Sealing capacity of the pure AH Plus sealer and with calcium hydroxide

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ABSTRACT:

The objective of this paper was to evaluate the apical sealing capacity of the AH Plus sealer pure and after the addition with 5% and 10% of calcium hydroxide. Eighty (80) recently extracted human canines were used that had the foramens standardized and the canals instrumented. After that, the teeth were sealed and separated in four groups in accordance with the sealer: group I: AH Plus; group II: AH Plus + 5% Ca $(OH)_2$; group III: AH Plus + 10% $Ca(OH)_2$; group IV: OZE. After the obturations, the teeth were immersed in a 2% blue methilene solution, at 37ºC, for 7 days. Following this period, the teeth were washed and seccionated. The thickest layer was used to evaluate the infiltration. Results showed that the addition of calcium hydroxide favored significantly the sealing ability of the AH Plus.

Key Words: Endodontic; root canal, obturation; dental cements.

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INTRODUCTION

Regarding cements, there has been an intense search for adequate filling material, which fulfills the ideal biological, physical and chemical characteristics, such as sealing, radiopacity, time of setting and flow. Most studies are devoted to obtain materials with a positive effect in the repair process, i.e., an essential role in the repair of apical and periapical pathologies.

Calcium hydroxide has been mixed to obturating cements and gutta-percha cones due to its biological role in the apical and periapical repair. In the alkaline environment and calcium liberation, this substance has biochemical properties which leads to the acceleration of the repairing process (Binnie, Mitchel, 1973, Estrela et al., 1994, 1995; Seux et al., 1991).

Berbert (1978) has associated calcium hydroxide to AH26 and, in a study in dogs teeth, reported improvement in the biological behavior of this material.

The study of the physical characteristics of the AH26 cement and its modifications with calcium hydroxide reported improvement of the apical sealing capacity (Moraes, 1984).

After Berbert (1978) it was introduced the Sealer 26 and studies with this material revealed satisfactory results (Tanomaru Filho et al., 1996, Duarte 1996).

From the commercial point of view, one of the first cements using calcium hydroxide was Sealapex. A study by Holland & Souza (1985) with this material revealed excellent biological results, confirming the adequacy of the association of calcium hydroxide with obturating cements.

Studies in monkey teeth (Tagger, Tagger 1989), dogs (Berbert, 1978, Tronstad et al., 1988) and in subcutaneous tissue of mouse and guinea pig (Oliveira et al., 1980, Yesilsoy et al., 1988), mainly conducted with Sealapex, has confirmed the beneficial association of calcium hydroxide and obturating materials, including gutta-percha, which leads to improved sealing (Holland et al., 1996b).

A new endodontic cement, the AH Plus, was recently released but in its composition there is calcium tungstenium instead of calcium hydroxide.

In a study of the biological and sealing behavior of this cement Almeida (1997) has reported good results. Clinically, it shows adequate radiopacity.This material, however, has a fluid consistency and it has been observed leakage of material in root canal obturation. This problem is difficult to avoid since the material comes in two pastes of similar flow. Therefore, it was questioned the effect on the sealing characteristic with the addition of calcium hydroxide to AH Plus, which is the objective of this study.

MATERIALS AND METHODS

The AH Plus cement was prepared according to the manufacturer instructions. For the proposed modification, the two portions were weighted and 5% or 10% of this weight in powder of calcium hydroxide was added.

In this study 80 fresh human canine teeth were used. Teeth were initially preserved in a 10% formalin solution. They were opened by a conventional coronal opening till the root canal. Foramen padronization was made by total dilatation with a type- K #30 file. Root canal instrumentation was made by step back technique. The apical step was determined 1 mm before the total extension using as standard a type-K #45 file. The step back procedure was made up to the type-K #60 file.

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During the instrumentation the site was rinsed with 1 ml of 1% sodium hypochloryd at each change of instrument and, at the end, EDTA[1] for 3 minutes followed by irrigation with saline. Teeth were externally rendered impermeable by two layers of slow setting araldite[2] and a single layer of nail enamel. Afterwards, teeth were allocated in four groups according to the cement used in the process:

Group I: AH Plus;

Group II: AH Plus with 5% calcium hydroxide;

Group III: AH Plus with10% calcium hydroxide;

Group IV: control – cement with zinc oxide and eugenol.[3]

After selection of the principal cone of gutta-percha, according to the surgical diameter, the root canal was obturated. The technique was that of the sole cone, introducing cement in the channel with a Lentullo # 3[4] spiral and than the cone itself. Exceeding cone in the pulp chamber was removed with heated condensators and the final cleaning was made with cotton and alcohol previously to the sealing process with Cimpat. The crown was rendered impermeable with cast wax. Afterwards, teeth were immersed in a 2% methilene blue solution for 7 days and at a temperature of 37°C. After one week teeth were removed from the coloring solution and rinsed with flowing water. The inpermeabilization was removed and the teeth were cut in the vestibule-lingual plane obtaining two hemi-sections. The thicker section was preserved for infiltration reading and the other discarded. Reading for infiltration was made under a microscope with micrometric ocular.[5] Readings were made by planimetric technique (ocular 12,5 X and objective 4 X) being the tooth section fixed in a glass slide with utility wax and illuminated with direct light. Measures were made from the top of the cone and than towards the cervical region. Figures were recorded in a table and later rendered in millimeters. Two independent examiners made readings and results were discussed to arrive to a common result. Averages were calculated and figures were statistically analyzed by KRUSKAL-WALLIS and MILLER tests.

RESULTS

TABLE 1 shows values for apical infiltration in millimeters. TABLE 2 describes the global comparison of infiltration among materials according to Kruskal-Wallis test. TABLE 3 shows the individual comparison for infiltration among the studied groups according to Miller test.

1. Biodinâmica Química e Farmacêutica Ltda., Ibiporã, Brasil
2. Ciba-Geigy Química S.A., Taboão da Serra, Brasil
3. SS White, Rio de Janeiro, Brazil
4. Maillefer, Baillanges, Zwitzerland
5. Carl Zeiss, Alemanha

TABLE 1 – Marginal apical infiltration measured in millimeters according to the studied materials.

AHPlus puro	AH Plus	10%	AHPlus 5%	OZE
1	2,91	0,48	0,97	3,40
2	3,62	1,82	1,74	2,43
3	1,74	1,89	2,16	1,82
4	3,37	2,16	0,77	2,67
5	3,47	1,23	1,11	1,94
6	2,72	3,40	2,79	2,06
7	2,30	2,38	2,16	1,,96
8	2,55	1,62	2,47	2,79
9	2,30	2,91	1,26	3,32
10	3,37	1,74	2,38	4,13
11	2,89	2,11	1,99	2,11
12	2,91	2,43	0,85	5,10
13	3,40	2,38	1,21	4,86
14	4,66	2,28	1,43	2,67
15	3,64	1,33	2,38	2,43
16	1,57	2,43	2,16	2,43
17	2,55	2,96	1,82	2,72
18	2,18	1,62	1,96	3,32
19	2,43	0,36	3,08	2,35
20	3,28	2,67	4,00	3,93

TABLE 2 – Global comparison of apical infiltration among groups by the teste of Kruskal-Wallis.

Groups	medians	Semiamplitude total
AH Plus pure	2,90 B[1]	1,54
AH Plus 10% CA $(OH)_2$	2,13 A	1,52
AH Plus 5% CA $(OH)_2$	1,97 A	2,61
OZE	2,67 B	1,64
Result of the statistical test		20,78 (P<0,01)

(1) Two medians followed by the same letter do not differ (P>0,05) by the teste of Miller.

DISCUSSION

It is possible to observe that in the apical sealing the pure AH Plus showed a similar infiltration as that of the eugenol and zinc hydroxide, leading to non-satisfactory results.

The average value for apical infiltration was 2.893mm. Antonopoulos et al. (1998), proceeding to obturation by the technique of the sole cone and passive penetration of coloring substance have found infiltration of 1.58mm. However, the coloring substance was India Ink while in the present study the substance was methilene blue. The latter has small seized molecules, which favors a greater infiltration according to Ahlberg et al. (1995). Almeida (1997), studying the AH Plus reported infiltration of 1.01mm. It is important to note that in his study the cone has gone beyond the apice, reducing the cement film and he has also used active lateral condensation.

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The reduction of the cement film favors the sealing process as reported by Degge et al. (1994). Another aspect is that the setting of the cements took place in a dry environment – one should argue that humidity could interfere in the sealing process of the AH Plus. Although being a derived of the AH 26 – a cement with a good sealing capacity – the behavior of AH Plus regarding this property has not been similar. This was confirmed by Zmener et al. (1997) that, comparing AH Plus and AH 26, has found significantly worse results with the former. In that study it was rised the hypothesis that the shorter setting time of the AH Plus could lead to a greater contraction stress, causing to loosening of the dental walls and thus favoring infiltration. Another hypothesis to explain such poor results could be the presence of silicon oil and other materials. Since all specimens were keep in 100% humidity one can speculate that the penetration of silicon oil in the humid dentin could induce the formation of small spaces and, thus, favoring infiltration. Porkaew et al. (1990), testing the influence of remains of calcium hydroxide in the sealing of endodontic obturations, reported that Vitapex (which contains silicon oil) induced greater infiltration, which supports the hypothesis of Zmener et al (1997). In Zmener´s study the values for infiltration were higher after 10 days, namely 3.3 mm for AH Plus with active lateral condensation.

Regarding the inclusion of calcium hydroxide, it was clearly noted an improvement in the sealing capacity, both in the 5% and 10% proportion. These findings corroborate to reports by other authors (Bramante et al., 1996, Holland et al., 1991, Holland et al., 1996[a], Tanomaru Filho et al., 1996) that have demonstrated that cements containing calcium oxide and calcium hydroxide show better results if compared to those who do not contain this substances. Moraes (1984) developed epoxy cements containing calcium hydroxide and observed better sealing capacity if compared to AH 26 which is a epoxy cement without calcium hydroxide.

However, some concern could be raised whether the improved sealing capacity is due to the discoloration of the methilene blue as reported by Wu et al., (1998), or due to the incompatibility of the staining substance with alkaline substances (Index Merck, 1996). However, analyzing the results of the present study, it is observed that the AH Pus with 5% of calcium hydroxide showed slightly inferior infiltration that AH Plus with 10% calcium hydroxide. This is an interesting finding since the cement with 10% calcium hydroxide should show lesser infiltration and, thus, lead to a greater discoloration. Indeed, this was not observed and one may assume that the better sealing capacity was due to improvement in the manipulation. This is supported by Kuga et al., (1988) that added iodoform to Sealapex aiming better radiopacity and manipulation characteristics and, indeed, obtained improved sealing capacity.

It was also observed a great variability in the results for infiltration in every group that could be due to anatomical variations in sampled teeth (Kersten et al., 1988). For this reason, in the present study it was used a non-parametric test (Kersten et al., 1988, Schurrs et al., 1993).

A practical issue to be considered is the possibility of the conventional practitioner to calculate the adequate proportion since precision scales are not usually found in clinics. After some test, it is suggested the following procedure to overcome this problem: in the slab apply a half cup of the measure that accompanies the IRM of calcium hydroxide, divide in two equal portions and again in two other portions. Now, we have four small portions. Mix one of these portions (1/4) to the average amount of base paste and catalytic, that is, a portion 1.5 cm long spread in the slab.

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CONCLUSION

It is concluded that the inclusion of calcium hydroxide in the AH Plus cement in the proportions of 5% and 10% favored a significant improvement in the sealing capacity of this material ($p<0,05$).

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