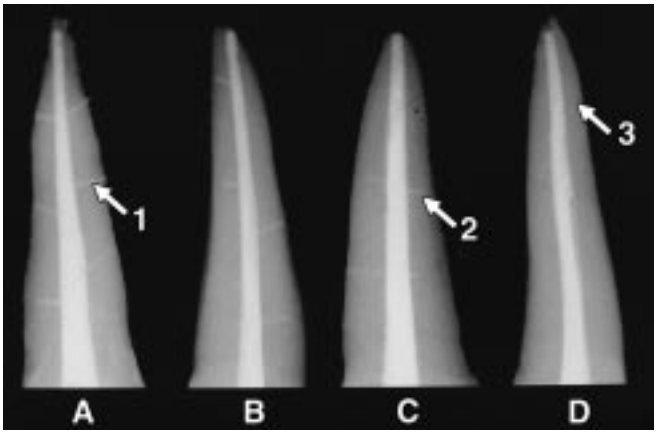

FIGURE 1 - Radiographic images of totally sealed, partially sealed and unsealed simulated root canals, according to the type of obturation. A) Grossman at ideal consistency; B) Grossman with excess of eugenol; C) Endométhasone® at ideal consistency; D) Endométhasone® with excess of eugenol. 1 = totally sealed lateral canal; 2 = partially sealed lateral canal; 3 = unsealed lateral canal.

It can be observed that the capacity of a zinc oxide- and eugenol-based root canal sealer in penetrating into lateral canals depends on two factors: the physical properties of the material and the correct manipulation of the sealer, respecting the powder-liquid ratio and observing the ideal clinical consistency for obturation, which is more important and, also, more controllable by the dentist. General practitioners, specialists, students and professors should be aware that, in order to obtain the optimum qualities of a root canal sealer, attention should be paid to the manipulation of the material.

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