MTA - It's New Way : An in Vitro Study

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Introduction

Endodontic surgery constitutes the last clinical resort for maintaining the tooth in oral cavity. Endodontic surgery is performed to resolve inflammatory processes that cannot be successfully treated by conventional techniques, which may be due to complex canal and/or apical anatomy and external inflammatory processes [(1)]. Surgical procedures may also be indicated for the resolution of procedural misadventures, to include root perforation that may occur either during canal instrumentation or post-space preparation[(1,2)].

Surgical treatment usually involves the placement of a material designed to seal the root canal contents from the periradicular tissues and repair root defects [[1]]. Although numerous materials have been recommended as root-end filling materials, none has so far been found to be totally ideal. Most endodontic failures are attributable to inadequate cleansing of the root canal and ingress of bacteria and other antigens into the periradicular tissues [(3,4)]. Therefore, in addition to sealing ability and biocompatibility, root-end filling materials should ideally have some antimicrobial activity.[(4)]

Mineral trioxide aggregate (MTA) is a biomaterial that has been investigated for endodontic applications since the early 1990s .This material has been investigated extensively by Torabinejad et al. [(5,6,7)]. It is now extensively used for different pulpal and endodontic therapy [(8)]. Studies have proved that MTA also possesses bactericidal effect on some of the facultative bacteria [(9)]. Antifungal effect of the material is also important aspect , as numerous studies have demonstrated the incidence of fungi within the root canals and have implicated its presence could be the possible cause of endodontic treatment failure [(10-11)].

Although studies on the additional antifungal properties of MTA have been published but none have mentioned the minimum levels of concentration of MTA required to be effective for its anti fungal efficacy.

The present study was thus taken up with the aim and objectives of in vitro evaluation of anti fungal efficacy of various concentrations of MTA at different time intervals.

Material & Methods

Candida Albicans (CA) was chosen as an indicator for antifungal activity because it is the most common cause of endodontic fungal infections. Candida (ATCC 10231) strain was chosen. Stock cultures of clinically isolated *C. albicans* were provided by the Microbiology laboratory, maintained in Sabouraud agar plate. A suspension was prepared by transferring three colonies from Sabouraud's agar plate using 4 mm diameter platinum loop to infusion broth in screw capped tubes and then incubated for one week at 37°c. Macrobroth dilution is the recommended standard microbiological technique to test the antifungal activity of CA against MTA. The testing was done in (sabouraud's dextrose broth) SDB at concentrations 160mg/ml, 80mg/ml, 40mg/ml, 20mg/ml, 10mg/ml, 5mg/ml, 2.5mg/ml and 1.25mg/ml for both freshly mixed and 24 hrs set MTA at 1 hr, 24hr, 3 days of incubation(fig1-4). At each time period, the presence of C. albicans colonies was assessed and recorded.

Results

Control : Negative control showed no fungal growth at all the periods of observation. Positive control showed fungal growth.

MTA freshly mixed 1 hr : Fungal growth seen at all i.e. 1.25mg, 2.5mg, 5mg, 10mg, 20mg, 40mg, 80mg, and concentrations of MTA

24 hr : No fungal growth was seen at 80mg/ml and 160mg/ml concentrations of MTA.

3rd day : No fungal growth was seen at 160mg/ml concentration of MTA.

MTA 24 hrs set: Observations were similar to the freshly mixed MTA.

Discussion

The method used in this study is the serial double dilution method. This method allows direct contact in the solution between fungal cells and the MTA material.C. albicans was chosen as a test organism in this study. It has been found in the infected root canal and in the periradicular tissue [(12-15)].It is more commonly isolated from persistent infections with apical periodontitis [(16-17)]. They may enter the pulp through dentinal tubules, deep caries lesion, and fracture, or as contaminants from the oral microflora during root-canal treatment [(18)].

In our study, the antifungal activity of freshly mixed and 24hs set MTA was similar. Both FM and 24hs MTA has no antifungal activity at 1hr of incubation. Torabinejad et al. [(6)] reported that MTA has long setting time of 3 hours, during this time, a chemical reaction of the mixed material is still taking place where the mixed elements might be not effective. After 24 hrs antifungal activity of MTA was seen at 80mg/ml and 160mg/ml and after 3 days antifungal activity was seen at 160mg/ml. This shows that C. albicans might be resisting the MTA materials for only short period of time. The antifungal effect of MTA against C. albicans was caused by its high pH or release of diffusible substances into the growth media [(6)].

This could explain the positive growth of the C. albicans in both fresh and 24-h set experiment during the 1-h observation.

A direct correlation was found between MTA concentration and its inhibition effect on C. albicans growth. Plates containing MTA in concentration of 50 mg/ml showed significantly better killing action against C. albicans in all of the time periods tested ($p < 0.001$). Plates containing MTA in concentration of 25 mg/ml showed antifungal activity only at 1 and 24-h time periods. Plates containing lower concentrations of MTA did not show any antifungal activity. It appears that under the conditions of this study, white-colored MTA in concentration of 50 mg/ml is effective in killing C. albicans for periods of up to 3 days. Lower MTA concentrations may not be effective.

Conclusion

As the reaction time of MTA to Candida Albicans increases the antifungal activity decreases but it has a good antifungal activity at 160mg/ml of concentration i.e. at higher concentrations.

References

1. Chong BS. Managing endodontic failure in practice. Chicago: Quintessence Publishing Co., Ltd.; 2004. p. 12347.
2. Lee YL, Lee BS, Lin FH, Lin AY, Lan WH, Lin CP. Effects of physiological environments on the hydration behavior of mineral trioxide aggregate. Biomaterials 2004; 25:78793.
3. Sen B, Piskin B, Demirci T. Observation of bacteria and fungi in infected root canals and dentinal tubules by SEM. Endod Dent Traumatol. 1995;11:6-9.
4. Nair PNR, SjoØgren U, Figdor D, Sundqvist G. Persistent periapical radiolucencies of root-filled human teeth, failed endodontic treatments, and periapical scars. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999;87:61727
5. Torabinejad M, Watson TF, Pitt Ford TR. Sealing ability of a mineral trioxide aggregate when used as a root end filling material. J Endod 1993;19:591-595.
6. Torabinejad M, Hong C, McDonald F, Pitt Ford T. Physical and chemical properties of a new root-end filling material. J Endodon 1995;21:34953.
7. Torabinejad M, Hong C, Pitt Ford T, Kettering J. Cytotoxicity of four root end filling materials. J Endodon 1995;21:48992.
8. Torabinejad M, Chivian N. Clinical applications of mineral trioxide aggregate.J Endodon 1999;25:197205.
9. Torabinejad M, Hong C, Pitt Ford T, Kettering J. Antibacterial effects of some root end filling materials. J Endodon 1995;21:4036.
10. Al-Nazhan S, Al- Judai A. Evaluation of antifungal activity of mineral trioxide aggregate.J Endod. 2003; 29:826-7
11. Al-Hezaimi K, Naghshbandi J, Oglesby S, Simon JH, Rotstein I. Comparison of antifungal activity of white-colored and gray-colored mineral trioxide aggregate (MTA) at similar concentrations against Candida albicans. J Endod. 2006; 32:365.
12. Najzar-Fleger D, Filipovi D, Prpif G, Kobler D. *Candida* in root canal in accordance with oral ecology. Int Endod J 1992; 25:40-42.
13. Nair PNR, Sjogren U, Krey G, Sundqvist G. Intraradicular bacteria and fungi in root-filled, asymptomatic human teeth with therapy-resistant periapical lesions. Along term light and electron microscopic follow-up study. J Endodon 1990; 16:5808.
14. Molven O, Olsen I, Kerekes K. Scanning electron microscopy of the bacteria in the apical part of root canals in permanent teeth with periapical lesions. Endod Dent Traumatol 1991; 7:2269.
15. Sen B, Piskin B, Demirci T. Observation of bacteria and fungi in infected root canals and dentinal tubules by SEM. Endod Dent Traumatol 1995;11:69.
16. Waltimo T, Siren E, Torkko H, Olsen I, Haapasalo M. Fungi in therapy resistant apical periodontitis. Int Endod J 1997; 30:96101.
17. Molander A, Reit C, Dahlen G, Kvist T. Microbiological status of root-filled teeth with apical periodontitis. Int Endod J 1998; 31:17.
18. Sen B, Safavi K, Spangberg L. Growth patterns of Candida albicans in relation to radicular dentin. Oral Surg 1997; 84:6873.

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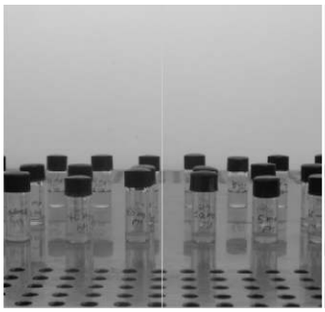

Fig. 1 : 160 mg of MTA was taken in 1 ml of standardized suspension of candida Saburods Dextrose Broth (SDB)

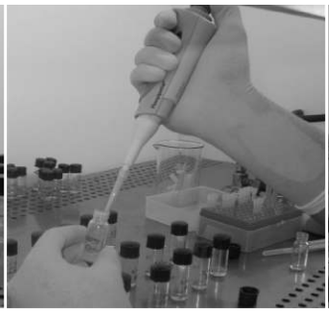

Fig. 2 : Serial double dilution done in remaining 7 tests tube containing 0.5 ml of standardized suspension of candida in SDB

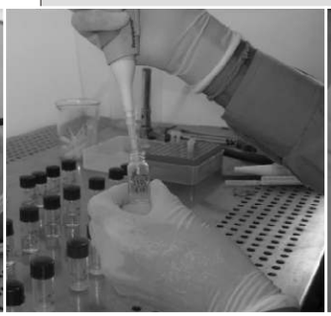

Fig. 3 : 1.1 ml of broth aliquotes taken from each tube & transferred to 2 ml of fresh SDB incubated for 1 week

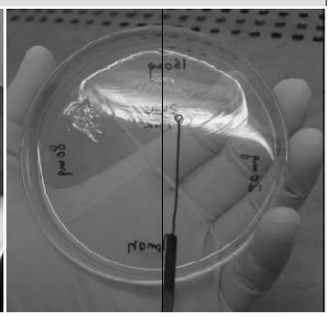

Fig. 4 : Culturing was done on Saburods dextrose agar plats

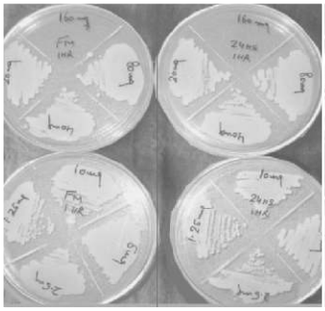

Fig. 5 : Action of MTA after 1 hour

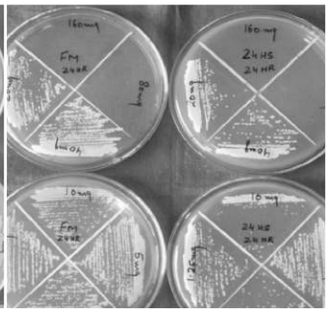

Fig. 6 : Action of MTA after 24 hours

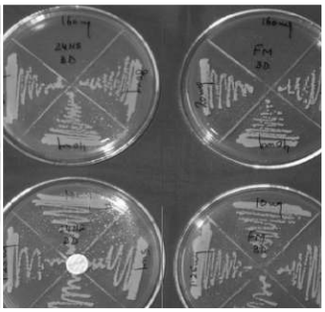

Fig. 7 : Action of MTA after 3 days