Radiopacity of AH Plus endodontic sealer plus MTA and Portland cement

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ABSTRACT

Introduction: To perform endodontic treatment of adequate quality, it is necessary for professionals to have knowledge of dental anatomy, effective techniques and filling material with chemical, physical and biological properties to provide satisfactory prognosis. One of these properties is radiopacity. The aim of this study was to evaluate the radiopacity of AH Plus endodontic sealer with addition of MTA or Portland cement at different proportions. **Methods:** The following specimens were prepared: (1) AH Plus, (2) MTA FillApex, (3) gutta-percha, (4) AH Plus + 10% MTA, (5) AH Plus + 20% MTA, (6) AH Plus + 30% MTA, (7) AH Plus + 10% Portland, (8) AH Plus + 20% Portland, and (9) AH Plus + 30% Portland. Specimens were placed on an optical plate, radiographed with aluminum penetrometer under ANSI/ADA standard (American Standard Association and American Dental Association). After sensitization, optical plates were scanned and radiopacity determined in radiographic density and aluminum millimeters. Specimens were analyzed using Digora system, and data were evaluated and compared by means of Mann-Whitney test. **Results:** MTA addition to AH Plus at a proportion of 20% and Portland cement at proportions of 20 and 30% reduced AH Plus radiopacity. **Conclusions:** MTA and Portland cement addition reduces AH Plus radiopacity; however, these associations showed radiopacity according to ADA, thus satisfying operative clinical needs.

Keywords: Endodontics. Contrast media. Radiology. Root canal filling.

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Introduction

Endodontics is one of the fastest growing areas of Dentistry. New techniques and material are daily launched. Therefore, it is necessary for professionals to be able to follow progress, updating and obtaining precise knowledge about market novelties.

Filling the root canal system means filling it with material that permanently fills, in the most hermetic manner possible, not interfering with and, preferably, stimulating the apical and periapical repair process that should occur after radical root canal treatment.[1,2]

Studies have shown that gutta-percha is the best root canal filling material, despite its slightly irritating characteristics due to the presence of zinc oxide in its composition.[3] However, its physical properties do not allow the canal to be hermetically sealed, requiring the use of sealing cement in order to fill the remaining spaces among irregular walls of the root canal and the solid material represented by the gutta-percha cone.[4,5]

There are several requirements for a filling cement and among them radiopacity plays an important role. Filling material with low radiopacity will not provide a good view from a radiographic point of view. Therefore, root canal filling material must have radiopacity enough to provide a clear and homogenous radiographic image throughout its length.[6]

The choice for optimal filling cement is of utmost importance for the final result; thus, several types of cement have been studied over the years, mainly in relation to their biological and physical properties, as well as filling capacity. Therefore, zinc-oxide-eugenol, calcium hydroxide, glass ionomer, resin, and most recently silicone-based cements as well as MTA have been currently indicated.[7,8,9]

In relation to resin cements, AH Plus deserves to be highlighted due to its good physical properties that, after small modifications in the original formula of its precursor, AH 26, has improved in biocompatibility.[10,11] In this context, MTA and/or Portland addition to AH Plus cement may improve its biological properties; however, its physicochemical properties should not be altered by this association. Thus, the aim of this study was to evaluate the radiopacity of AH Plus cement with addition of MTA or Portland cement at different proportions.

Methods

Analysis consisted of the following groups: (1) AH Plus, (2) MTA FillApex, (3) gutta-percha, (4) AH Plus + 10% MTA, (5) AH Plus + 20% MTA, (6) AH Plus + 30% MTA, (7) AH Plus + 10% Portland, (8) AH Plus + 20% Portland, and (9) AH Plus + 30% Portland.

The cements tested were proportioned and, after manipulation, they were placed on acrylic plates 6 mm in internal diameter and 2 mm in height on a smooth glass plate. After the material had been placed, another glass plate was used to compress the material and to standardize thickness of specimens, which were checked by means of a caliper. Five specimens were prepared for each cement tested. Gutta-percha was plasticized by the action of heat and compacted in the acrylic plates with the aid of amalgam compactors of appropriate size.

Specimens were placed on an optical plate (Digora), with identification, together with an aluminum penetrometer. Plates were sensitized with a Dabi Atlante X-ray apparatus set at 60 KV, 10 mA, exposure time of 0.25 seconds and distance of 40 cm, as recommended by ANSI/ADA (*American Standard Association American Dental Association*). ANSI/ADA also recommends that radiopacity of cements should be above 3 mm of aluminum, thus presenting higher radiopacity compared to dentine.

After sensitization, optical plates were scanned in Digora digital imaging apparatus (Windows version 2.5, Orion Corporation Soredex, Helsinki, Finland), and radiopacity determined in radiographic density, which was also converted into aluminum millimeters. To calculate density of material, the formula proposed by Duarte et al[12] = was used:

A X B / 2 + mmAL immediately below RDM

A = radiographic density of material (RDM) - radiographic density of the aluminum step below RDM.

B = radiographic density of aluminum step just above RDM - radiographic density of aluminum step below RDM.

2 = 2 mm increment between one step and another of aluminum

The values obtained for each material were evaluated and compared to each other for radiopacity. Data were cataloged and imported into he Microsoft

Office Excel software version 2007 and submitted to statistical analysis. The non-parametric Mann-Whitney test ($p < 0.05$) was applied.

Results

Radiopacity of MTA FillApex was lower than that of AH Plus cement with addition of MTA and Portland; however, all cement associations showed radiopacity higher than recommended by ADA specification N°. 57. Addition of MTA to AH Plus at proportions of 20 and 30% did not interfere in AH Plus cement radiopacity, whereas at a proportion of 10%, radiopacity reduced significantly. Regarding the addition of Portland cement, proportions of 20 and 30% reduced AH Plus radiopacity cement, while the 10% proportion did not affect it (Table 1 and 2).

Discussion

Knowing the radiopacity of filling material is essential to evaluate the quality of endodontic treatment. Radiopacity of a film or radiographic image can be measured through transparency, opacity and optical density. Transparency is the relation between light that can cross silver deposited on the film. Opacity is by definition the inverse of transparency, while optical density is defined as the decimal logarithm of opacity, in which the amount of light needed to exceed the image is measured through a photodensitometer.[13,14]

Differences in methodological tests on radiopacity of dental material make comparisons among studies difficult. In addition, changes in the formulation of dental material and other variables, such as sensitivity of radiographic films or processing solution (temperature and time of manufacture), may influence the results of studies assessing radiopacity of material.[15]

Table 1. Radiopacity values determined in radiographic density and converted into millimeters of aluminum.

Cements and associotions	Radiopacity	
	Median ± SD (DRM)	Medias (mm of Al)
MTA Fillapex	220.20±4.75	9.97
AH Plus	255±0	11
Guta-percha	235.20±1.26	9.17
AH Plus + 10% de Portland	254.93±0.136	10.93
AH Plus + 20% de Portland	253.26±0.93	10.86
AH Plus + 30% de Portland	252.66±1.28	10.78
AH Plus + 10% de MTA	255±0	10.79
AH Plus + 20% de MTA	253.39±1.16	11
AH Plus + 30% de MTA	255±0	11

Table 2. Comparison of radiopacity values by Mann-Whitney test.

Radiopacity	
Cements and associotions	p*
AH Plus X MTA Fillapex	0.009*
AH Plus X Guta-percha	0.009*
AH Plus X AH Plus + 10% de Portland	0.6015
AH Plus X AH Plus + 20% de Portland	0.009*
AH Plus X AH Plus + 30% de Portland	0.009*
AH Plus X AH Plus + 10% de MTA	0.009*
AH Plus X AH Plus + 20% de MTA	1
AH Plus X AH Plus + 30% de MTA	1

*($p < 0,05$).

Based on the update of ADA specification N°. 57, 2006, it was determined that endodontic cements should have higher radiopacity than dentin in radiographic images. It is recommended to measure the radiopacity in millimeters of aluminum equivalents.[16] The aluminum penetrometer should be exposed along with the samples, making it possible to obtain radiopacity values that could be compared with other studies. This is because such device aims to eliminate any external influence that may alter the image.[17]

In the digital system, radiopacity is calculated by means of pixel intensity of the image, which can be directly obtained. Should that be the case, specimens are placed on sensors and sensitized with X-ray apparatus. When indirectly obtained, specimens are radiographed on films and then scanned using appropriate scanner.[18] The present study used the indirect method and, after sensitization of sensors, images were scanned to Digora software.

Regarding the radiopacity of material, the association of AH Plus cement with Portland cement at a proportion of 10% did not interfere in its radiopacity, probably due to the small amount of material without opacifying substance. Proportions of 20 and 30% showed reduction in radiopacity due to the greater amount of Portland cement. As for addition of MTA to AH Plus at proportions of 20 and 30%, there was no interference in AH Plus cement radiopacity, while at a proportion of 10%, radiopacity decreased significantly. This fact was explained by the lower radiopacity of MTA in relation to AH Plus, despite having bismuth oxide in its composition.[19,20]

Results of the present study have shown that association of MTA or Portland cement with AH Plus presented higher radiopacity compared to gutta-percha and dentin, being easily identified in radiographs, as recommended by ADA specification N°. 57.[21] This makes associations capable of satisfying clinical needs regarding visualization of filling inside the root canal.

Conclusion

Addition of MTA and Portland cement interfered in radiopacity of AH Plus cement; however, these associations showed higher radiopacity compared to dentin, according to ADA specification N°. 57.

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