ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

*International Journal of Dental Science and Innovative Research (IJDSIR)*

*IJDSIR : Dental Publication Service*

*Available Online at: www.ijdsir.com*

*Volume – 6, Issue – 3, June - 2023, Page No. : 440 – 445*

# Comparative evaluation of perforation sealing ability of Mineral Trioxide Aggregate, Light Cured GIC and Zirconomer in the repair of furcal area: An invitro study

[1]Dr. Jain Deepti, MDS, Reader, Govt. Dental College, Raipur, Chhattisgarh

[2]Dr. Kunhappan Sanjeev, MDS, Professor, Govt. Dental College, Raipur, Chhattisgarh

[3]Dr. Saraf K K, MDS, Reader, Govt. Dental College, Raipur, Chhattisgarh

[4]Dr. Kota Krishna Chaitanya, Postgraduate Student, Govt. Dental College, Raipur, Chhattisgarh

[5]Dr. Aletivoshishma, Postgraduate Student, Govt. Dental College, Raipur, Chhattisgarh

[6]Dr. Motwani Yash, Postgraduate Student, Govt. Dental College, Raipur, Chhattisgarh

**Corresponding Author:** Dr. Sanjeev Kunhappan, MDS, Professor, Department of Conservative Dentistry and Endodontics, Govt. Dental College, Raipur, Chhattisgarh,

**Citation of this Article:** Dr. Jain Deepti, Dr. Kunhappan Sanjeev, Dr. Saraf K K, Dr. Kota Krishna Chaitanya, Dr. Aletivoshishma, Dr. Motwani Yash, "Comparative evaluation of perforation sealing ability of Mineral Trioxide Aggregate, Light Cured GIC and Zirconomer in the repair of furcal area: An invitro study", IJDSIR- June - 2023, Volume – 6, Issue - 3, P. No. 440 – 445.



**Type of Publication:** Original Research Article

**Conflicts of Interest:** Nil

## Abstract

**Aim:** Iatrogenic furcation performance needs an appropriate treatment for the affected tooth to be salvaged which requires complete sealing of the defect. The present study aims to assess the sealing ability of MTA, LC-GIC and Zirconomer in furcation perforation.

**Materials and Method:** Fifty periodontally compromised maxillary and mandibular first molars were extracted. The teeth were divided into five groups of 10 in each. Access cavity preparation was done and dentinal walls were smoothed out for 40 teeth, remaining 10 were left intact which served as negative control. A perforation was done in the centre of pulp chamber and filled with respective materials. The teeth were divided into following groups: Group I – MTA, Group II – LC GIC, Group III – Zirconomer, Group IV – Positive control, Group V – Negative control. The positive control group did not receive any restoration. They were immersed in 2% methylene blue dye then sectioned buccolingually and analysed under stereomicroscope for leakage of dye. Collected data were analysed using one way nova and post hoc Tukey.

**Results:** MTA has shown significantly lesser microleakage than LC-GIC. Zirconomer has non-significant leakage microleakage than LC GIC.

**Conclusion:** MTA has proved to better material for furcation perforation repair than Zirconomer and LC GIC.

**Keywords:** Furcation perforation, MTA, LC-GIC, Sealing ability, Zirconomer

**Introduction**

Perforation at the furcal area of a multirooted tooth can pose a risk to the success of endodontic treatment. This iatrogenic procedural error, which is common, can lead to microleaking in the surrounding periodontal tissues instigating symptoms such as pain, suppuration as well as breakdown of furcation tissues. This osseous breakdown can even lead to loss of tooth. Thus, in case of a fractional perforation, sealing off the communication becomes necessary. There have been surgical and non-surgical ways in the literature to manage these perforation repairs with each having to their own indications and advantages.[1] A surgical approach is utilised if the perforation is inaccessible. However, it is avoided to maintain the patency of periodontal tissue.[2]A non-surgical approach is usually the treatment of choice in case of accessible perforation where placement of a sealing/repair material is done intracoronally.[3]Numerous materials have been tried and tested for their sealing capacity of and endodontic perforation however the search for the best is unending.

Mineral trioxide aggregate (MTA) is an inert biocompatible material developed in 1993 and since then has been a material of choice for various procedures such as root end filling and perforation repair.[4] The material has been used to achieve a hermetic seal without any adverse reaction to the surrounding tissues. It achieves radioopacity, sets well even in the presence of moisture with excellent marginal adaptability.[5,6]The disadvantages include longer setting time, expensive and technique sensitivity[7] thus leading to finding of other alternatives which can provide an equal to or better sealing abilities.

Glass ionomer cement (GIC) is a self-adhesive material which have a multipurpose use in dentistry. It has been undergone upgradation in its composition and properties over the years to fulfil the desired objectives of its use. Light cured GIC has an added advantage where the setting time can be controlled. Studies have shown that light cure GIC (LC-GIC) have shown better seal than that of amalgam or Cavit in dentinal defects or furcation repair.[8] The properties of light cure GIC is found to be superior to that of conventional GIC in terms of sealing ability.[9]

Zirconomer is a novel material which was introduced as a mixture of GIC and zirconia to exhibit the advantages of amalgam and GIC and overcome their disadvantages. It is documented to have the strength of amalgam and fluoride releasing capacity of GIC.[10] It also eliminates the harmful effect of mercury, thus termed as white gold.[11] Since the mixture has GIC as its primary component, the sealing capacity in furcation repair could be of great use. Thus, the present study was undertaken to assess the sealing capacity of MTA, LC-GIC and Zirconomer in iatrogenic furcal perforation using an in vitro dye penetration method.

**Materials and Method**

The study involved 50 maxillary and mandibular first molars obtained from the department of oral and maxillofacial surgery which were extracted due to periodontal reasons to ensure intactness of the furcation area. To avoid any damage caused by carious lesion, endodontically involved teeth were omitted. Any tooth showing malformations, anomaly or fracture/cracks which may cause leakage of dye was also excluded from the study. The selected teeth were stored in 10% formalin for 10 days. The teeth were thoroughly

debrided to remove any tissue tags or calculus if resent using ultrasonic and hand scalers. They were then washed with distilled water and stored in saline. The guidelines for disinfection and storage of the sample were followed as recommended by Kohli et al. [12]

An access opening was performed in all the collected teeth except for negative control using endoacess bur (Dentsply), then Endo Z bur was used for refining the walls of pulp chamber. Once the floor of the pulp chamber is visible, a perforation was made into furcation area directly in the centre with a round no. 2 bur (Figure 1A). The procedure was carried out with a high-speed handpiece along with water coolant. The depth of the perforation was in accordance with dentin cementum thickness in the furcation area. It was dried using compressed air and mounted on modelling wax. The perforated specimens were divided into five groups.

**Group I –MTA** (Biostructure MTA, Safe endo): The powder and liquid was mixed as per the manufacturer's instructions using a paper pad, when the consistency was appropriate mixture was placed in the perforation using carrier gun. Endodontic pluggers and moist cotton pellets were used to condense in the perforated area.

**Group II – LC GIC** (GC Gold, glass ionomer light cured universal restorative): It was also mixed as per the manufacturer's instructions on paper pad in a luting consistency and was flowed in the perforation. The material was then light cured using a curing light (Ivoclar) of frequency 460 nm for 20 seconds. Incremental technique was used to fully fill the perforated area.

**Group III – Zirconomer**(SHOFU- zirconia reinforced glass ionomer cement): The mixture was prepared as instructions given by the manufacturer. The perforation was filled by this prepared mixture using carrier instruments and pluggers.

The perforated area was restored till the level of pulpal floor, if the material was overextended it was left as it is however, care was taken to not to underfill the area. A moist cotton pellet was used to moistened the root inertly. Then the entire access opening was restored with light cure composite resin (IVOCLAR-VIVADENT). (Figure 1B)

**Group IV – Positive control**: The access cavity and perforation were prepared and no restoration or cotton was used to fill the defect.

**Group V – Negative control**: Intact tooth without any perforation was used.

A nail varnish was applied on the specimens to prevent dye from leaking in except the perforated areas. In case of negative control entire tooth was coated with the varnish. They were then left to dry for 24 hours. The teeth were then dipped in 2% methylene blue dye for 24 hours (Figure 1C). The samples were then washed under running water to clear off excess dye. A precision diamond saw was used to section off the teeth buccolingually in the center (Figure 1D). These sections were examined under optical stereomicroscope (GX52, Olympus) under 40X magnification. The furcation area was critically observed for the amount of dye penetration as it corresponds to the amount of leakage. The length of perforation wall (dentin-cementum thickness) and leakage of dye was measured in millimeters. (Figure 1E, 1F, 1G, 1H)

Statistical Analysis: The data obtained were tabulated and subjected to statistical analysis. One way nova along with post hoc Tukey was used for descriptive statistics and pairwise comparison for significance amongst the groups respectively.

**Results**

The dentin cementum thickness was assessed so as ensure the homogeneity of fractional length for the

sample teeth in test groups which have shown non-significant results amongst the three test groups. The dye penetration and dentin cementum thickness varied with each group. The dye penetration and hence microleakage was least with MTA (1469.83±480.09) followed by Zirconomer (1661.44±192.74) and was highest with LC GIC (2201.22±38.00) amongst the test groups (Table 1). There was statistically significant difference amongst MTA and LC GIC however no significant difference was obtained when Zirconomer was compared with other two test groups (Table 2). The negative control showed no penetration of dye and positive control showed highest amount of dye penetration with value of 3281.68±29.18.

**Discussion**

Perforation of the furcation area can be the result from misjudgement on the part of clinician. The successful management of this lapse requires not only an early diagnosis and prognosis of the defect but also shutting off any communication of the pulpal as well as periodontal tissues to increase the survival chances of the affected tooth. Thus, choosing a material which serves this purpose and is biologically compatible is an ardent task. Numerous materials are available but in order for them to be ideal there are certain requirements. The sealing material should not only provide adequate seal but also be able to produce osteogenesis and cement genesis. It should be non-toxic, bacteriostatic, easy to use and radiopaque.[13] To find a material with all these properties is difficult hence the present study was done to compare three different repair materials and evaluate their efficacy in terms of dye leakage. Methylene blue dye was used in this study.

MTA has been a choice of material for repair for apical[14] as well as furcal perforation. It has been attributed to its prolonged setting time resulting in lesser shrinkage and better sealing. It is also unaffected with the wet environment which cause contamination of other materials due to its hydrophilic composition.[15] The setting of the material is due to hydration reaction to tricalcium and dicalcium silicate. It has shown excellent strength. The alkaline ph is responsible for it antimicrobial effects thus making it a near ideal material.[16] The present study has shown dye penetration was minimum in case of MTA application over the defect. The aforementioned properties is the probable explanation of this finding which was in consistence with that of Singh et al[1] and Balachandran and Gurucharan.[17]Sinkar et al on the other hand, has shown the sealing capacity of MTA to be inferior to that of another test material.[18]

The LC GIC was tested in the study which has shown maximum leakage of the dye. Similar results have been found with the studies done by other authors. [1,16] This can be due to the fact that presence of moisture could have affected the polymerization reaction of the material resulting in shrinkage and thus in adequate sealing of the defect. Alhadainy and Abdalla in their study have shown conflicted results as compared to the present study where had shown effective sealing of furcal perforation.[19]

Zirconomer, a relatively recent dental material was developed through a rigorous manufacturing technique to attain the strength comparing to that of amalgam. The material undergoes finely controlled micronization for the glass component to obtain desirable properties. This homogenized amalgamation of zirconia particles in the glass component of the cement results a durable compound.[20] The microleakage observed in the Zirconomer group in our study was less than that of LC GIC but more than that of MTA. Lagisetti et al compared MTA with Zirconomer in a similar study where results were agreeing with that of ours. They

proposed that the results were due to the fact that cement in the material could have been affected by the presence of moisture causing less than adequate sealing; also, the viscous nature may have resulted in incomplete bonding on the dentinal walls.[21]

The invitro dye leakage studies are difficult to standardize [21] but an objective method of spectrophotometer was preferred. Though efforts were made to keep the study free from any errors but our study had certain limitations which include smaller sample size. The manipulation of the materials was standardized but to achieve similar precision every time is highly subjective.

**Conclusion**

The study compared three different materials for perforated furcation repair. The results obtained have proved MTA to be better choice amongst the three materials in natural conditions following by Zirconomer. The LC GIC have shown maximum leakage thus should be avoided in case of repair where moisture plays an important part.

**References**


1. Singh P, Paul J, Al-Khuraif A, Vellappally S, Halawany HS, Hashim M et al. Sealing ability of mineral trioxide aggregate, calcium phosphate cement, and glass ionomer cement in the repair of furcation perforations. Acta medica (hradeckrálové) 2013;56:97–103.
2. Regan JD, Witherspoon DE, Foyle DM. Surgical repair of root and tooth perforations. Endod Topics 2005;11:152–78.
3. Arens DE, Torabinejad M. Repair of furcal perforations with mineral trioxide aggregate: two case reports. Oral Surg Oral Med Oral Pathol Oral radiolendod1996;82:84–8.
4. Jeevani E, Jayaprakash T, Bolla N, Vemuri S, Sunil CR, Kalluru RS. Evaluation of sealing ability of MMMTA, Endosequence, and biodentine as furcation repair materials: UV spectrophotometric analysis. J Conserv Dent 2014;17:340-3.
5. Kocak MM, Kocak S, Aktuna S, Gorucu J, Yaman SD. Sealing ability of retro filling materials following various root-end cavity preparation techniques. Lasers Med Sci 2011:26:427-31.
6. Rosales-Leal JI, Olmedo-Gaya V, Vallecillo-Capilla M, Luna-del-Castillo JD. Influence of cavity preparation technique (rotary vs. Ultrasonic) on microleakage and marginal fit of six end-root filling materials. Med Oral Pathol Oral Cir Bucal 2011;16:e185-9.
7. Roberts HW, Toth JM, Berzins DW, Charlton DG. Mineral trioxide aggregate material use in endodontic treatment: a review of the literature. Dent Mater 2008;24:149-64.
8. Alhadainy HA, Himel VT. Evaluation of the sealing ability of amalgam, cavit and glass ionomer cement in the repair of furcation perforations. Oral surg1993;75:362-6.
9. Alhadainy HA, Himel VT. Comparison of light-cured materials versus chemically cured in the repair of furcation perforation. Oral Surg Oral Med Oral Path 1993;76:338-42.
10. Abdulsamee N, Elkhadem AH. Zirconomer and zirconomer improved (white amalgams): restorative materials for the future. Review. EC Dent Sci 2017;15:134-50.
11. Walia R, Jasuja P, Verma KG, Juneja S, Mathur A, Ahuja L et al. A comparative evaluation of microleakage and compressive strength of ketac molar, giomer, zirconomer, and ceram-x: an in vitro study. J Indian Soc pedodprev Dent 2016;34:280-4.

12. Kohli A, Puttaiah R, Bedi R. Infection Control & Occupational Safety Recommendations for Oral Health Professionals in India. 1st ed. New Delhi: Dental Council of India; 2007.
13. Kakani AK, Veeramachaneni C, Majeti C, Tummala M, Khiyani L. A review on perforation repair materials. J Clin Diagn Res 2015;9:ZE09-13.
14. Lee SJ, Monsef M, Torabinejad M. Sealing ability of a mineral trioxide aggregate for repair of lateral root perforation. J Endod1993;19:541–4.
15. Kakani AK, Veeramachaneni C. Sealing ability of three different root repair materials for furcation perforation repair: An in vitro study. J Conserv Dent 2020;23:62-5.
16. Nikoloudaki GE, Kontogiannis T, Meliou HA, Kerezoudis NP. A comparative in-vitro study of sealing ability of four different materials used in furcation perforation. Open J Stomatol2014;4:402-11.
17. Balachandran J, Gurucharan. Comparison of sealing ability of bioactive bone cement, mineral trioxide aggregate and Super EBA as furcation repair materials: A dye extraction study. J Conserv Dent 2013;16:247-51.
18. Sinkar RC, Patil SS, Jogad NP, Gade VJ. Comparison of sealing ability of proroot MTA, retromta, and biodentine as furcation repair materials: an ultraviolet spectrophotometric analysis. J Conserv Dent 2015;18: 445-8.
19. Alhadainy HA, Abdalla AI. Artificial floor technique used for the repair of furcation perforations: a microleakage study. J Endod1998;24:33-5.
20. Patel MU, Punia SK, Bhat S, Singh G, Bhargava R, Goyal P et al. An in vitro evaluation of microleakage of posterior teeth restored with amalgam, composite and zirconomer - a stereomicroscopic study. J Clin Diagn Res 2015;9:65-7.
21. Lagisetti AK, Hegde P, Hegde MN. Evaluation of bioceramics and zirconia-reinforced glass ionomer cement in repair of furcation perforations: An in vitro study. J Conserv Dent 2018;21:184-9.
22. Asl Aminabadi N, Erfanparast L, Sohrabi A, Ghertasi Oskouei S, Naghili A. The Impact of Virtual Reality Distraction on Pain and Anxiety during Dental Treatment in 4–6-Year-Old Children: a Randomized Controlled Clinical Trial. J Dent Res Dent Clin Dent Prospects. 2012 Fall;6(4):117-24.
23. Murphy, Nancy. (1997, May). A multisensory vs. Conventional approach to teaching spelling. Unpublished master's thesis, Kean College, New Jersey, USA. (Eric Document Reproduction Service No. ED 405 564)