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Sealing Ability of MTA Cements as Orthograde Root Filling Materials

Capacidade de Selamento de Cimentos MTA como Material de Obturação de Canal Radicular

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RESUMO

Objetivo: Avaliar a capacidade de selamento de MTA cinza (GTMA), MTA branco (WMTA) e guta-percha + Cimento AH-26 como material obturador de canais radiculares.
Método: Sessenta e seis incisivos centrais superiores humanos foram utilizados. No Grupo A, os canais radiculares de 20 dentes foram obturados com o GTMA. No Grupo B, os canais radiculares de 20 dentes foram obturados com o WMTA e no Grupo C, os dentes foram obturados com guta-percha + AH-26. Três dentes foram usados como controle positivo (obturados com o uso da técnica de cone único sem cimento) e três dentes foram usados como controle negativo (obturados com guta-percha e AH-26, cobertos com duas camadas de esmalte cosmético. Um modelo de infiltração bacteriana utilizando o microorganismo *Enterococcus faecalis* foi usado para a avaliação. A infiltração foi observada quando turbidez foi verificada.
Resultados: Os grupos controles demonstraram comportamento como esperado. No Grupo A (GMTA), três amostras, no Grupo B (WMTA) quatro amostras e no Grupo C (GP+H-26) cinco amostras apresentaram infiltração. Não se observou diferença estatisticamente significante entre o GTMA e WMTA e entre o GTMA e guta-percha + H-26 (p>0,05).
Conclusão: Ambos os cimentos, GTMA e WMTA podem ser recomendados como materiais de obturação de condutos.

ABSTRACT

Objective: To evaluate the sealing ability of grey-coloured mineral trioxide aggregate (GMTA), white-coloured MTA (WMTA), and gutta-percha+AH-26 sealer as root filling materials.
Method: Sixty-six human maxillary central incisors were used in the present study. In the Group A, 20 teeth were filled with GMTA. In the Group B, 20 teeth were filled with WMTA and in the Group C, 20 teeth were filled with gutta-percha and AH-26 sealer. Three teeth were used as positive (obturated using the single gutta-percha cone technique without sealer) and three were used as negative (obturated with gutta-percha and AH-26 sealer, coated with two layers of nail varnish) controls. A bacterial leakage model utilizing *Enterococcus faecalis* was used for evaluation. Leakage was noted when turbidity was observed.
Results: Controls behaved as expected. In the Group A (GMTA) three samples, in the Group B (WMTA) four samples, and in Group C (GP+H-26), five samples were leaked. There was no statistically significant difference between GMTA and WMTA or GMTA and gutta-percha and sealer (p>0.05).
Conclusion: GMTA and WMTA can be recommended as orthograde root filling materials.

DESCRITORES

Endodontia; Obturação do canal radicular; *Enterococcus faecalis;* Materiais restauradores do canal radicular.

DESCRIPTORS

Endodontics; Root canal obturation; *Enterococcus faecalis;* Root canal filling materials.

INTRODUCTION

Microorganisms play an essential role in pulpal and periapical disease[1-3]. Therefore, the purpose of endodontic treatment is to eliminate microorganisms from the root canal system and to prevent recontamination by creating a seal barrier between the oral microflora and the root canal system and periapical tissue. In reality, creating a fluid-tight apical, lateral, and coronal seal is necessary to prevent recontamination and long-term clinical success[4].

Several root-filling materials and techniques have been developed with the purpose of obtaining a tight root canal seal. Ideally, the root canal filling should be a complete, homogenous mass that fills the prepared canal completely.

Mineral trioxide aggregate (MTA) has a variety of potential uses, including as a root canal obturating material[5]. Studies have demonstrated encouraging regeneration of periradicular tissues, such as periodontal ligament, bone, and cementum, when MTA was used in endodontic procedures[5-7].

There are also several reports of its superior biocompatibility with periodontal tissues[8,9], excellent sealing ability in the presence of moisture[10,11], and appropriate mechanical properties as apical sealing material[8]. These encouraging outcomes from in vivo and in vitro studies have prompted many clinicians to consider the use of MTA as a root end filling material and as a material suitable for repairing perforations and performing apexification[5-7]. MTA has been used for apexification of immature roots instead of Ca(OH)2 because of its facilitation of normal periradicular architecture by inducing hard tissue barriers[5].

MTA has also presented promising outcomes when used for the repair of lateral and furcation perforations. Formation of cementum surrounding MTA was observed, even after extrusion of MTA into a furcation[12]. On the basis of these findings, MTA may be an appropriate material for apical sealing of immature root canals as well as mature root canals with open apices, which may impose technical challenges in obtaining adequate obturation because of apical perforation, over-instrumentation, resorption, or former surgical treatment. Successful prognosis from conservative treatment with MTA for such difficult cases without surgical treatment would be of great benefit for patients.

The purpose of this was to compare the sealing ability of GMTA and WMTA as orthograde root filling materials.

METHODOLOGY

Sixty-six extracted human maxillary central incisors were used for this study. The teeth were examined and radiographed and those presenting radicular calcifications or anatomical abnormalities were excluded. After preparation of coronal access, working length was determined. Canal length was determined by placing a #10 K-file through the canal space until it could be visualized exiting the apical foramen. Working length was determined by subtracting 1 mm from the canal length. The coronal two thirds of the canals were prepared sequentially with size 2 and 3 Gates-Glidden burs (Dentsply, Maillefer). The apical third of the canal was instrumented up to size 60. Irrigation was carried out using 5 mL of a 5.25% NaOCl solution between files. After preparation, the canals were irrigated with 5 ml 17% EDTA for three minutes to remove the smear layer, followed by 5 ml 5.25% NaOCl. The final irrigation was done with 5 ml distilled water. The canals were then dried with sterile paper points.

Teeth were divided into three experimental groups of 20 teeth each and two control groups of 3 teeth each. In groups A and B, roots were filled with GMTA (ProRoot MTA, Tulsa Dental, Tulsa, OK, USA) and WMTA (ProRoot MTA, Tulsa Dental, Tulsa, OK, USA), respectively. In the group C teeth were filled with gutta-percha and AH-26 sealer (Dentsply, De Trey, Konstanz, Germany). Three roots were obturated using the single gutta-percha cone (#60) technique without sealer and served as positive controls. Three roots were obturated with gutta-percha and AH-26 sealer (Dentsply, De Trey, Konstanz, Germany), coated with two layers of nail varnish (entire root plus apical foramen) and served as negative controls. Each tooth was radiographed to confirm the length and density of the root canal obturation. Each tooth was then individually sealed in a plastic vial in 100% humidity and placed in an incubator at 37° C for 48h to allow the obturation materials to set. Next, the teeth were removed from the vials, dried and then coated with two layers of nail varnish leaving the apical 3-mm of the roots and the coronal access cavities exposed.

Glass tubes equipped with microcaps were used to suspend the prepared teeth in Brain Heart Infusion (BHI) broth. A hole was made through the centre of each cap and the tooth was placed into the hole to the cementoenamel junction. The gap between the tooth and the hole was filled with sticky wax. The completed apparatus was then sterilized with ethylene dioxide. A 24-h broth culture of Enterococcus faecalis was placed into the pulp chamber of the tooth was suspended in sterile BHI broth to a level sufficient to cover the apical 3mm of the root tip. Tubes were incubated at 37° C until the BHI broth became turbid, indicating bacterial growth. Fresh 24-h cultures of E. faecalis were added every two days throughout the study. Turbidity of the broth was recorded daily for a total period of 90 days. Fisher exact test was used to show any significant differences. Significance was established at $p<0.05$.

RESULTS

At the end of 90 days, in groups A and B, leakage was observed in three and four samples, respectively. In the group C, leakage was observed in five samples. All roots in the positive control group showed broth turbidity within

48h. Roots in the negative control group did not show broth turbidity during the entire monitoring period. Statistically, there was no significant difference in leakage GMTA and WMTA or between GMTA and gutta-percha and sealer (p>0.05) (Figure 1).

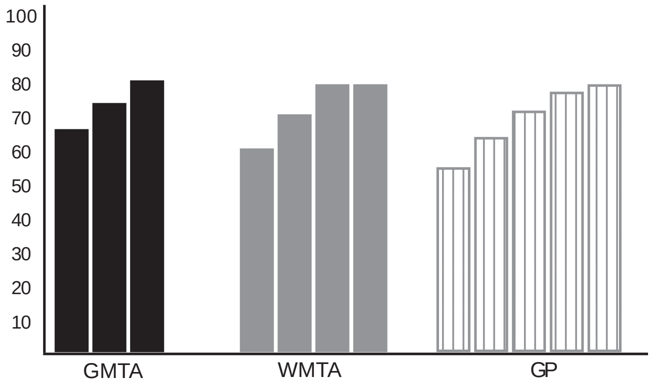

Figure 1. Material leakage time (days).

DISCUSSION

In the present study a bacterial leakage model was used because it is more reliable than dye penetration and fluid filtration methods. Controls behaved as expected which confirms the method. The findings of the present study are in contrast with those obtained by Al-Hezaimi et al.[13] They assessed the sealing ability of GMTA and WMTA for a total period of 42 days and found that GMTA as well as WMTA had the better sealing ability than gutta-percha and Kerr Canal Sealer EWT. The difference could be attributed to the test microorganism as well as the type of sealer. In the present study E. faecalis was used, whereas in Al-Hezaimi et al.[13] study whole saliva was used. Furthermore, the results of the present study differ from those of Vizgirda et al.[14] who reported that the apical seal produced by laterally-condensed gutta-percha and sealer was superior to that produced by MTA. The difference could be attributed to the some variables. In the present study leakage was measured by bacterial penetration as opposed to dye penetration. Further, human teeth were used here instead of bovine teeth.

In the present study, the difference between the two formulations of MTA was not statistically significant. Ferris and Baumgartner[15] compared the ability of GMTA and WMTA to seal furcation perforations in vitro and found no difference between the two preparations. Parirokh et al.[16] compared GMTA and WMTA as pulp capping agents in dog's teeth and found that calcified bridge could be seen 1 week after treatment with both types of MTA, with no significant differences. In another study, De-Deus et al.[17] compared the ability of Portland cement and MTA to prevent coronal leakage through repaired furcal perforations in molar teeth and found that there was no statistically significant difference between the two groups.

Clinical support for the use of MTA as an obturating material, however, was presented in some case reports. In a case report, O'Sullivan and Hartwell[18] used MTA as the obturating material for the root canal system of a retained primary second molar. At the 4-month follow-up, the patient was asymptomatic, clinical findings were within normal limits, and there was evidence of radiographic healing. In another case report, MTA was used for obturation of the root canal system of two mature mandibular central incisors with apical periodontitis. A 2-year follow-up radiographic examination demonstrated the dramatic regeneration of periradicular tissue[19].

Extrapolation of the result of this in vitro study to clinical situation must be performed with caution. Post space preparation is often required immediately following root canal obturation. In addition, retrieving of the set MTA from the root canal is difficult if nonsurgical retreatment is indicated. Therefore, orthograde root canal filling with MTA should be limited to selected cases such as one - visit apexification and situations where future nonsurgical retreatment is nonfeasible or may not render better tooth prognosis.

CONCLUSION

Within the limitations of the present study the coronal seal produced by MTA preparations was equally to that produced by lateral gutta-percha technique.

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