

Antimicrobial Efficacy of Biodentine, Mineral Trioxide Aggregate, and Theracal LC against *Enterococcus faecalis* and *Candida albicans*

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Abstract

Background: Microorganisms are the main culprits responsible for the development of pulpal and periapical diseases and can cause endodontic treatment failures. The present study was conducted for assessing antimicrobial efficacy of Biodentine, mineral trioxide aggregate (MTA), and Theracal LC against *Enterococcus faecalis* and *Candida albicans*. **Materials and Methods:** The present study was conducted for assessing antimicrobial efficacy of Biodentine, MTA, and Theracal LC against *E. faecalis* and *C. albicans*. The culture media used were brain heart infusion broth, MacConkey agar, Sabouraud dextrose broth, and Sabouraud dextrose. Assessment of the outcome was done in terms of minimal bacterial count (colony-forming units [CFUs]) for all three-calcium silicate material against *E. faecalis* and *C. albicans*. All the results were recorded and analyzed using SPSS software. **Results:** Mean CFUs counts of *Candida* among patients of MTA group, Biodentine group, and Theracal LC group were 73.5, 76.9, and 81.7, respectively. Mean CFUs counts of *E. faecalis* among patients of MTA group, Biodentine group, and Theracal LC group were 42.6, 55.9, and 62.1, respectively. Significant results were obtained while comparing CFU counts of *Candida* and *E. faecalis* among different study groups. **Conclusion:** Biodentine has shown to have good antifungal and antibacterial property as compared to MTA and Theracal LC.

Keywords: Biodentine, Mineral trioxide aggregate, Theracal LC.

INTRODUCTION

Microorganisms are the main culprits responsible for the development of pulpal and periapical diseases and can cause endodontic treatment failures. Provision of an effective seal to prevent recontamination as well as successful elimination or reduction of microorganisms in the root canal system can positively affect the outcome of endodontic treatment. The endodontic procedural steps such as chemomechanical instrumentation, root canal irrigation, application of intracanal medicaments, and sealing of the pulp chamber eliminate the microorganisms and enhance regeneration of periapical tissues. After chemomechanical preparation, however, some bacteria may remain in ramifications and dentinal tubules and lead to treatment failure. There is no definite strategy to completely eliminate residual bacteria. Moreover, many of the currently available biomaterials may not create an ideal seal. Thus, it is imperative to use endodontic cements with the ability to inhibit bacterial growth. Therefore, the antimicrobial properties of these biomaterials should be investigated. The

agar diffusion test is the most widely used technique to assess the antimicrobial properties of dental materials.^[1-3]

Enterococcus faecalis can withstand high pH of intracanal dressings like calcium hydroxide and is, hence, found in higher concentration in reinfection cases. Most endodontic failures are attributable to inadequate cleansing of the root canal and egress of bacteria and other antigens into the periradicular tissues. When inflammation or infection persists in the bony area around the end of the tooth after a root canal procedure, then it is necessary to perform an apicoectomy and a root-end filling is placed to prevent reinfection of the root. Hence, in addition to sealing ability and biocompatibility, root-end

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filling materials should ideally have some antimicrobial activity to prevent bacterial and fungal growth. One of the well-known root-end filling material is glass ionomer cement (GIC), which has unique properties such as adhesion to moist tooth structure, low shrinkage, and biological acceptance, but low antimicrobial efficacy.^[4-6] Hence, the present study was conducted for assessing antimicrobial efficacy of Biodentine, mineral trioxide aggregate (MTA), and Theracal LC against *E. faecalis* and *Candida albicans*.

MATERIALS AND METHODS

The present study was conducted for assessing antimicrobial efficacy of Biodentine, MTA, and Theracal LC against *E. faecalis* and *C. albicans*. The culture media used were brain heart infusion broth, MacConkey agar, Sabouraud dextrose broth, and Sabouraud dextrose. Addition of *E. faecalis* was done to tube number 1–5. Further, this was followed by incubation at 37°C. This was followed by subculturing on MacConkey agar. At the end of 24 h of incubation, the readings were noted. The antibacterial efficacy of these materials was evaluated in a similar manner, wherein 10 different strains of *E. faecalis* were analyzed. Assessment of the outcome was done in terms of minimal bacterial count (colony-forming units [CFUs]) for all three-calcium silicate material against *E. faecalis* and *C. albicans*. All the results were recorded and analyzed using SPSS software.

RESULTS

Mean CFUs counts of *Candida* among patients of MTA group, Biodentine group, and Theracal LC group were 73.5, 76.9, and 81.7, respectively (Table 1). Mean CFUs counts of *E. faecalis* among patients of MTA group, Biodentine group, and Theracal LC group were 42.6, 62.1, and 55.9, respectively. Significant results were obtained while comparing CFU counts of *Candida* and *E. faecalis* among different study groups (Table 2).

DISCUSSION

The purpose of the direct pulp capping is to cover the damaged pulp surface, ensure the vitality of the pulp together with its function and biological activity. Pulp damage may be caused by microorganisms, which survived in the dentin after the cavity preparation. To prevent this damage, direct pulp-capping materials placed directly over the pulp and localized under the permanent restoration must have good antimicrobial activity. At the same time, direct pulp-capping materials have to ensure the formation of hard tissue through the stimulation of pulp cells. MTA was the first marketed biomaterial, launched as a root-end filling material in the endodontic surgical procedures and as a repair material for the perforations. Nowadays, MTA is used confidently for conservative pulp treatment, treatment of the root resorptions, and apexification procedures. It is shown that MTA is a bioactive material, which stimulates the formation of the hard tissue and tolerated by the contacted tissues due to its

favorable biocompatibility.^[7-10] Hence, the present study was conducted for assessing antimicrobial efficacy of Biodentine, MTA, and Theracal LC against *E. faecalis* and *C. albicans*.

In the present study, mean CFUs counts of *Candida* among patients of MTA group, Biodentine group, and Theracal LC group were 73.5, 76.9, and 81.7, respectively. Kawle and Saraf compared the antimicrobial efficacy of MTA Angelus, Biodentine, and Theracal LC against *E. faecalis* and *C. albicans*. An *in vitro* study was conducted using three silicate-based cements; MTA Angelus, Biodentine, and Theracal LC. Their antimicrobial efficacy was evaluated using tube dilution method and their minimum inhibitory concentration (MIC) and bacterial counts (CFUs) were assessed and compared. The MIC was highest and CFUs were lowest with Biodentine in comparison with other two materials. There were statistically significant differences noted between Biodentine and MTA angelus. Their study results concluded that Biodentine was found to be more antibacterial as compared to MTA angelus and Theracal LC.^[10]

In the present study, mean CFUs counts of *E. faecalis* among patients of MTA group, Biodentine group, and Theracal LC group were 42.6, 55.9, and 62.1, respectively. Significant results were obtained while comparing CFU counts of *Candida* and *E. faecalis* among different study groups. Meghna *et al.* evaluated the antibacterial and antifungal properties of MTA compared to Biodentine and resin-modified GIC (RMGIC). Pellets of MTA, Biodentine, and RMGIC were prepared to test the influence of these cements on the growth of strains of *E. faecalis*, *Staphylococcus aureus*, and *C. albicans* using the agar diffusion method. Wells were formed by removing agar and the test materials were manipulated and placed in the wells. The growth inhibition diameter around each material against the tested organism was measured after 24 h incubation at 37°C. Inhibition zones for Biodentine against *E. faecalis* and *C. albicans* are significantly larger ($P < 0.01$) when compared to MTA and RMGIC. All materials showed antimicrobial activity against the tested strains except RMGIC against *C. albicans*.^[11]

Table 1: CFU counts of *Candida* among different study groups

Materials	MTA	Biodentine	Theracal LC	P-value
Mean	73.5	76.9	81.7	0.00 (significant)
SD	28.3	29.4	31.8	

MTA: Mineral trioxide aggregate, CFU: Colony-forming unit

Table 2: CFU counts of *E. faecalis* among different study groups

Materials	MTA	Biodentine	Theracal LC	P-value
Mean	42.6	55.9	62.1	0.00 (significant)
SD	13.8	26.8	19.4	

E. faecalis: *Enterococcus faecalis*, MTA: Mineral trioxide aggregate, CFU: Colony-forming unit

CONCLUSION

From the above results, the authors concluded that Biodentine has shown to have good antifungal and antibacterial property as compared to MTA and Theracal LC.

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