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Original Research

Comprehensive Estimation and Evaluation of Antimicrobial Efficiency of Different Pulp Capping Materials: An (In-Vitro) Original 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. A bactericidal material could make pulp-capping treatments long-term. The present study was conducted to assess antibacterial 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*. **Results:** Statistical analysis was done using statistical software 'Statistical Package for the Social Sciences (SPSS)'. The recorded data was subjected to suitable statistical tests to obtain p values and mean. $P \leq 0.05$ was considered as statistically significant. It was found that zone of inhibition against S. mutans was 3.5 mm and against E. faecalis was 3.2 mm with Biodentine material. It was 2.5 mm and 2.6 mm with MTA. The difference was non- significant (P> 0.05). **Conclusion:** Authors found both the tested materials effective against S. mutans and against E. faecalis. However, Biodentine produced higher inhibition zone than MTA.

Key words: Biodentine, MTA, S. Mutans

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INTRODUCTION

Historically, the first pulp capping procedure was performed in 1756, by the Phillip pfaff, who packed a small piece of gold over an exposed vital pulp to promote healing. The era of vital-pulp therapy has been greatly enhanced with the introduction of various pulp capping materials. 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] Calcium hydroxide ($Ca(OH)_2$) was introduced to the dental

profession in 1921 by Hermann and has been considered the "gold standard" of direct pulp capping materials for several decades, against which new materials should be, tested. Haskell et al estimated a 12-year survival after asymptomatic carious exposures and pulp-capping.[2] 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. Mineral trioxide aggregate (MTA) has been accepted quickly in dentistry since it was introduced in 1993. 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 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] The present study was conducted to assess antibacterial efficacy of different pulp capping material.

MATERIALS & METHODS

The present study was conducted in the Department of Conservative Dentistry and Endodontics of the institute. It comprised of 50 mg Biodentine (Septodont RandD, France) and 50 mg MTA material (Angelus Ind. De Prod. Odontologicos S/A Brasil). 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. Inoculation was completed by using sterile cotton swab brushed over the media. 4mm wells were prepared on plates with a copper puncher, and under aseptic conditions according to the instructions of the manufacturing company. The diameter of bacterial inhibition zones around each well was measured to the nearest size in mm with a digital caliper. 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. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

STATISTICAL ANALYSIS AND RESULTS

Resultant data were sent for statistical analysis using statistical software Statistical Package for the Social Sciences version 21 (IBM Inc., Armonk, New York, USA). The resulting data was subjected to suitable statistical tests to obtain p values, mean, standard deviation, chi- square test, standard error and 95% CI. Table I shows that we used 50 mg Biodentine and 50 mg MTA material. Table II, graph I shows that zone of inhibition against S. mutans was 3.5 mm and against E. faecalis was 3.2 mm with Biodentine material. It was 2.5 mm and 2.6 mm with MTA. The difference was non- significant (P> 0.05). Table III shows Comparison of difference between groups and basic statistical description with level of significance evaluation using Pearson chi-square test. The difference was non-significant (P> 0.05).

Table I: Materials used in study

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

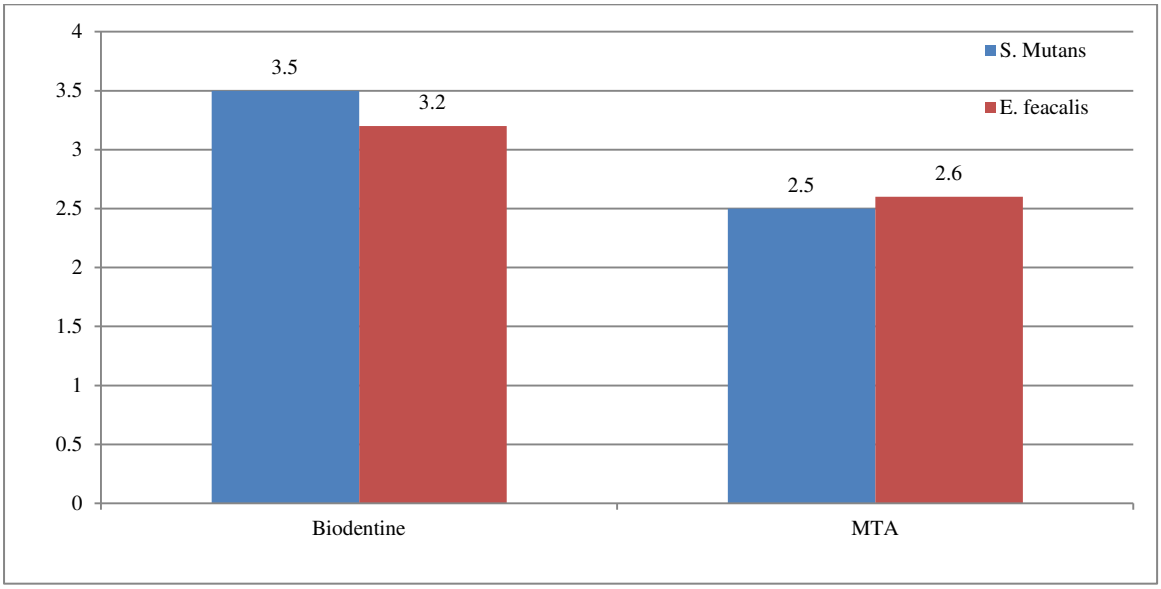
Table II: Anti- bacterial activity of materials

Groups	Materials	Zone of inhibition S. mutans	Zone of inhibition E. faecalis	P value
I	Biodentine	3.5	3.2	0.54
II	MTA	2.5	2.6	0.21

Table III: Comparison of difference between groups and basic statistical description with level of significance evaluation using Pearson chi-square test

Groups	Mean (grams)	Std. Deviation	Std. Error	95% CI	Pearson Chi-Square Value	df	Level of Significance (p value)
I	0.00048	0.565	0.342	2.34	2.567	1.0	0.61
II	0.00059	1.345	0.786	1.23	2.265	1.0	

Graph I: Anti- bacterial activity of materials



DISCUSSION

In the treatment of carious teeth, infected dentine should always be completely removed. However, infected dentine is sometimes left in the cavity for many reasons. Bacteria left in the cavity are one of the factors leading to secondary caries or pulpal injury after restoration. Antibacterial treatment of the cavity is thus recommended before restoration is completed. Moreover, if the removal of all the dentine affected by caries results in the exposure of tooth pulp in deep lesions, we dentists often try to leave some carious dentine to save the teeth and pulp as much as possible. Also, 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. 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. In present study, we used 50 mg Biodentine and 50 mg MTA material.

We found that zone of inhibition against S. mutans was 3.5 mm and against E. faecalis was 3.2 mm with Biodentine material. It was 2.5 mm and 2.6 mm with MTA. The difference was non- significant (P>0.05). The principal advantages of biodentine over MTA are its greater viscosity and its shorter setting time. A long setting time of MTA is inconvenient to both dentist and patient, because for direct pulp capping with MTA it requires two visits: application of MTA in the first visit and seating of the permanent restoration over the sufficiently hardened MTA in the second visit. Moreover, it may increase the risk of bacterial contamination. Finer particles in the powder with larger surface areas contribute to the short setting time of Biodentine that will make it possible for treatment to be performed in single visit.[7] Parirokh et al 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.[8] 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. Pulp therapy procedures involve removal of local irritants and placement

of a protective material directly or indirectly over the pulp.[11-13] These treatments must be followed by an overlying tight-sealed restoration to decrease bacterial leakage from the restoration-dentin interface. Pulp therapy is performed to treat reversible pulpal injury in order to promote root development, apical closure and accomplish complete root canal therapy.[14-18] There are controversies within the studies on Pulp therapy regarding judgment criteria and pulpal status at the time of treatment, optimal technique and treatment outcomes.[19-20]

CONCLUSION

Within the limitations of the study, authors found both materials effective against S. mutans and against E. faecalis. However, Biodentine produced higher inhibition zone than MTA. Our study results must be considered as suggestive for presuming prognosis for similar clinical conditions. However, we expect some other large scale studies to be performed that might further establish certain standard and concrete guidelines in these perspectives.

REFERENCES

1. Min KS, Park HJ, Lee SK, Park SH, Hong CU, Kim HW, *et al.* Effect of mineral trioxide aggregate on dentin bridge formation and expression of dentin sialoprotein and heme oxygenase‐1 in human dental pulp. J Endod 2008;34:666‐70.
2. Haskell EW, Stanley HR, Chellemi J, Stringfellow H. Direct pulp capping treatment: a long-term follow-up. J Am Dent Assoc. 1978;97:607-12.
3. Accorinte Mde L, Holland R, Reis A, Bortoluzzi MC, Murata SS, Dezan E Jr, *et al.* Evaluation of mineral trioxide aggregate and calcium hydroxide cement as pulp‐capping agents in human teeth. J Endod 2008;34:1‐6.
4. Nowicka A, Lipski M, Parafiniuk M, Sporniak‐Tutak K, Lichota D, Kosierkiewicz A, *et al.* Response of human dental pulp capped with biodentine and mineral trioxide aggregate. J Endod 2013;39:743‐7.
5. Camilleri J, Pitt Ford TR. Mineral trioxide aggregate: a review of the constituents and biological properties of the material. Int Endod J. 2006;39(10):747-54.
6. Ribeiro CS, Kuteken FA, Hirata Júnior R, Scelza MF. Comparative evaluation of antimicrobial action of MTA, calcium hydroxide and Portland cement. J Appl Oral Sci 2006;14:330-3.
7. Holt DM, Watts JD, Beeson TJ, Kirkpatrick TC, Rutledge RE. The anti-microbial effect against enterococcus faecalis and the compressive strength of two types of mineral trioxide aggregate mixed with sterile water or 2% chlorhexidine liquid. J Endod. 2007;33:844-7.
8. Parirokh M, Torabinejad M. Mineral trioxide aggregate: A comprehensive literature review – Part III: Clinical applications, drawbacks, and mechanism of action. J Endod 2010;36:400‐13.
9. Asgary S, Akbari Kamrani F, Taheri S. Evaluation of antimicrobial effect of MTA, calcium hydroxide, and CEM cement. Iran Endod J 2007;2:105‐9.
10. Zhang H, Pappen FG, Haapasalo M. Dentin enhances the antibacterial effect of mineral trioxide aggregate and bioaggregate. J Endod 2009;35:221‐4.
11. Wang X, Du Y, Yang J, Tang Y, Luo J. Preparation, characterization, and antimicrobial activity of quaternized chitosan/organic montmorillonite nanocomposites. J Biomed Mater Res A 2008;84:384-90.
12. Hoshino E. Predominant obligate anaerobes in human carious dentin. J Dent Res 1985;64:1195-8.
13. Duarte MA, Martins CS, de Oliveira Cardoso Demarchi AC, de Godoy LF, Kuga MC, Yamashita JC. Calcium and hydroxide release from different pulp-capping materials. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;104:e66-9.
14. Shen Q, Sun J, Wu J, Liu C, Chen F. An in vitro investigation of the mechanical-chemical and biological properties of calcium phosphate/ calcium silicate/bismutite cement for dental pulp capping. J Biomed Mater Res B Appl Biomater 2010;94:141-8.
15. Holland R, de Souza V, Nery MJ, Otoboni Filho JA, Bernabé PF, Dezan Júnior E. Reaction of rat connective tissue to implanted dentin tubes filled with mineral trioxide aggregate or calcium hydroxide. J Endod 1999;25:161-6.
16. Estrela C, Sydney GB, Bammann LL, Felippe Júnior O. Mechanism of action of calcium and hydroxyl ions of calcium hydroxide on tissue and bacteria. Braz Dent J 1995;6:85-90.
17. Takita T, Hayashi M, Takeichi O, Ogiso B, Suzuki N, Otsuka K, et al. Effect of mineral trioxide aggregate on proliferation of cultured human dental pulp cells. Int Endod J 2006;39:415-22.
18. Fava LR, Saunders WP. Calcium hydroxide pastes: Classification and clinical indications. Int Endod J 1999;32:257-82.
19. Siqueira JF Jr, Lopes HP. Mechanisms of antimicrobial activity of calcium hydroxide: A critical review. Int Endod J 1999;32:361-9.
20. Gbureck U, Knappe O, Grover LM, Barralet JE. Antimicrobial potency of alkali ion substituted calcium phosphate cements. Biomaterials 2005;26:6880-6.