INTERNATIONAL JOURNAL OF CURRENT MEDICAL AND PHARMACEUTICAL RESEARCH
ISSN: 2395-6429, Impact Factor: 4.656
Available Online at www.journalcmpr.com
Volume 5; Issue 02(A); February 2019; Page No. 4071-4074
DOI: http://dx.doi.org/10.24327/23956429.ijcmpr201902624

Review Article

COMPARATIVE EVALUATION OF PUSH-OUT BOND STRENGTH OF MTA HP, WHITE MTA AND BIODENTINE - AN IN VITRO STUDY

Anamika Sinha, Ashish Jain, Tripti Jagtap, Nupur Nidhi, Amit Patil, and Pramanika Kapoor

Shah Aracde Sector-6 Kharghar Navi Mumbai Maharashtra

ARTICLE INFO

Article History:
Received 06th November, 2018
Received in revised form 14th December, 2018
Accepted 23rd January, 2019
Published online 28th February, 2019

Key words:

Perforation repair, MTA HP, White MTA , Biodentine

ABSTRACT

Various materials have been used in managing perforations. MTA HP (Angelus, Londrina, Brazil), a more recent silicate-based cement material, was developed based on the biological and physical properties of calcium-silicate cements, claiming improved performance compared with traditional MTA. Although several studies have assessed the bond strength of MTA HP to dentin, none of them have evaluated the effect of blood contamination on the dislocation resistance of the new material. Therefore, the present study was designed to investigate the resistance to dislodgment provided by MTA HP. Biodentine (Septodont, St. Maur-des-Fossés, France) and White MTA (Angelus, Londrina, Brazil) were used as reference materials for the comparison.

INTRODUCTION

A perforation is a communication that arises between the periodontium and the root canal space. Perforations can be pathological, resulting from caries or resorptive defects, but most commonly occur iatrogenically (during or after root canal treatment). It has been identified as the second greatest cause of endodontic failure that accounts for 9.6% of all unsuccessful cases (Pitt Ford, *et al*., 1995).[1]An infectious process once started at the perforation site either from the root canal or from periodontal tissues impairs the healing and initiates an inflammatory process that exposes the supporting tissues to infection, pain and suppurations. In chronic conditions may lead to abscess and fistulae including bone resorptive processes, thus making prognosis for treatment questionable leading to extraction of the affected tooth ,however if diagnosed early and with appropriate management of the perforation will lead to long term survival of the tooth.[2,3]Various materials have been used in managing perforations, including zinc oxide–eugenol, amalgam, calcium hydroxide, composite resin, glass ionomer and resin modified glass ionomer. The ideal material for treating radicular perforations should be nontoxic, non-absorbable, radiopaque, and bacteriostatic or bactericidal; it should also provide a seal against micro leakage from the perforation.[1,4]

Mineral trioxide aggregate (MTA) has been considered as an ideal material for perforation repair, apexification retrograde filling, pulp capping etc. However, the drawbacks of the MTA such as difficult handling, slow setting-3 to 4 hours, with the possibility of solubilized by being in contact with oral fluids as this process occurs and shorter working time, has been bothersome to the clinician.[5,6,7]Biodentine was introduced as an alternative to MTA. It has shorter setting time approximately 12 minutes and it is easy to handle and has high alkaline pH which makes it a biocompatible material. However,its inferior radio-opacity makes it difficult for the clinician to distinguish it from the dentine.[7,8,9]MTA HP (Angelus, Londrina, Brazil), a more recent silicate-based cement material, was developed based on the biological and physical properties of calcium-silicate cements, claiming improved performance compared with traditional MTA. MTA HP powder is composed mainly of tricalcium silicate, dicalcium silicate, tricalcium aluminate, calcium oxide, calcium carbonate (filler material) and calcium tungstate (radiopacifier), whereas the liquid supplied for mixing with the cement powder consists of water and a plasticizing agent. According to the manufacturer, this new material has high-plasticity and improved physical properties, as compared with White MTA.[10]

**Corresponding author:* Anamika Sinha
Shah Aracde Sector-6 Kharghar Navi Mumbai Maharashtra

Perforations that occur during root canal treatments should be immediately sealed using a biocompatible material resistant to dislodging forces applied during restorative procedures and functional activities. Therefore, it is important to use a push-out assay to evaluate the dentin bond strength of reparative materials. Although several studies have assessed the bond strength of MTA HP to dentin, none of them have evaluated the effect of blood contamination on the dislocation resistance of the new material. Therefore, the present study was designed to investigate the resistance to dislodgment provided by MTA HP. Biodentine (Septodont, St. Maur-des-Fossés, France) and White MTA (Angelus, Londrina, Brazil) were used as reference materials for the comparison.

MATERIALS

- 24 extracted mandibular molars
- MTA HP(Angelus, Brazil)
- Biodentine (Septodont, Saint-Maur-des-Fosses, France)
- White MTA (Angelus, Brazil)
- Low speed saw with diamond disc, universal testing machine (Praj labs, Pune).
- Normal saline (Amanta, Gujarat)
- No. 4 round bur (Mani, India)
- Collagen matrix- Coloplug (dentalkart.com)
- 5% Sodium hypochlorite (Prime dental, Bhiwandi)
- 27 gauge needle (Hindustan syringes, Faridabad)
- Blood from blood bank

Study Groups

GROUPS	MATERIAL	NO. OF SAMPLE
GROUP I	BIODENTINE	8
GROUP II	MTA HP	8
GROUP III	WHITE MTA	8
TOTAL SAMPLES		24

METHODOLGY

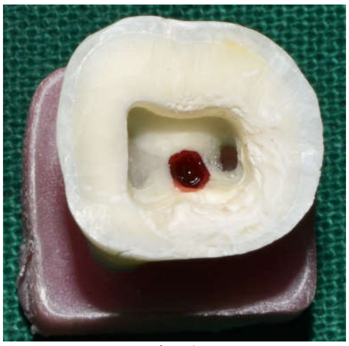
This study used 24 human extracted mandibular first molars with mature apices, and no signs of any carious lesions, shape or size anomalies, fused roots, or previous root canal.The teeth were cleaned by removing the hard deposits using curettes, and the soft tissues, by soaking in 5.25% sodium hypochlorite for 10 minutes and were stored in normal saline till use.A standard endodontic access cavity was prepared in each tooth. The teeth weredecoronated 5 mm above the pulpal floor using a water-cooled diamond disk and were mounted on acrylic resin to stabilize the roots.Perforations were created using no.4 round bur, perpendicular to the furcal floor and parallel to the tooth axis. A periodontal probe was used to measure penetration depth (2 mm).All the samples were rinsed with distilled water to remove debris produced during the procedure.An internal matrix of collagen was placed and compacted beyond the perforation using hand pluggers. To simulate contamination, a 27-gauge syringe was used to inject the perforation cavities with blood, provided by the blood bank and excess blood was removed with paper points (size 40), without touching the walls of the perforated dentin.

All the 24 teeth were then divided into three groups, each with 8 samples and based on the three repair materials. The subgroups were- Biodentine, MTA HP and White MTA.Biodentinewas mixed for 30 s using an amalgam mixer.MTA HP and White MTA were mixed according to manufacturer's recommendations and were packed in the perforations.Cottonpellets, wet with normal saline, were placed over the reparative material in each tooth. All samples were kept in an incubator at 37°C and 95% relative humidity for 14 days, after which they were subjected to a push-out test.
PICTURES

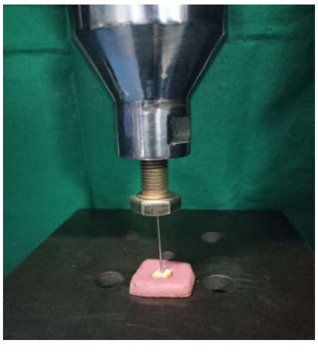

Pic- 1


Pic- 2


Pic-3


Pic- 4


Pic- 5


Pic- 6

Push-Out Test

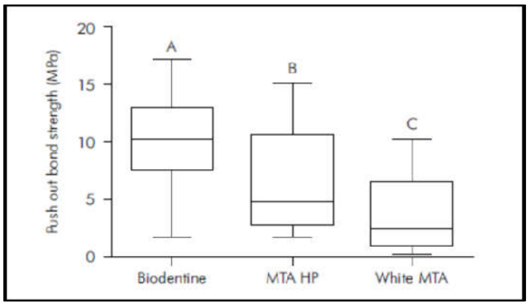
The push-out test was conducted using a universal test machine (universal testing machine, Praj labs, Pune). The material placed in the perforation cavity was subjected to a load at a crosshead speed of 1 mm/min in the apical direction and parallel to the long axis of the tooth, using a cylindrical plunger with 1.0 mm diameter, until dislodgement occurred. The maximum load applied to dislodge the reparative material was recorded in Newtons.The push-out bond strength was calculated in MPa using this formula:(Force needed to dislodge the material) / (π × diameter of perforation site × height of perforation)

Statistical Analysis

The main outcome variable in the present study was the push-out bond strength (MPa). A Kruskal-Wallis test was applied to assess the effect of each endodontic cement on the push-out bond strength. Mann-Whitney with Bonferroni correction was used to isolate the differences. The alpha-type error was set at 0.05. The analysis was done using PC based program MedCalc Statistical Software version 14.8.1 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org;2014).

RESULTS

All the specimens had measurable push-out values, and no premature failure occurred. There were significant differences among the materials ($p < 0.05$). Biodentine specimens had the highest push-out bond strength values ($p < 0.05$). MTA HP had significantly higher bond strength than White MTA ($p < 0.05$). Box plots illustratingthe variance of the push-out bond strength data in each experimental group.



DISCUSSION

The material used to seal the external surface of the teeth should be able to prevent leakage and remain in place under dislodging forces, such as functional pressures or the application of other restorative materials.[11] To the best of our knowledge, this study is the first to evaluate the push-out bond strength of MTA HP, a modified tri-calcium silicate-based material, in comparison with Biodentine and White MTA in presence of simulated blood contamination. The present results pointed out a significantly different performance among the tested materials. Biodentine produced higher bond strength values to root dentin than both MTA HP and White MTA ($p < 0.05$).

Biodentine outperformance cannot be regarded as a novelty, since it has been well documented in endodontic literature. [12,13,14]Biodentine biomineralization ability can most likely be attributed to the formation of tags, and may be the cause of its superior dislodgement resistance herein demonstrated. Han and Okijishowed that calcium and silicon ion uptake into dentin, leading to the formation of tag-like structures in Biodentine, was higher than in MTA, and may have a role in the overall adaptation to root dentin.[15] Moreover, the different particle sizes of MTA and Biodentine may affect their penetration into the dentinal tubules, with consequences to displacement resistance. Atmeh *et al*. demonstrated that Ca-Si cements facilitate the permeation of Ca and OH ions into the dentine, due to their caustic effect.[16]It can be assumed that the improved ability to release remineralizing Ca and OH ions by Biodentine is responsible for the improved formation of apatite at the interface, and for micromechanical anchorage.[17,18,19]MTA HP showed improved push-out bond strength values compared with those of White MTA ($p < 0.05$). The substitution of bismuth oxide for calcium tungstate as a radiopacifier agent in the MTA HP could explain the better results of this cement in comparison with White MTA. Calcium tungstate contributes to higher calcium release, promoting higher biomineralization. [10,20]Moreover, the high-plasticity of MTA HP may positively affect the marginal adaptation of the cement to the root walls, and this can be associated with higher bond strength.

The moistening of calcium silicate cements during setting is particularly important, since these cements have greater comprehensive strength when kept in a moist environment.[21] In addition, the retention characteristic and push-out strength of calcium silicate cements increases over time if kept under moist conditions.[22] In the present study, all the samples were kept in a 95% relative humidity using wet cotton pellets until the push-out test was performed. Considering the clinical conditions, contamination of the site with blood was imitated. The previous literature has evaluated the effect of blood contamination on the push-out bond strength values of endodontic materials.[23,24,25] The results of these studies are conflicting, showing that blood could improve, decrease or make no difference in the push-out values. However, in the present study, blood had no effect on the dissociation resistance of the materials.

Nevertheless, this study is in an exploratory level, and more advance probing with larger sample size is required to gain concrete resolve.

CONCLUSION

MTA HP showed better push-out bond strength than its predecessor, White MTA; however, Biodentine showed better results than both MTA formulations.

References

1. Fuss Z, Trope M. Root perforations: classification and treatment choices based on prognostic factors. Endod Dent Traumatol 1996; 12(6):255–64.
2. Farzaneh M, Abitbol S, Friedman S. Treatment outcome in endodontics: the Toronto study. Phases I and II: Orthograde retreatment. Journal of Endodontics. 2004; 30: 627-633.
3. Gorni FG, Gagliani MM. The outcome of endodontic retreatment: a 2-yr follow-up. Journal of Endodontics. 2004; 30: 1-4
4. . Tsesis I, Fuss Z. Diagnosis and treatment of accidental root perforations. Endod Top 2006; 13:95–107.
5. Main C, Mirzayan N, Shabahang S, Torabinejad M. Repair of root perforations using mineral trioxide aggregate: A long-term study. Journal of Endodontics. 2004; 30: 80-83.

6. Narasimhan D, Hedge P, Hedge NM. Comparative evaluation of the efficacy of three different dental materials in sealing perforation an in vitro study. Indian Journal of Applied Research. 2015; 5: 135
7. Molina AC. Biodentine™ in corrective surgery: A solution to the root perforations
8. Priyalakshmi S, Ranjan M. Review of Biodentine - a bioactive dentin substitute. IOSR Journal of Dental and Medical Sciences. 2014; 13: 13-17
9. Han L, Okiji T. Uptake of calcium and silicon released from calcium silicate–based endodontic materials into root canal dentine. *International Endodontic Journal*. 2011; 44: 1081-1087.
10. Angelus® [homepage]. Londrina: Produtos Angelus; 2015[cited 2015 Sep 28] Available from: http://angelus.ind.br/MTA-REPAIR-HP-292.html
11. Pelliccioni GA, Vellani CP, Gatto MR, Gandolfi MG, Marchetti C, Prati C. Proroot mineral trioxide aggregate cement used as a retrograde filling without addition of water: an in vitro evaluation of its microleakage. J Endod.2007;33(9):1082-5. doi:10.1016/j.joen.2007.04.009
12. El-Ma'aita AM, Qualtrough AJ, Watts DC. The effect of smear layer on the push-out bond strength of root canal calcium silicate cements. Dent Mater. 2013;29(7):797-803. doi:10.1016/j.dental.2013.04.020
13. Guneser MB, Akbulut MB, Eldeniz AU. Effect of various endodontic irrigants on the push-out bond strength of biodentine and conventional root perforation repair materials. J Endod. 2013;39(3):380-doi:10.1016/j.joen.2012.11.033
14. Elnaghy AM. Influence of acidic environment on properties of biodentine and white mineral trioxide aggregate: a comparative study. J Endod. 2014;40(7):953-7. doi 10.1016/j.joen.2013.11.007
15. Han L, Okiji T. Uptake of calcium and silicon released from calcium silicate-based endodontic materials into root canal dentine. Int Endod J. 2011;44(12):1081-7. doi:10.1111/j.1365-2591.2011.01924.
16. Atmeh AR, Chong EZ, Richard G, Festy F, Watson TF. Dentin-cement interfacial interaction: calcium silicates and polyalkenoates. J Dent Res. 2012;91(5):454-9. doi:10.1177/0022034512443068
17. Gandolfi MG, Taddei P, Modena E, Siboni F, Prati C. Biointeractivity-related versuschemi/physisorption-related apatite precursor-forming ability of current root end filling materials. J Biomed Mater Res B ApplBiomater. 2013;101(7):1107-23. doi:10.1002/jbm.b.32920
18. Gandolfi MG, Parrilli AP, Fini M, Prati C, Dummer PM. 3D micro-CT analysis of the interface voids associated with Thermafil root fillings used with AH Plus or a flowable MTA sealer. IntEndod J. 2013;46(3):253-63doi:10.1111/j.1365-2591.2012.02124
19. Iacono F, Gandolfi MG, Huffman B, Sword J, Agee K, Siboni F *et al*. Push-out strength of modified Portland cements and resins. Am J Dent. 2010;23(1):43-6.
20. Huffman BP, Mai S, Pinna L, Weller RN, Primus CM, Gutmann JL *et al*. Dislocation resistance of ProRoot Endo Sealer, a calcium silicate-based root canals sealer, from radicular dentine. IntEndod J. 2009;42(1):34-46. doi:10.1111/j.1365-2591.2008.01490
21. Gancedo-Caravia L, Garcia-Barbero E. Influence of humidity and setting time on the push-out strength of mineral trioxide aggregate obturations. J Endod. 2006;32(9):894-6. doi:10.1016/j.joen.2006.03.004
22. Reyes-Carmona JF, Felippe MS, Felippe WT. Biomineralization ability and interaction of mineral trioxide aggregate and white portland cement with dentin in a phosphate-containing fluid. J Endod. 2009;35 (5):731-6. doi:10.1016/j.joen.2009.02.011
23. Aggarwal V, Singla M, Miglani S, Kohli S. Comparative evaluation of push-out bond strength of ProRoot MTA, Biodentine, and MTA Plus in furcation perforation repair. J Conserv Dent. 2013;16(5):462-5. doi:10.4103/0972-0707.117504
24. Rahimi S, Ghasemi N, Shahi S, Lotfi M, Froughreyhani M, Milani AS *et al*. Effect of blood contamination on the retention characteristics of two endodontic biomaterials in simulated furcation perforations. J Endod.2013;39 (5):697-700. doi:10.1016/j.joen.2013.01.002
25. Üstün Y, Topçuoğlu HS, Akpek F, Aslan T. The effect of blood contamination on dislocation resistance of different endodontic reparative materials. *J Oral Sci*. 2015;57(3):185-90. doi:10.2334/josnusd.57.185

How to cite this article:

Anamika Sinha et al (2019) ' Comparative Evaluation of Push-Out Bond Strength of Mta Hp, White Mta and Biodentine - an in Vitro Study', *International Journal of Current Medical And Pharmaceutical Research,* 05(02), pp 4071-4074.

****