Austin Journal of Dentistry

Open Access

Austin Publishing Group

Research Article

Evaluation of Apical Infiltration in Retrofillings of Root Canals with Portland Cement and MTA Added to AH Plus Cement

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Received: March 22, 2020; **Accepted:** April 08, 2020; **Published:** April 15, 2020

Abstract

Introduction: The objective of this research was to evaluate the degree of infiltration of the MTA Angelus® retro-obturator material and Portland cement added to the AH Plus® resin cement in extracted teeth. Materials and methods: Forty palatine roots of extracted upper molars were instrumented, submitted to apicectomy and retro-preparation with ultrasound. The tested materials were manipulated and inserted in the retro-cavities. The roots were waterproofed and submerged in 2% aqueous methylene blue solution for 72 hours. Results and discussion: After the expiry of the period, the roots were washed in running water for 24 hours and sectioned on its long axis with a carborundum disc to assess the degree of infiltration through three evaluators previously calibrated with the aid of an operating microscope, the results were cataloged and subjected to statistical analysis. Conclusion: It can be concluded that the addition of AH Plus® cement to MTA Angelus® and Portland cements did not influence their seal quality, since there was no statistical difference between the materials ($p > 0.05$).

Keywords: Apical Infiltration; Mineral Trioxide Aggregate; Retro Filling

Introduction

Following the evolution of studies in dentistry, endodontics has undergone favorable changes, both in the biological field and in clinical techniques and procedures. As a result, the success rates of endodontic therapy have increased, allowing the affected dental structures to remain in harmony with the stomatognathic system. However, despite the emergence of new techniques and materials, root canal treatments are performed through technical operative steps, subject to failures, accidents and various types of complications in their clinical execution, affecting the treatment prognosis.

In order to find substances that present physico-chemical properties and capable of inducing tissue repair and physiologically and functionally reestablishing compromised dental structures, the Mineral Trioxide Aggregate (MTA) was launched on the dental market. Biocompatibility, marginal adaptation, setting time, radiopacity, dimensional stability, compression strength, adhesion to dentinal walls, antimicrobial capacity, ability to stimulate the formation of mineralized tissue barrier and adequate marginal sealing ability, preventing infiltrations, define this material [1].

With a property that differentiates it from other dental materials, MTA has the possibility of being used in the oral environment in the presence of fluids (blood). Its sealing capacity justifies the indication of MTA in retrobturation, in the treatment of lateral root perforations and in the root perforations of the pulp chamber in the furcation region, in addition to pulp capping and pulpotomy [2,3].

U.S. patent no. 5,415,547 and 5,769,638 for MTA states that the base of MTA is Portland cement to which bismuth oxide has been added to make the mixture radiopaque. This generated interest in its evaluation as a clinical alternative. Recent studies have compared MTA with Portland cement. The comparative analysis of the composition between the two materials revealed that there was significant similarity, except that there was no detectable amount of bismuth in the Portland cement composition [4]. Islam I, et al, [5]. Suggest that Portland cement has the potential to be developed as a final filling material.

Despite presenting advantages over other materials in procedures that involve cementoblast stimulation and bone healing, there is technical difficulty for the clinical use of MTA. Fridleand M, et al [6]. Reported that even in the proportions recommended by the MTA manufacturer, the mixture has excess liquid, giving rise to a pasty consistency.

The resinous cement AH Plus, when compared with other endodontic cements, presents good biological behavior, with low cytotoxicity, not interfering in the tissue healing process. In addition, it has a great maginal sealing capacity [7-10].

It is considered relevant to evaluate the association of MTA with a material that improves its consistency for clinical use, however, without changing its properties, thus being able to improve its performance as a retrofilling material.

The present research proposes to study the sealing capacity of MTA and Portland cement added to the resin cement AH plus in retrofilling of palatal roots of extracted upper molars, with the objective of improving handling, and facilitating its clinical application.

Citation: Falcão DF, Almeida WC, Gomes GS, Falcão LF, Ferraz MAAL and Falcão CAM. Evaluation of Apical Infiltration in Retrofillings of Root Canals with Portland Cement and MTA Added to AH Plus Cement. Austin J Dent. 2020; 7(1): 1132.

Materials and Methods

Eighty palatine roots of extracted upper molars obtained from the UNINOVAFAPI University Center tooth bank were used, which were subjected to disinfection with 1% sodium hypochlorite for 48 hours and preserved in saline until the time of the experiment.

Initially, the length of the palatal roots was performed with a K-file (Dentply, Maillefer) # 15 until reaching the apical foramen and receding 1 mm to define the working length. Then, Gates Gliden drills (INJECTA®) number 2 and 3 were used to prepare the cervical and middle thirds, and then the roots were instrumented using the programmed stepwise regression technique. The apical stop was made with instruments type K 20, 25 30, followed by scheduled scheduling up to file K # 45, always being irrigated with 1% sodium hypochlorite. After instrumentation, the root canals were dried with absorbent paper tips (DENTSPLY Industria e Comércio Ltda.) And flooded with E.D.T.A. (Biodinâmica Europa S. L.) solution, stirring with K # 30 file for 3 min in order to remove the smear layer. The substance was neutralized with irrigation of the 1% sodium hypochlorite solution and dried, then they were filled by the active lateral condensation technique using the main gutta-percha cone (DENTSPLY Industria e Comércio Ltda.) And accessory cones (DENTSPLY Industria e Comércio Ltda.) Associated with endodontic cement AH plus (DENTSPLY De Trey GmbH 78467 Konstanz, GERMANY LOT: 1101000670).

At the end of the filling, the pulp chamber was sealed with composite resin and then the roots were subjected to apicectomy of the apical 3 mm perpendicular to the long axis of the tooth with the aid of a Z endo drill (DENTSPLY, Maillefer) in high rotation. Afterwards, the specimens were pre-prepared with ultrasound (Satelec Systen, Gnatus, Brazil), tip n°608 DF (Multisonic S Gnatus, Satelec system number S12.900 - Gnatus, Ribeirão Preto, SP.).

The roots were randomly divided into 4 groups of 20 specimens each, according to the retrofilling material to be used:

Group I: Mineral Trioxide Aggregate – MTA

Group II: MTA + AH Plus

Group III: Portland Cement

Group IV: Portland Cement + AH Plus

Portland Cement (POTY®): was manipulated by adding distilled water to the powder following the same recommendations of the manufacturer of the MTA (Angelus Indústria de Produtos Odontológicas S / A, LOT: 17975). The association of MTA and Portland cement with AH plus was carried out by equal parts weighed on a high precision scale and manipulated until the paste reached visible uniformity.

After handling the materials, they were inserted into the back cavities and condensed with the aid of Bernabé micro condenser and the excesses removed with the aid of a gauze pad. The roots were stored in saline for 24 hours. After this period, they were dried at room temperature for 24 hours and then waterproofed with a layer of cyanocrilate (LOCTITE® Super Bonder®) and three layers of colorless cosmetic enamel (IMPALA Mundial), from the cutting regions. After drying the waterproofing agent, the apical extremities of the roots were immersed in 2% aqueous methylene blue solution (GALENO REG Manipulation Pharmacy: 343109) for 72 hours at room temperature and washed with running water for 24 hours to remove the excess of dye.

After removing the waterproofing with a scalpel blade, the roots were sectioned on its long axis with the aid of a carborundum disc and subjected to the measurement of infiltration from the apical surface and the retrograde cavity wall until the maximum penetration of the dye solution. Using the operating microscope (D.F. Vasconcellos Sp-Sp) with a 16-fold magnification.

The level of infiltration was obtained using scores, according to the following criteria:

1. Little or no infiltration;
2. Medium infiltration;
3. High infiltration.

For criterion 1, it was considered those samples which there were no infiltration or infiltration up to 1 mm. For criterion 2, the samples showed infiltration up to half of the cavity (<1.5mm). For criterion 3, samples that had infiltration beyond half the cavity (> 1.5 mm) were considered.

The infiltration level was read by three previously calibrated operators and the mean of each sample was adopted as the final infiltration.

The results were cataloged, imported into the Microsoft Office Excel Program and submitted to statistical analysis in which the Student's T test was applied.

Results and Discussion

The specimens were analyzed with the aid of an operating microscope. The results obtained from the scores representative of the different levels of infiltration are shown in the Table 1 and the result of the statistical analysis using the Student's T test is shown in Table 2.

Different methodologies have been used to assess marginal leakage, since the American National Standards Institute / American Dental Association (ANSI / ADA) has not standardized a method for its study, and these methods aim to evaluate the sealing ability of filling materials and different filling techniques. Marginal infiltration can be assessed through: electrochemical test, pressurized fluid filtration, nucleic radio, electrochemical reactions, constant pressure technique and sensors and hydrostatic pressure. Among all the methodologies, dye penetration is the most used [11]. There are several substances used, however the largest number of researches are focused on the use of methylene blue in different concentrations [12-14]. And rondamina B [14-18]. The present research used 2% methylene blue for 72 hours [19].

Marques L, et al [20]. evaluated different methods used for external root waterproofing to study the infiltration with dyes and concluded that cyanocrilate and n-butyl were the best waterproofing agents among those tested. One layer of cyanoacrylate and three layers of cosmetic enamel were used in order to obtain efficient waterproofing [10-16,21].

Table 1: Marginal infiltration, by score.

	Score 1	Score 2	Score 3
MTA	5	9	6
MTA + AH plus	7	3	10
Portland	8	7	5
Portland + AH plus	6	5	9

Score 1. Little or no infiltration; Score 2. Medium infiltration; Score 3. High infiltration.

Table 2: Student's T test result.

MTA x MTA + AH plus	0,423309	No significant
MTA x Portland	0,34555	No significant
MTA x Portland + AH plus	0,239074	No significant
MTA + AH plus x Portand	0,115062	No significant
Portland + AH plus x MTA + AH plus	0,741283	No significant
Portlant x Portland + AH plus	0,050442	No significant

Source: Direct search (p>0,05).

The instrumentation technique used was the stepwise regression because it is easy to perform and to work the three thirds of the root canal more effectively, eliminating all infected dentin and favoring the most hermetic filling possible. It should also be emphasized that coronal sealing is probably as or more important than apical sealing for the long-term success of endodontic therapy. The root canal filling was performed using the lateral condensation technique, which is easy to perform and proven to be effective [12,18].

The option to use ultrasonic tips for retro-preparation was based on studies that reference them as one of the greatest technical developments in parendodontic surgeries. These tips are built specifically for making the apical preparation. In addition to being small and easier to use, they provide preparations that better accompany the long axis of the root canal, deeper, more parallel, smoother and smoother layer of cavity walls when compared to apical cavities prepared with the use of drills. Amid so many advantages, the use of ultrasound is so widespread that it is becoming routine in the preparation of retrograde filling cavities [13,15,17,22].

As the dentin structure is permeable due to the large number of dentinal canaliculi, variations in the apicectomy cut angle lead to the exposure of a large surface area, canal light and dentinal canaliculi. With this greater exposure of dentinal tubules, apical dentinal permeability increases. The ultrasonic device allows the adaptation of tips with small dimensions and different inclinations, which facilitate access and assist in making the retrocavity in a centralized and parallel manner along the long axis of the root, in addition to allowing conservative retropreparations, since it preserves the thickness of dentinal walls, reducing the risk of perforation. The modality of perpendicular apicectomy followed by retro-preparation made with ultrasonic tips favors the achievement of positive results in parendodontic surgery [13,15,17,18].

In addition to having good biological properties, the MTA also has a good sealing ability due to its hydrophilic nature and a gentle expansion of the material when its prey occurs in a humid environment. The hydrophilic nature of the MTA powder particles gives this product a special characteristic and can be used in the presence of moisture, just as it happens during clinical procedures in cases of perforation and parendodontic surgery, therefore not requiring a dry field [13]. Portland cement (construction cement) has macro and microscopic characteristics, composition, antimicrobial action and ph similar to that of MTA cement, with the exception that Portland cement does not have a radiopacifier [4,5,12,16].

According to the manufacturer, the hardening time for MTA-Angelus® is 10 minutes and the handling time is only five minutes. Its consistency is sandy and a few minutes after homogenization, this cement dries out.

The proposal to add MTA-Angelus® powder and Portland cement to a resin cement aims to combine the excellent properties of MTA with ease of insertion and good working time.

The selection of an endodontic cement suitable to the conditions of the root canal must be supported by physical and biological properties [10]. The choice of AH Plus® cement in this research was based on the physical and biological characteristics of this material in terms of its ability to reduce marginal apical infiltration.

AH Plus® is a cement with a resinous component, which offers greater embryo in the dentinal tubules, which can contribute to the reduction of percolation between dentin and retrofilling. AH Plus® cement has an epoxy resin in its composition that presumably can favor retroapical sealing [14].

It was observed that during the experimental phase, the insertion of MTA and Portland was hampered by the characteristics of the materials. The groups that used MTA and Portland plus the AH plus cement provided a mixture consistency that remained constant for a longer period of time, allowing for an adequate insertion of the materials in the cavities.

The degree of apical infiltration observed in the present study showed that there was no statistically significant difference between the four groups tested (p> 0.05). Thus, the results obtained with the use of MTA and Portland cement added to AH plus were similar to the results obtained with the materials in pure form.

MTA alone is considered a good retrofit cement, with satisfactory apical sealing and proven biological properties. Increasing your working time and facilitating its handling would raise these properties even further. The association of MTA with other materials in order to improve its application is reported [13,21]. however, studies that study the other properties of this material have not been found in the literature. associated with AH Plus resin cement. The prospect of clinical use of this association is promising, since both AH plus and MTA have excellent physical, chemical and biological properties.

Conclusion

- After the results obtained, it was concluded that:
- All materials tested showed apical infiltration;
- The addition of AH Plus® cement to MTA Angelus® and Portland cements did not influence their apical sealing;
- Other *in vitro* and *in vivo* studies are yet to be performed.

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