Original Research

The Effect of Thickness on Sealing Ability of Calcium Enriched Cement as a Coronal Seal Barrier

Shiva Sadeghi[1], Ramin Tabari[2], Sepideh Hosseini[3]

[1]Associate professor, Dental Sciences Research center, Dept. of Endodontics, Faculty of Dentistry, Guilan University of Medical Sciences, Rasht, Iran
[2]Assistant professor, Department of Endodontics, Faculty of Dentistry, Guilan University of Medical Sciences, Rasht, Iran
[3]DMD, private practice

Received 27 July 2017 and Accepted 12 September 2017

Abstract

Introduction: Thickness of a coronal seal barrier is an important factor for preventing microleakage. The aim of this in vitro study was to compare the sealing ability of two different thicknesses of calcium Enriched Mixture (CEM) cement as a coronal seal barrier. **Methods:** A total of 40 canals of extracted maxillary central incisors were instrumented and obturated using lateral compaction technique. The teeth were randomly divided into two experimental (N=15) and two control groups (N=5). For experimental groups, the obturation material was removed up to the experimental depths (2 and 3 mm) and were sealed with CEM. Sealing ability was evaluated by dye penetration method using pelikan ink and a stereomicroscope at x10 magnification and 0.01 mm accuracy. Data was analyzed using T-test and P<0.05. **Results:** The mean linear dye microleakage for the two thicknesses of CEM cement groups (2mm and 3mm) were 0.930 and 0.67 mm respectively. There was no statistically significant difference between the two groups (p<0.088). **Conclusion:** under the condition of this in vitro study, coronal microleakage in 2mm thickness of CEM cement had no statistically significant difference with 3 mm thickness of the material.

Key words: sealing ability, coronal seal, CEM.

Sadeghi S, Tabari R, Hosseini S. The Effect of Thickness on Sealing Ability of Calcium Enriched Cement as a Coronal Seal Barrier. J Dent Mater Tech 2017; 6(4): 166-9.

Introduction

The importance of placement of a coronal seal barrier to prevent leakage prior to the placement of final restoration or during nonvital bleaching is well known (1-6). Various materials have been suggested and used for coronal seal barrier such as amalgam, cavit, composite resin, Glass -Ionomer cement, mineral trioxide aggregate (MTA) and Calcium enriched mixture (CEM). CEM has been recently introduced as a hydrophilic tooth colored cement. CEM cement powder mainly contains calcium oxide, calcium sulfite, phosphorus oxide and silica (7). CEM is alkaline cement that exhibits several advantages including tissue biocompatibility, hard tissue induction, effective sealing ability, ability to set in an aqueous environment, antibacterial effects and resistance to wash out (8-10).

A literature search showed that there are a limited number of studies regarding the sealing ability of CEM as an intra-orifice barrier (11-14). Ramezanali et al. compared the coronal microleakage of 3 mm thickness of CEM, MTA and Biodentin using India ink dye penetration. CEM had the lowest and MTA showed the highest dye penetration although these differences were not statistically significant (11). Moghadam et al. compared sealing properties of 3 mm thickness of CEM and Mineral Trioxide Aggregate (MTA) orifice barriers during intra-coronal bleaching. The results showed that CEM cement can be used as a cervical barrier with sealing properties comparable to that of MTA (12). Zarenejad et al. evaluated the Coronal microleakage of 3mm thickness of CEM, MTA and Glass ionomer as intra-orifice barriers during nonvital bleaching and reported no statistically significant difference (13).

Yavari et al. compared microleakage of 2 mm thickness of CEM with MTA, amalgam and resin composite as intra-orifice barriers in endodontically treated teeth and reported that CEM and MTA are more effective than amalgam and composite resin (14).
The thickness of intra-orifice barrier plays an important role in the prevention of coronal microleakage, however, a literature search failed to reveal any published study that directly compares different thicknesses of CEM cement as a coronal seal barrier. An investigation compared the sealing ability of 1, 2 and 3 mm thickness of CEM as a root-end filling material and showed that CEM cement has an adequate sealing ability in 3 mm thickness (15).
Placement of a 1-4 mm thickness of an intra-orifice barrier has been suggested for the prevention of coronal microleakage especially in endodontically treated teeth. One mm is very thin and has shown the greatest percentage of dye penetration (16) and 4mm is too thick especially for short roots treated endodontically, so the purpose of the present study was to compare the coronal microleakage of 2 and 3 mm thicknesses of CEM cement as intra-orifice barrier.

Materials and Methods

Forty recently extracted human permanent central incisor teeth with single canals and mature apexes were used. All samples were kept in 5.25% sodium hypochlorite for thirty minutes to be disinfected. All teeth were decoronated at cementoenamel junction so that the remaining roots were about 15 ± 1 mm. A #10 K-file (Mani, INC, Japan) was inserted and advanced into the canal until it was just seen penetrating the foramen. Working length was calculated by subtracting 1mm from this point. All root canals were instrumented with K-files using Step-back technique up to #35 file. Flaring was performed by Gates Glidden #1 through #3 (Mani, Beijing, Japan), followed by hand files #40-70 and then checked to be uniform using 4 endodontic hand pluggers (Hu-Friedy, Chicago, IL,USA) at the different depths of 7,9,11 and 13 mm from the apical foramen. Irrigation with 2ml of 2.5% Sodium hypochlorite solution was performed using a 22-gauge needle between each file.
The forty roots were randomly divided into two experimental groups of 15 teeth, according to the coronal plug thickness (2 and 3 mm) and two negative and positive control groups each including 5 teeth. All canals in experimental groups were filled with AH26 sealer (Dentsply Detrey, Konstanz, Switzerland) and gutta-percha points (Gapadent CO., Ltd. Germany) using lateral compaction method. The quality of obturation was tested radiographically for all samples. All preparations were completed by a single operator.
A flamed-heated hand plugger was used to remove gutta-percha to the experimental depths and the depths were verified with a periodontal probe. CEM (Bionique Dent, Tehran, Iran) was prepared according to the manufacturers' directions and placed into the orifices. Samples were maintained in 100% humidity and 37 ºC for 24 h to allow the barriers and the sealer to be set. Two layers of nail polish were placed on all experimental teeth from root apex to the level of cementoenamel junction, so that dye could penetrate only from coronal. Negative leakage control teeth were obturated and completely coated with nail polish, including the orifices. Positive controls were obturated without sealer and their orifices were not coated with nail polish.
After keeping all samples in Pelikan ink (Pelikan, Honover, Germany) for 72 h, the roots were washed with water and were left to dry for 24 h. Nail polish was then removed by Acetone. The roots were then sectioned buccolingually. The greatest penetration of dye from the coronal extent of the orifice was measured blindly by two examiners using a stereomicroscope (Olympus, Tokyo, Japan) and a digital caliper to accuracy of 0.01mm. The mean score was calculated. Finally, collected data was compared using T-test at a significace level of $P<0.05$.

Results

The negative leakage control demonstrated no dye penetration while the positive leakage control showed dye penetration along the root canals.
The mean linear dye leakage for all groups is shown in Table-1. The results of the Shapiro wilk test evaluating normality of data showed that the data had normal distribution. T-test analysis showed that there was not a significant difference between microleakage of 2mm and 3mm thicknesses of CEM cement ($P<0.088$).

Groups	Mean(SD)	t	P-value
2-mm thickness	0.930(0.382)		
3-mm thickness	0.697(0.339)	1.767	P<0.088

Table-1. Mean dye leakage (mm) in experimental groups

Discussion

Placement of an intra-orifice barrier is a method of decreasing coronal microleakage. In cases where there is not enough space or depth to put the barrier material, a minimum thickness of the material which can prevent microleakage is of great importance. , The aim of the present study was to evaluate the effect of thickness of CEM, a novel dental material, on sealing ability when used as a coronal seal barrier and to compare coronal sealing ability of two different thicknesses of CEM.

Linear dye penetration method and longitudinal sectioning of the roots were used to evaluate coronal microleakage because it is convenient, sensitive and easy to accomplish and does not require sophisticated materials or equipments (17). In this in-vitro study, all of the positive controls showed microleakage throughout the cavities, confirming that coronal barrier material was necessary to prevent microleakage; in contrast, all negative controls showed no microleakage, showing that nail polish prevented microleakage, with dye only penetrating the coronal portion of the teeth.

In this study, extracted central teeth with large and straight canals were selected and were instrumented up to # 35 file in all groups. The diameter of the orifices and root canal flaring was also checked to be equal, minimizing variables such as anatomical variation, canal size and diameter which can affect dye leakage. As it has been reported that longer roots have a potential for greater leakage (18), roots with 15 ± 1 mm long were used.

In order to eliminate operator variable, all preparations were completed by a single operator. Two examiners measured dye leakage levels in order to eliminate or reduce possible bias and evaluator error.

Under the condition of this in vitro study, our results showed that there was no statistically significant difference between leakages of different thicknesses of CEM. As all variables were standardized in this study, good sealing property of CEM is verified. It is demonstrated that 2 mm thickness of CEM can provide sealing properties comparable to a 3mm thick material. There is no published study regarding the standard thickness of CEM as a coronal seal barrier, thus, the finding of this in vitro study should be evaluated by future investigations. However, using 2% Rhodamine B solution, Rahimi et al (15) evaluated the effect of thickness on sealing ability of CEM cement as a root end filling material and reported no significant differences among sealing abilities of 1,2 and 3 mm CEM cement as a retrofilling material, which also confirmed the results of the present study.

Furthermore, the majority of the studies on the sealing ability of CEM as a coronal seal barrier have been performed for a short time at a depth of 3mm.To provide more accurate results that can be extended to clinical conditions, long term dye or bacterial leakage studies and similar animal and clinical studies are recommended.

Conclusion

Under the condition of this in vitro study, coronal microleakage of 2mm thickness of CEM cement had no statistically significant difference with 3 mm thickness of the material.

Acknowledgment

This investigation was based on a thesis submitted by the third author to the faculty of Dentistry of Medical Sciences (GUMS) in Iran, in partial fulfillment of the requirements for receiving a Doctoral degree.

References

1. Parekh B, Irani RS, Sathe S, Hegde V. (2014).Intraorifice sealing ability of different materials in endodontically treated teeth: An invitro study. J Conserv Dent.17 (3):234-7.
2. Malik G, Bogra P, Singh S, Samra RK. (2013). Comparative evaluation of intracanal sealing ability of mineral trioxide aggregate and glass ionomer cement.J Conserv Dent. 16(6):540-5.
3. Vosoughhosseini S, Lotfi M, Shahmoradi K3, Saghiri MA, Zand V, Masoumeh Mehdipour, Bahram Ranjkesh, Hadi Mokhtari, Amin Salemmilani, Sirvan Doosti. (2011). Microleakage comparison of glass-ionomer and white mineral trioxide aggregate used as a coronal barrier in nonvital bleaching. Med Oral Patol Oral Cir Bucal. 16(7): e1017-21.
4. Bailón-Sánchez ME, González-Castillo S, González-Rodríguez MP, Poyatos-Martínez R, Ferrer-Luque CM. (2011).Intraorifice sealing ability of different materials in endodontically treated teeth. Med Oral Patol Oral Cir Bucal. 16(1): e105-9.
5. Pisano DM, DiFlore PM, McClanahan SB, Lautenschlager EP, Duncan J. (1998).intraorifice sealing of gutta-percha obturated root canals to prevent coronal microleakage. J Endod. 24(10): 659-62.
6. Zimmerli B, Jeger F, Lussi A. Bleaching of nonvital teeth. (2010). A clinically relevant literature review. Schweiz Monatsschr Zahnmed. 120(4):306-20.
7. Asgary S, Shahabi S, Jafarzadeh T, Amini S, Kheirieh S. (2008). The properties of a new endodontic material. J Endod. 34(8):990-3.

8. Asgary S, Eghbal MJ, Parrirokh M. (2008). Sealing ability of a novel endodontic cement as a root-end filling material. J Bio Mater Res A. 87(3):706-9.
9. Eghbal MJ, Fazlyab M, Asgary S. (2014).Repair of an extensive furcation perforation with CEM cement: A case study. Iran Endod J. 9(1):79-82.
10. Ashraf H, Dajmar R, Moradi Majd N, Homayouni H. (2014).Effects of two bioactive materials on survival and osteoblastic differentiation of human mesenchymal stem cells. J Conserve Dent. 17(4): 349-53.
11. Ramezanali F, Aryanezhad S, Mohammadian F, Dibaji F, Kharazifard MJ.(2017). In Vitro Microleakage of Mineral Trioxide Aggregate, Calcium-Enriched Mixture Cement and Biodentine Intra-Orifice Barriers. Iran Endod J. 12(2): 211–215.
12. Moghadam N, Abdollahi AA, Aghabalayi Fakhim H, Borna Z. (2017). In Vitro Sealing Properties of Calcium-Enriched Mixture and Mineral Trioxide Aggregate Orifice Barriers during Intra-Coronal Bleaching. Iran Endod J. 12(2): 231–235.
13. Zarenejad N, Asgary S, Ramazani N, Haghshenas MR, Rafiei A, Ramazani M. (2015).Coronal microleakage of three different dental biomaterials as intra-orifice barrier during nonvital bleaching. Dent Res J (Isfahan). 12(6): 581–588.
14. Yavari H, Samiei M, Asgary S. (2012).Microleakage comparison of four dental materials as intra-orifice barriers in endodontivcally trated teeth. Iran Endod J. 7 (1): 25-30.
15. Rahimi S, Asgary S, Samiei M, et al. (2015). The effect of thickness on the sealing ability of CEM cement as a root end filling material. J Dent Res Clin Prospects. 9(1):6-10.
16. Olmez A, Tuna D, Ozdogan YT, Ulker AE.(2008).The effectiveness of different thickness of mineral trioxide aggregate on coronal leakage in endodontically treated deciduous teeth. J Dent Child (Chic). 75 (3):260-3.
17. Bodrumlu E, Tunga U. (2006).Apical leakage of Resilon obturation material. J Contemp Dent Pract.7 (4):45-52.
18. Porkaew P, Retief DH, Barfield RD, Lacefield WR, Soong SJ. (1990).Effects of calcium hydroxide paste as an intracanal medicament on apical leakage.J Endod.16 (8): 369-74.

Corresponding Author:
Shiva Sadeghi,
Associate professor,Dental Sciences Research center, Dept. of Endodontics,
Faculty of Dentistry, Guilan University of Medical Sciences, Rasht, Iran
Tel: +98 131 33486406
Fax: +98 131 33486423
E-mail: Sadeghi.dds@ gmail. Com