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Original Research Article

Antibacterial Property of Biodentine and Mineral Trioxide Aggregate Cement Against Streptococcus and Enterococcus

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Abstract

Background: Removal of endodontic infection is quite different from most other sites in the human body. ***Aim:*** To investigate the antibacterial property of biodentine and mineral trioxide aggregate cement against Streptococcus and Enterococcus. ***Methods****:* Antibacterial activity of Biodentine and mineral trioxide aggregate was evaluated by the agar diffusion method against E. faecalis and S. mutans among sixty patients. The experimental materials included 50 mg Biodentine and 50 mg mineral trioxide aggregate. The diameter of microbial inhibition zones around each well was measured to the closest size in mm with a digital caliper. ***Results:*** Biodentine produced 3.02±0.27 mm inhibition zone against Streptococcus mutans and Enterococcus faecalis within 24 hours. This difference between the S. mutans and E. faecalis was not statistically significant. Sililarly Mineral trioxide aggregate produced 2.01±0.22 mm inhibition zone against Streptococcus mutans and Enterococcus faecalis within 24 hours. ***Conclusion:*** Biodentine showed us encouraging results against Streptococcus and Enterococcus compared to mineral trioxide aggregate by creating higher inhibition zones.
Keywords: Biodentine, mineral trioxide aggregate, treatment, streptococcus.

INTRODUCTION

Removal of endodontic infection is quite different from most other sites in the human body. Host measures that are sufficient to eliminate infectious microorganisms in other sites do not suffice for complete elimination of endodontic infection mainly because of complex anatomy of the pulp space system [1]. Debridement of the pulp space system by instrumentation and irrigation in collaboration with prevention of re-infection is considered the most important factor in prevention and treatment of endodontic diseases [2].

Microorganisms are able to survive in periods of starvation and predominate even post thorough cleaning and shaping of the pulp space [3]. The most frequently isolated antimicrobial resistant species, by far in previously root filled teeth with apical periodontitis are Streptococcus mutans and Enterococcus faecalis [4].

Setting time is little long for mineral trioxide aggregate thus chances of staining of tooth structure, poor handling characteristics, low resistance to compression and high cost are some of its disadvantages [5]. Biodentine decreases this setting time to 9–12 min but cannot be used in the presence of moisture [6]. Therefore, the present study was to investigate the antibacterial property of biodentine and mineral trioxide aggregate cement against Streptococcus and Enterococcus.

METHODS

This cross-sectional study was planned by a dental hospital of Jammu region. Antibacterial activity of Biodentine and mineral trioxide aggregate was evaluated by the agar diffusion method against E. faecalis and S. mutans among sixty patients. The experimental materials included 50 mg Biodentine and 50 mg mineral trioxide aggregate. The manufacturer's instructions were followed for better compliance.

The bacterial stock culture E. faecalis was obtained and culture was grown overnight in brain heart infusion broth and inoculated in Mueller-Hinton agar plates. S. mutans was inoculated onto blood agar media.

Inoculation was performed by utilizing sterile cotton swab brushed over the media. Wells 4 mm in diameter and 4 mm deep 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.

Written and informed consent was obtained from study subjects. Permission of ethical committee was obtained from the Institutional Ethics Committee. All the questionnaires were manually checked and edited for completeness and consistency and were then coded for computer entry. After compilation of collected data, analysis was done using Statistical Package for Social Sciences (SPSS), version 21 (IBM, Chicago, USA). The results were expressed using appropriate statistical variables.

RESULTS

Biodentine produced 3.02±0.27 mm inhibition zone against Streptococcus mutans and Enterococcus faecalis within 24 hours. This difference between the S. mutans and E. faecalis was not statistically significant. Sililarly Mineral trioxide aggregate produced 2.01±0.22 mm inhibition zone against Streptococcus mutans and Enterococcus faecalis within 24 hours. This difference between the S. mutans and E. faecalis was also not statistically significant. The difference between Biodentine and Mineral trioxide aggregate was found to be statistically significant (Table-1).

Table-1: Antibacterial response of biodentine and mineral trioxide aggregate against streptococcus mutans and enterococcus faecalis among study subjects

Biocompatible materials	Zone of inhibition		Mean	SD	P-value	
	Streptococcus mutans	Enterococcus fecalis				
Biodentine	3.7	3.0	3.02	0.27	>0.05	<0.05
Mineral trioxide aggregate	2.2	2.4	2.01	0.22	>0.05	

Bar chart depicts the zone of inhibition produced by streptococcus and enterococcus in response to biocompatible materials (Figure-1).

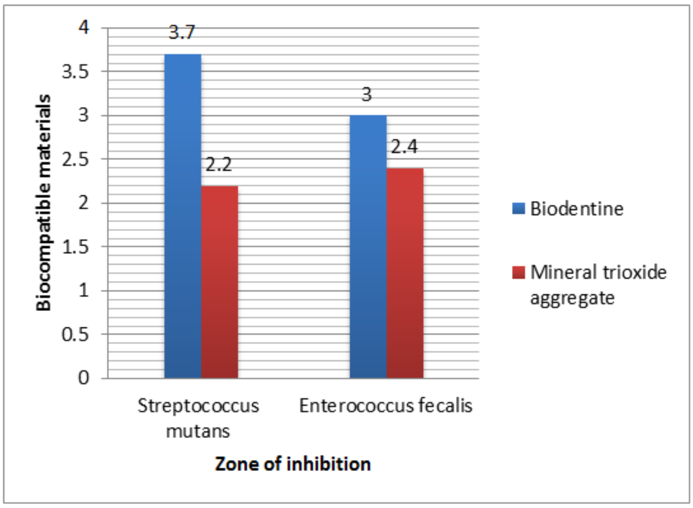

Fig-1: Bar chart showing zone of inhibition produced by streptococcus and enterococcus in response to biocompatible materials

DISCUSSION

Functioning pulp is capable of initiating many defense mechanisms to shield the body from microorganism invasion [8]. 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.

Mineral trioxide aggregate has excellent biocompatibility, which stimulates the formation of the hard tissue, which acts like a barrier and preserves the vitality of the damaged pulp, and thus eliminate the need of a root canal treatment. The composition includes CaSiO4, bismuth oxide, calcium carbonate, calcium sulfate, and calcium aluminate [9]. It contains a hydrophilic powder that reacts with water and produces a calcium hydroxide and CaSiO4 hydrated gel. However, as its setting time is long (4–6 h), chances of staining of tooth structure, poor handling characteristics, low resistance to compression and high cost are some of its disadvantages [10]. These disadvantages necessitate more ideal restorative material.

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 [11].

Agar diffusion test is the most commonly employed technique for evaluation of antibacterial activity that is why it was used in the present study. It is able to demonstrate the activity of freshly mixed materials, which makes its inclusion interesting for comparative reasons with previous studies [12]. Moreover, the culture plate diffusion method is not appropriate to determine the minimum inhibitory concentration (MIC), asitis impossible to quantify the amount of the antimicrobial agent diffused into the medium. Nevertheless, an approximate MIC can be calculated for some microorganisms and antibiotics by comparing the inhibition zones with stored algorithms.

Biodentine was introduced by Septodont (USA) in 2009 [13]. 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. The liquid contains calcium chloride in aqueous solution which accelerates the hydration reaction, with an admixture of polycarboxylate instead of water, which decreases setting time (9–12 min), also reduces the amount of water required for mixing by improving its handling properties. Biodentine has a limitation that it cannot be used in the presence of moisture, unlike MTA [14].

In this study we observed that Biodentine produced 3.02±0.27 mm inhibition zone against Streptococcus mutans and Enterococcus faecalis within 24 hours. This difference between the S. mutans and E. faecalis was not statistically significant. Sililarly Mineral trioxide aggregate produced 2.01±0.22 mm inhibition zone against Streptococcus mutans and Enterococcus faecalis within 24 hours. This difference between the S. mutans and E. faecalis was also not statistically significant. Parirokh and Torabinejad *et al*., [15] 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.

Zhang *et al*., [16] investigated the antimicrobial effect of gray MTA and white MTA, and they found gray MTA showed greater E. faecalis growth inhibition than white MTA. Estrela *et al*., [17] 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*., [18].

CONCLUSION

On the basis of findings of this investigation, it can be concluded that biodentine showed us encouraging results against Streptococcus and Enterococcus compared to mineral trioxide aggregate by creating higher inhibition zones. This material can be successfully used for direct pulp application. Further larger studies are needed to support our findings.

REFERENCES

1. Xie, Q., Bedran-Russo, A. K., & Wu, C. D. (2008). In vitro remineralization effects of grape seed extract on artificial root caries. *Journal of dentistry*, *36*(11), 900-906.
2. Pérard, M., Le Clerc, J., Meary, F., Pérez, F., Tricot-Doleux, S., & Pellen-Mussi, P. (2013). Spheroid model study comparing the biocompatibility of Biodentine and MTA. *Journal of Materials Science: Materials in Medicine*, *24*(6), 1527-1534.
3. Brown, J. C., Huang, G., Haley-Zitlin, V., & Jiang, X. (2009). Antibacterial effects of grape extracts on Helicobacter pylori. *Appl. Environ. Microbiol.*, *75*(3), 848-852.
4. Torabinejad, M., Hong, C. U., Ford, T. R. P., & Kariyawasam, S. P. (1995). Tissue reaction to implanted super-EBA and mineral trioxide aggregate in the mandible of guinea pigs: a preliminary report. *Journal of Endodontics*, *21*(11), 569-571.
5. Holland, R., De Souza, V., Nery, M. J., Otoboni Filho, J. A., Bernabé, P. F., & Dezan Jr, E. (1999). Reaction of rat connective tissue to implanted dentin tubes filled with mineral trioxide aggregate or calcium hydroxide. *Journal of Endodontics*, *25*(3), 161-166.
6. Chedea, V. S., Braicu, C., Chirilă, F., Ober, C., & Socaciu, C. (2011). Antibacterial action of an aqueous grape seed polyphenolic extract. *African Journal of Biotechnology*, *10*(33), 6276-6280.
7. Dammaschke, T. (2012). A new bioactive cement for direct pulp capping. *Int Dent-Aust ed*, *7*, 52-58.
8. Tran, X. V., Gorin, C., Willig, C., Baroukh, B., Pellat, B., Decup, F., ... & Boukpessi, T. (2012). Effect of a calcium-silicate-based restorative cement on pulp repair. *Journal of dental research*, *91*(12), 1166-1171.
9. Prestegaard, H., Portenier, I., Ørstavik, D., Kayaoglu, G., Haapasalo, M., & Endal, U. (2014). Antibacterial activity of various root canal sealers

and root-end filling materials in dentin blocks infected ex vivo with Enterococcus faecalis. *Acta Odontologica Scandinavica*, *72*(8), 970-976.
10. Carranza, F. A., Newman, M. G., Takei, H. H., & Klokkevold, P. R. (2006). Carranza's clinical periodontology. 10th ed. St. Louis, Mo.: Saunders Elsevier; Chap 6: 42.
11. Chang, S. W., Baek, S. H., Yang, H. C., Seo, D. G., Hong, S. T., Han, S. H., ... & Bae, K. S. (2011). Heavy metal analysis of ortho MTA and ProRoot MTA. *Journal of endodontics*, *37*(12), 1673-1676.
12. Torabinejad, M., Hong, C. U., Ford, T. P., & Kettering, J. D. (1995). Antibacterial effects of some root end filling materials. *Journal of endodontics*, *21*(8), 403-406.
13. Luczaj-Cepowicz, E., Pawińska, M., Marczuk-Kolada, G., Leszczyńska, K., & Waszkiel, D. (2008). Antibacterial activity of two Mineral Trioxide Aggregate materials in vitro evaluation. In *Annales Academiae Medicae Stetinensis*, 54(1):147-50.
14. Duarte, M. A. H., de Oliveira Demarchi, A. C. C., Yamashita, J. C., Kuga, M. C., & de Campos Fraga, S. (2003). pH and calcium ion release of 2 root-end filling materials. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*, *95*(3), 345-347.
15. Parirokh, M., & Torabinejad, M. (2010). Mineral trioxide aggregate: a comprehensive literature review—part III: clinical applications, drawbacks, and mechanism of action. *Journal of endodontics*, *36*(3), 400-413.
16. Zhang, H., Pappen, F. G., & Haapasalo, M. (2009). Dentin enhances the antibacterial effect of mineral trioxide aggregate and bioaggregate. *Journal of Endodontics*, *35*(2), 221-224.
17. Estrela, C., Bammann, L. L., Estrela, C. R. D. A., Silva, R. S. D., & Pecora, J. D. (2000). Antimicrobial and chemical study of MTA, Portland cement, calcium hydroxide paste, Sealapex and Dycal. *Brazil Dental Journal*, 11:3-9.
18. Asgary, S., Kamrani, F. A., & Taheri, S. (2007). Evaluation of antimicrobial effect of MTA, calcium hydroxide, and CEM cement. *Iranian endodontic journal*, *2*(3), 105-109.