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Evaluation of antibacterial efficiency of different pulp capping materials method against *E. faecalis* and *S. mutans*: An *in vitro* study

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Abstract
Background: Pulp damage might be resulted from the leftover microorganisms in dentine after the cavity preparation. This damage makes it necessary to use pulp-capping agents with antimicrobial activity underneath permanent restorations. The present study was conducted to evaluate antimicrobial efficacy of different pulp capping material.
Materials & Methods: It comprised of 50 mg Biodentine and 50 mg MTA material. The antibacterial activity of Biodentine and MTA was evaluated by the agar diffusion method against *E. faecalis* and *S. mutans*.
Results: It was found that zone of inhibition against *S. mutans* was 3.2 mm and against *E. faecalis* was 3.4 mm with Biodentine material. It was 2.4 mm and 2.8 mm with MTA. The difference was non-significant ($P>0.05$).
Conclusion: Authors found both materials effective against *S. mutans* and against *E. faecalis*. However, Biodentine produced higher inhibition zone than MTA.

Keywords: Antibacterial effect, bacteria, Biodentine, calcium hydroxide, MTA

Introduction
Pulp damage might be resulted from the leftover microorganisms in dentine after the cavity preparation. This damage makes it necessary to use pulp-capping agents with antimicrobial activity underneath permanent restorations. The treatment can fail when the microorganisms in dentine, pulp, and periapical tissues persist and reproduce, especially in the long-term. A vital, functioning pulp is capable of initiating many defense mechanisms to shield the body from microorganism invasion. Its advantageous to preserve the vitality of an exposed pulp rather replacing it with a biocompatible material following pulp exposure. Direct pulp capping in cariously exposed pulp of young teeth has yielded, especially high success rate. Pulp damage might be resulted from the leftover microorganisms in dentine after the cavity preparation. This damage makes it necessary to use pulp□capping agents with antimicrobial activity underneath permanent restorations. The treatment can fail when the microorganisms in dentine, pulp, and periapical tissues persist and reproduce, especially in the long□term [1]
Haskell *et al*. [2] estimated a 12-year survival after asymptomatic carious exposures and pulp-capping. The presence of microorganisms played a fundamental role in the development and progression of pulpal and periapical disease and pulp-capping failures. A bactericidal material could make pulp-capping treatments long-term.
A pulp-capping material ought to: (1) Secure the pulp against thermal shocks; (2) disconnect opposed to galvanic action inherent to all amalgam restorations; (3) damage the penetration of mercury from the amalgam restorations into underlying dentin, thus preventing color changes of the tooth; (4) wield an anodyne effect on the pulp; (5) have some antibacterial activity so as to sterilize underlying dentin and residual caries in deep caries lesions; and (6) reduce marginal infiltration around restorations, thus restricting the diffusion of bacterial toxins and soluble molecules into underlying dentin and pulp. In order to protect the pulp from secondary infection caused by residual bacteria or microleakage, an ideal pulp-capping agent should have some antibacterial capability [3, 4]
Mineral trioxide aggregate" (MTA), known by its trade name, has been accepted quickly in dentistry since it was introduced in 1993 by Torabinejad who showed reparative dentin

formation by odontoblast-like cells. Bismuth oxide served as a radiopacifier. They affirmed that the main ions in MTA were calcium and phosphorus tricalcium silicate, tricalcium aluminate, tricalcium oxide, and silicate oxide were the main components consisting of fine hydrophilic particles. Calcium and phosphorus were declared as the main ions in MTA. Their antibacterial traits are ascribed to its release of CH on surface hydrolysis of the calcium silicate components [3].

A new bioactive material Biodentine was introduced by Septodont in 2009. The powder consists of tricalcium, dicalcium silicate, and calcium carbonate act as a nucleation site in the hydrating mass, enhancing the hydration and leading to faster setting and zirconium oxide is a radiopacifier [4]. On the biological level, its stimulation of odontoblast activity and reparative dentin, by induction of cell differentiation makes it perfectly biocompatible and capable of inducing the apposition of the reactionary dentin [4, 3].

The present study was conducted to evaluate antimicrobial efficacy of different pulp capping material.

Materials & Methods

The present study was conducted in the department of Endodontics. It comprised of 50 mg Biodentine and 50 mg MTA material. The antibacterial activity of Biodentine and MTA was evaluated by the agar diffusion method against *E. faecalis* and *S. mutans*. The bacterial stock culture *E. faecalis* was obtained and culture was grown overnight in brain heart infusion broth. *S. mutans* was inoculated onto blood agar media. 4mm wells were prepared on plates with a copper puncher, and under aseptic conditions according to the instructions of the manufacturing company. Immediately filled with freshly manipulated test materials. Then, all the Agar plates were incubated at 37 °C in an incubator and evaluated at 24 h. The diameter of microbial inhibition zones around each well was measured to the closest size in mm with a digital caliper. All statistical analyses were performed using SPSS for Windows, version 10.0 (SPSS, Chicago, USA). The findings were analyzed statistically by Kruskal–Wallis test and Kruskal–Wallis *post-hoc* analysis. $P<0{\cdot}05$ were considered significant.

Results

Table 1: Materials used in study

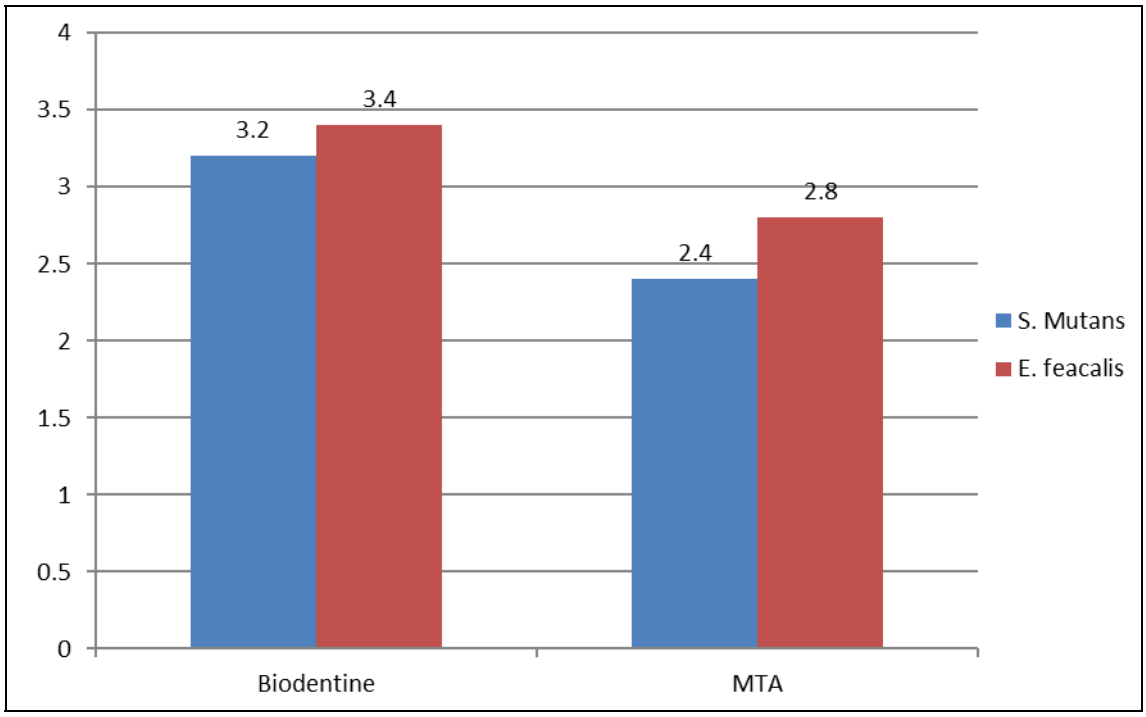
Materials	Biodentine	Mineral trioxide aggregate (MTA)
Quantity	50 mg	50 mg

Table 1 shows that we used 50 mg Biodentine and 50 mg MTA material.

Table 2: Anti- bacterial activity of materials

Materials	Zone of inhibition *S. mutans*	Zone of inhibition *E. faecalis*	P value
Biodentine	3.2	3.4	0.34
MTA	2.4	2.8	0.14

Table 2, graph 1 shows that zone of inhibition against *S. mutans* was 3.52 mm and against *E. faecalis* was 3.4 mm with Biodentine material. It was 2.4 mm and 2.8 mm with MTA. The difference was non- significant ($P>0.05$).



Graph 1: Anti- bacterial activity of materials

Discussion

Vital pulp therapies consist of indirect and direct pulp capping, partial (superficial) pulpotomy, and cervical pulpotomy. Calcium hydroxide (CH) and calcium silicate based materials, and therapeutic agents are utilized widely within endodontics and dental traumatology in a wide range of treatment modalities. In general, only mechanically exposed healthy pulps of permanent teeth have been covered with a wound dressing consisting of CH [5].

MTA has antimicrobial effect against some microorganisms. Ribeiro *et al*. [6] focused that these variations might be due to the methodology used, such as aerobic and anaerobic incubations. On an aerobic atmosphere, MTA could generate reactive oxygen species which, as reported above, have antimicrobial activity similar to that obtained with calcium hydroxide. However, under anaerobic conditions, a decrease

in the generation of radicals was observed. The present study was conducted to assess antibacterial efficacy of different pulp capping material [7].

In present study, we used 50 mg Biodentine and 50 mg MTA material. We found that zone of inhibition against *S. mutans* was 3.2 mm and against *E. faecalis* was 3.4 mm with Biodentine material. It was 2.4 mm and 2.8 mm with MTA. The difference was non- significant ($P > 0.05$).

Parirokh *et al*. [8] evaluated antibacterial effect of MTA and found that MTA showed an antibacterial effect on some of the facultative bacteria but no effect on strictly anaerobic bacteria. The previous authors have shown controversial results regarding the antimicrobial efficacy of pulp capping agents. For instance, while in some studies MTA was effective against *E. faecalis*, in the others its antimicrobial activity was limited. Estrela *et al*. concluded that MTA had no antimicrobial activity against *E. faecalis*, but the present study proved its antimicrobial efficacy against *E. faecalis*. Calcium hydroxide showed significantly better antibacterial effect than MTA according to Asgary *et al*. [9]

Zhang *et al*. [10], the antibacterial effect of MTA and BA at low concentrations was investigated with their suspensions, and they showed similar bacterial killing and wholly destroyed all bacteria in 1 hour. They found that gray MTA showed greater *E. faecalis* growth inhibition than white MTA. Previous studies have shown conflicting results regarding the antibacterial activity of pulp capping materials. For instance, while in some studies MTA was effective against microorganisms including *E. faecalis*, in the others its antimicrobial activity was limited. Concentrations and the type of preparation determine the antibacterial efficacy of MTA [11, 12].

The principal advantages of Biodentine over MTA are its greater viscosity and its shorter setting time (12 min). These properties make Biodentine both a substitution material for dentine and a suitable material for use in pulp-capping. Biodentine™ has an advantage over such materials, which arises from the fact that besides its biocompatibility, the strong suggestion of its mechanical and physical properties that in the future it will be used not only as a pulp capping agent but as a dentin substitute [13, 14]

Conclusion

Authors found both materials effective against *S. mutans* and against *E. faecalis*. However, Biodentine produced higher inhibition zone than MTA.

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