MedCrave
Step into the World of Research

Journal of Dental Health, Oral Disorders & Therapy

Sealing Ability of Biomaterials as Apical Plug, A Literature Review

Abstract

Endodontic management of the teeth with immature apices and necrotic pulps has always been challenging. Therefore fabrication of an artificial hard tissue barrier with a biomaterial has indicated as an alternative to more traditional apexification procedure. Successful endodontic treatment needs to prevent leakage of intracanal irritants into the peri radicular tissues. On the other hand, achieving an ideal tight seal in teeth with open apices is hard if not impossible. To reach this goal placement of a biomaterial with good sealing properties is suggested in such cases. The aim of this study is to review on sealing ability of biomaterials as apical plug. The resources were PubMed, and Google Scholar, using different keyword combinations including 'immature tooth', 'open apex', 'sealing ability', 'micro leakage', 'endodontic' 'CEM cement', 'apical plug', 'calcium silicate', 'Endocem', 'portland cement', 'MTA' and 'bio dentine'. All biomaterials used in apexification may leak in different concentrations. Because of the importance of apical seal on long-term success in endodontically treated immature teeth these materials should be applied carefully. The need for more research in this field and introduce new biomaterials with improved sealing ability is evident.

Keywords: Sealing ability; Micro leakage; Apical plug; Biomaterial

Review Article

Volume 2 Issue 6 - 2015

Sohrab Tour Savadkouhi and Pooneh Mohebbi*

Endodontics Department, Islamic Azad University, Iran

***Corresponding author:** Pooneh Mohebbi, Endodontics Department, Islamic Azad University, Iran, Tel: 009882122598224; Email: pooneh.mohebbi@gmail.com

Received: June 17, 2015 | **Published:** August 21, 2015

Abbreviations: CH: Calcium Hydroxide; MTA: Mineral Trioxide Aggregate; CEM: Calcium-Enriched Mixture; NEC: New Endodontic Cement

Introduction

Endodontic management of the teeth with immature apices and necrotic pulps has always been challenging. Traditionally, Calcium hydroxide (CH) has been used for apexification and induction of an apical hard tissue matrix which the filling material being packed against [1,2]. The main disadvantage of this procedure is the need for multiple visits and extended treatment time; this long-term treatment procedure makes the tooth susceptible to fracture [3,4]. Therefore fabrication of an artificial hard tissue barrier with a biomaterial has indicated as an alternative to more traditional apexification procedure. Successful endodontic treatment needs to prevent leakage of intracanal irritants into the peri radicular tissues [5].

Microbial tight seal of biomaterials as apical plug is mandatory [6]. On the other hand, achieving an ideal tight seal in teeth with open apices is hard if not impossible. To reach this goal placement of a biomaterial with good sealing properties is suggested in such cases [7,8]. The main destination for root canal therapy of immature teeth is to seal the wide apical portion of the canal, and provide a barrier against which filling material can be compacted [9,10].

An important factor for successful endodontic treatment in open-apex teeth is the sealing ability of apical plug. The quality of apical sealing obtained by root-end filling materials has been assessed using different methodologies such as dye penetration [11,12], bacterial penetration [13], endotoxin [14], human saliva penetration [15] and fluid filtration technique [16].

A broad literature search from 2000 to 2015 was done. The resources were PubMed, and Google Scholar, using different keyword combinations including 'immature tooth', 'open apex', 'sealing abillity', 'micro leakage', 'endodontic', 'CEM cement', 'apical plug', 'calcium silicate', 'Endocem', 'portland cement', 'MTA' and 'bio dentine'.

Nowadays, the widely used material as apical barrier is Mineral trioxide aggregate (MTA). MTA is a modification form of Portland cement and has few drawbacks including long setting time, tooth discoloration potential, and difficult manipulation [9]. Several factors including biocompatibility, one visits application, hard tissue induction and good-sealing properties makes the MTA more popular [17,18].

Many researchers concluded that MTA and Portland cement had similar microbiological, chemical, physical and biological properties [19,20]. De-Deus G et al. [21] showed in an In Vitro study that fluid movement test for apical plugs using white MTA Angelus, MTA Bio, Pro-Root MTA and Portland cement had no significant difference [21].

Bidar M et al. [22] concluded in an In Vitro study that intracanal calcium hydroxide as inter appointment medicament had no adverse effect on sealing properties of a MTA plug [22]. However, Adel M et al. [23] showed intra canal calcium hydroxide therapy had adverse effects on sealing properties of MTA apical plug [23].

Stefopoulos S et al. [24] showed in an In Vitro study on sealing ability of white and grey Pro Root MTA as apical plugs that both formulas were comparable but pretreatment by calcium hydroxide, reduces white MTA sealing properties [24].

Butt N et al. [25] concluded in an In Vitro study that Bio dentine has superior sealing ability as apical plug compared to white MTA [25].

Mohammad Yazdizadeh et al. [26] showed in an In Vitro study that immediate obturation of the entire root canal after MTA apical plug leads to more leakage compared to 24 hours interval between apical plug placement and obturation by gutta-percha [26]. Therefore, MTA requires adequate time for setting in the presence of the moisture, and final obturation should be delayed until final MTA setting. In the other hand, Khalilak J et al. [4] showed in an In Vitro study that leakage of MTA apical plug using one- and two-step technique are comparable [4].

Mehrvarzfar P et al. [27] concluded in an In Vitro study on teeth with immature Apices that apical plug fabrication by Pro Root MTA Mixed with Normal Saline had least amount of micro leakage compared to MTA mixed with Calcium Chloride or KY Jelly [27].

Kim US et al. [28] showed ultrasonically placed ortho grade MTA apical plugs were effective at reducing and delaying bacterial leakage [28].

Another biomaterial used for apical plug is calcium-enriched mixture (CEM) cement, which consists of different calcium compounds [29] the sealing ability of CEM cement as retrograde filling material is satisfactory [30]. CEM cement has shown a similar, if not superior, sealing ability compared to MTA [31]. CEM cement has osteo-conductive properties comparable to MTA [32].

Bidar M et al. [33] concluded that premedication with intra canal calcium hydroxide had no adverse effect on sealing properties of CEM cement as apical plug [33].

Mirhadi H et al. [34] showed CEM cement sealing properties was comparable to MTA at both 5.5 and 7.4 pH levels. In addition, an acidic pH environment has adverse effect on sealing ability of MTA and CEM cement [34].

Tabrizizade M et al. [35] showed in an In Vitro study on Sealing Ability of MTA and CEM Cement as Apical plug with Different Obturation Techniques that there were no significant differences between micro leakages of the both. The impact of lateral compaction or thermo plasticized injectable gutta-percha or obturation by filling the entire canal with apical plug material on micro leakage was not significant, either [35].

Adel M et al. [7] concluded that reducing canal diameter or increasing apical plug thickness and the time interval between plug and obturation reduces the micro leakage amount. Furthermore, CEM cement plugs demonstrated superior sealing ability compared to MTA plugs [7].

Conclusion

All biomaterials used in apexification may leak in different concentrations. Because of the importance of apical seal on long-term success in endodontically treated immature teeth these materials should be applied carefully. The need for more research in this field and introduce new biomaterials with improved sealing ability is evident.

Acknowledgment

The authors deny any conflicts of interest related to this study.

References

1. Schumacher JW, Rutledge RE (1993) An alternative to apexification. J Endod 19(10): 529-531.
2. Torabinejad M, Chivian N (1999) Clinical applications of mineral trioxide aggregate. J Endod 25(3): 197-205.
3. Andreasen JO, Farik B, Munksgaard EC (2002) Long-term calcium hydroxide as a root canal dressing may increase risk of root fracture. Dent Traumatol 18(3): 134-137.
4. Khalilak Z, Vali T, Danesh F, Vatanpour M (2012) The Effect of One-Step or Two-Step MTA Plug and Tooth Apical Width on Coronal Leakage in Open Apex Teeth. Iran Endod J 7(1): 10-14.
5. Parirokh M, Torabinejad M (2010) Mineral trioxide aggregate: a comprehensive literature review--Part I: chemical, physical, and antibacterial properties. J Endod 36(1): 16-27.
6. Johnson BR (1999) Considerations in the selection of a root-end filling material. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 87(4): 398-404.
7. Adel M, Nima MM, Shivaie Kojoori S, Norooz Oliaie H, Naghavi N, et al. (2012) Comparison of endodontic biomaterials as apical barriers in simulated open apices. ISRN Dent 2012: 359873.
8. Orosco FA, Bramante CM, Garcia RB, Bernadineli N, Moraes IG (2008) Sealing ability of grar MTA AngelusTM, CPM TM and MBPc used as apical plugs. J Appl Oral Sci 16(1): 50-54.
9. Parirokh M, Torabinejad M (2010) Mineral trioxide aggregate: a comprehensive literature review--Part III: Clinical applications, drawbacks and mechanism of action. J Endod 36(3): 400-413.
10. Hong ST, Bae KS, Baek SH, Kum KY, Lee W (2008) Microleakage of accelerated mineral trioxide aggregate and Portland cement in an in vitro apexification model. J Endod 34(1): 56-58.
11. Bortoluzzi EA, Broon NJ, Bramante CM, Garcia RB, de Moraes IG, et al. (2006) Sealing ability of MTA and radiopaque Portland cement with or without calcium chloride for root-end filling. J Endod 32(9): 897-900.
12. Xavier CB, Weismann R, de Oliveira MG, Demarco FF, Pozza DH (2005) Root-end filling materials: apical microleakage and marginal adaptation. J Endod 31(7): 539-542.
13. Al-Kahtani A, Shostad S, Schifferle R, Bhambhani S (2005) In-vitro evaluation of microleakage of an orthograde apical plug of mineral trioxide aggregate in permanent teeth with simulated immature apices. J Endod 31(2): 117-119.
14. Tang HM, Torabinejad M, Kettering JD (2002) Leakage evaluation of root end filling materials using endotoxin. J Endod 28(1): 5-7.
15. Al-Hezaimi K, Naghshbandi J, Oglesby S, Simon JH, Rotstein I (2005) Human saliva penetration of root canals obturated with two types of mineral trioxide aggregate cements. J Endod 31(6): 453-456.
16. Martin RL, Monticelli F, Brackett WW, Loushine RJ, Rockman RA, et al. (2007) Sealing properties of mineral trioxide aggregate orthograde apical plugs and root fillings in an in vitro apexification model. J Endod 33(3): 272-275.
17. Torabinejad M, Parirokh M (2010) Mineral trioxide aggregate: a comprehensive literature review--part II: leakage and biocompatibility investigations. J Endod 36(2): 190-202.
18. Coneglian PZ, Orosco FA, Bramante CM, de Moraes IG, Garcia RB, et al. (2007) In vitro sealing ability of white and gray mineral trioxide

aggregate (MTA) and white Portland cement used as apical plugs. J Appl Oral Sci 15(3): 181-185.

19. Funteas UR, Wallace JA, Fochtman EW (2003) A comparative analysis of Mineral Trioxide Aggregate and Portland cement. Aust Endod J 29(1): 43-44.
20. Abdullah D, Ford TR, Papaioannou S, Nicholson J, McDonald F (2002) An evaluation of accelerated Portland cement as a restorative material. Biomaterials 23(19): 4001-4010.
21. De-Deus G, Audi C, Murad C, Fidel S, Fidel R (2008) Similar expression of through-and-through fluid movement along orthograde apical plugs of MTA Bio and white Portland cement. Int Endod J 41(12): 1047-1053.
22. Bidar M, Disfani R, Gharagozloo S, Khoynezhad S, Rouhani A (2010) Medication with calcium hydroxide improved marginal adaptation of mineral trioxide aggregate apical barrier. J Endod 36(10): 1679-1682.
23. Adel M, Majd NM, Samani Y (2014) Effect of prior calcium hydroxide intracanal placement on sealing ability of MTA plugs. Gen Dent 62(4): e34-e36.
24. Stefopoulos S, Tsatsas DV, Kerezoudis NP, Eliades G (2008) Comparative in vitro study of the sealing efficiency of white vs grey ProRoot mineral trioxide aggregate formulas as apical barriers. Dent Traumatol 24(2): 207-213.
25. Butt N, Talwar S, Chaudhry S, Nawal RR, Yadav S, et al. (2014) Comparison of physical and mechanical properties of mineral trioxide aggregate and Biodentine. Indian J Dent Res 25(6): 692-697.
26. Mohammad Yazdizadeh, Zeinab Bouzarjomehri, Navid Khalighinejad, Leyli Sadri (2013) Evaluation of Apical Microleakage in Open Apex Teeth Using MTA Apical Plug in Different Sessions. ISRN Dentistry 2013: 959813.
27. Mehrvarzfar P, Akhavan H, Ghasemi S, Khodaei F, Tour Savadkouhi S, et al. (2014) Mineral Trioxide Aggregate Mixed with Normal Saline, Calcium Chloride or KY Jelly as Apical Plug in Simulated Open Apices: An In vitro Microleakage Study. Iran Endod J 9(1): 45-49.
28. Kim US, Shin SJ, Chang SW, Yoo HM, Oh TS, et al. (2009) In vitro evaluation of bacterial leakage resistance of an ultrasonically placed mineral trioxide aggregate orthograde apical plug in teeth with wide open apexes: a preliminary study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 107(4): e52-e56.
29. Hasan Zarrabi M, Javidi M, Naderinasab M, Gharechahi M (2009) Comparative evaluation of antimicrobial activity of three cements: new endodontic cement (NEC), mineral trioxide aggregate (MTA) and Portland. J Oral Sci 51(3): 437-442.
30. Asgary S, Eghbal MJ, Parirokh M, Ghanavati F, Rahimi H (2008) A comparative study of histologic response to different pulp capping materials and a novel endodontic cement. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 106(4): 609-614.
31. Asgary S, Eghbal MJ, Parirokh M, Torabzadeh H (2006) Sealing ability of three commercial mineral trioxide aggregates and an experimental root-end filling material. Iran Endod J 1(3): 101-105.
32. Asgary S, Eghbal MJ, Parirokh M, Ghoddusi J (2009) Effect of two storage solutions on surface topography of two root-end fillings. Aust Endod J 35(3): 147-152.
33. Bidar M, Disfani R, Asgary S, Forghani M, Gharagozlo S, et al. (2012) Effect of calcium hydroxide premedication on the marginal adaptation of calcium-enriched mixture cement apical plug. Dent Res J (Isfahan) 9(6): 706-709.
34. Mirhadi H, Moazzami F, Safarzade S (2014) The Effect of Acidic pH on Microleakage of Mineral Trioxide Aggregate and Calcium-Enriched Mixture Apical Plugs. Iran Endod J 9(4): 257-260.
35. Tabrizizade M, Asadi Y, Sooratgar A, Moradi S, Sooratgar H, et al. (2014) Sealing ability of mineral trioxide aggregate and calcium-enriched mixture cement as apical barriers with different obturation techniques. Iran Endod J 9(4): 261-265.

Citation: Savadkouhi ST, Mohebbi P (2015) Sealing Ability of Biomaterials as Apical Plug, A Literature Review. J Dent Health Oral Disord Ther 2(6): 00068. DOI: 10.15406/jdhodt.2015.02.00068