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Evaluation of Antimicrobial Activity of Mineral Trioxide Aggregate (MTA)

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ABSTRACT

Aims: To evaluate the antimicrobial activity of MTA against selected microorganisms compared with a widely used root end filling materials. **Materials and methods**: Fifteen mm discs of MTA, GIC and Amalgam were prepared and three types of microorganisms; two bacteria and one fungus, were grown in 4 ml of brain heart infusion broth for 18 hr. Then 0.5 ml of each growth was spread over selected media (three plates for each sample) and the discs were applied on the agar, incubated for 24–48 hr and the zone of inhibition was measured. **Results:** Amalgam did not demonstrate any antimicrobial activity, whereas MTA showed antimicrobial effect against all tested microorganisms and was highly significant. GIC showed antibacterial activity comparable to MTA but failed to produce antifungal effect. **Conclusions:** MTA demonstrated antibacterial and antifungal effect, while GIC showed only antibacterial activity, whereas Amalgam did not show any activity.

Keywords: antimicrobial activity, MTA

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INTRODUCTION

Microorganisms are regarded as the main etiological factor in pulpal and periapical diseases and their elimination during root canal treatment by instrumentation, irrigation and intracanal medication is essential [1,2]. However, even after these procedures, microorganism might still be found inside root canal [3]. Therefore, root filling plays an essential role in the control of reinfection by residual organisms through antimicrobial activity of endodontic sealing materials [4].

An ideal root end filling material should adhere and adapt to the dentinal walls of root end preparation, preventing leakage of microorganisms and their by-products into periradicular tissues in addition to its biocompatibility and insolubility in tissue fluids[5].

Numerous materials have been used as root canal end filling materials as gutta percha, zinc oxide–eugenol, composite resin, gold foil and glass ionomer cement (GIC). However, no materials have been found to have all ideal properties of root end filling materials [6].

An experimental material, mineral trioxide aggregate (MTA) was developed to seal off all pathways of communication between root canal system and external surface of tooth [7]. It has been shown that MTA posses biological and physical properties of an ideal filling materials [8,9].

The current study is to evaluate the antimicrobial activity of MTA against selected microorganisms and comparing the results with a widely used root end filling materials such as amalgam and glass ionomers cement.

MATERIALS AND METHODS

Preparation of Sealer Filling Materials:

Mineral trioxide aggregate (ProRoot; Tulsa Dental, USA) was prepared by mixing three parts powder with one part aqueous solution[10]. After 30 seconds, the mixture should exhibit putty–like consistency.

Then MTA should immediately be placed in a mold which is a prefabricated a celluloid tablet sheath to obtain a uniform disk like of 15 mm diameter.

Glass ionomer cement (Megadenta Gmbit Dental product, Radeberg, Germany) was mixed according to the manufacturer instructions and applied in a putty–like consistency using the same method in MTA.

Aprecapsulated high copper, non–gamma 2 alloy (Viva cap, Vivadent, Ets. Germany) was used. It was triturated with mechanical amalgamator (Silamat, vivadent, Schoan, Liechtestien, Germany) for 10 seconds and immediately condensed into the corresponding celluloid sheath cavities to obtain a disc shape of the same dimension as for MTA and GIC.

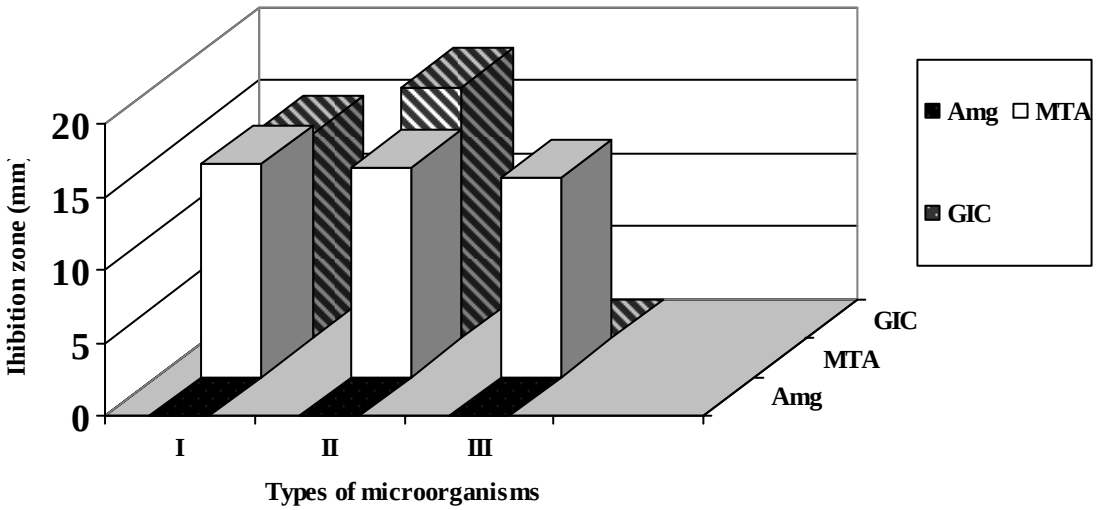
Antimicrobial Assay

The antimicrobial effect was studied using disk diffusion method [11]. Three microorganisms were used in this study, *S. aureus* as gram positive, *E. coli*, as gram negative and *C. albicans* as fungi. These microorganisms were grown in 4 ml of brain heart infusion broth to enhance their growth at 37 C^{o} for 18 hr [12]. Then three replicates plates of blood agar for *S. aureus*, Mac-Conkey agar for *E. coli* and Sabouraud agar for *C.albicans* were inoculated each with 0.1 ml of selected microorganism and spread over the plate [13]. Then discs of selected root end filling materials were applied to the surface of the agars and incubated at 37 C^{o} for 24 hr (for bacteria) and 48 hr (for fungi) and the zone of inhibition was examined.

RESULTS

The antimicrobial activity of the root end filling materials against different microorganisms is shown in Figure 1. Amalgam did not demonstrate any antimicrobial activity, whereas GIC and MTA showed clear antimicrobial activities against bacteria. The antifungal effect was clear in MTA compared to amalgam and GIC.

Statistical analysis using Duncan's Multiple Range Analysis is shown in Table 1. The antibacterial activity of MTA and GIC is highly significant compared to Amalgam (p<0.01), whereas the antifungal activity of MTA is highly significant compared to Amalgam and GIC (p<0.01).



Amg: Amalgam; GIC: Glass Ionomer Cement; MTA: Mineral Trioxide Aggregate; *I: E.coli; II: S.aureus; III: C. albicans.*

Figure (1): Histogram of Mean zone of inhibitions of different root end filling materials against different microorganisms.

Table (1): Duncan's Multiple Range Analysis of Mean zone of inhibition.

Sealers	Microorganisms					
	E. coli		***S. aureus***		***C.albicans***	
Amalgam	0	A	0	A	0	A
GIC	14	B	17.3	B	0	A
MTA	14.6	B	14.3	B	13.6	B

Different letters means significant $p< 0.01$.

DISCUSSION

A variety of root end filling materials have been used for a long time. The development of material that meets an ideal root end filling material is a goal of most dental companies. MTA is a new generation that has been shown to possess biological and physical properties of an ideal root end filling materials. It has a superior sealing ability [7], less cytotoxic [8] and biocompatible in animal studies.[9]

The present work was conducted to evaluate the effect of MTA on a selected microorganisms compared to other root end filling materials. The study extends other studies which demonstrated different antimicrobial effects of MTA [8,15–18].

Based on the results of this study, it appears that Amalgam did not demonstrate any antimicrobial activity against tested microorganisms. This result is comparable with others [19]. Other studies demonstrated antibacterial effect of Amalgam [20–22]. This disagreement could be attributed to the available nutrients, level of oxygen, method of evaluation and different laboratory set up [19]. The method used to study antimicrobial activity was agar diffusion method. Different factors may affect the reading of the results including type of medium, microorganisms, amount of inoculum and reading point of zone of inhibition [18].

The antimicrobial activity of MTA in this work was clear against tested bacteria and fungi. Others demonstrated no activity of MTA against *S.aureus*, *E. coli* and *C. albicans*, [19, 23] although MTA was the same that used in the experiment. The possible explanation for such differences is the strain of microorganisms used and method of measuring antimicrobial activity.

CONCLUSIONS

MTA showed antimicrobial activity against tested microorganisms similar to GIC except for C.albicans, while Amalgam failed to show any effect.

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