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An In-Vitro Comparative Evaluation Of Sealing Ability Of Resin Modified Glass Ionomer Cement, Mineral Trioxide Aggregate And BiodentineAs A Furcation Repair Material: Analysis By Confocal Laser Microscopy.

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Abstrac:*This study evaluated the sealing ability of Resin Modified GIC, White MTA and Biodentine as furcation repair materials using a dye penetration method seen under Confocal Laser Microscopy. Forty mandibular molars were randomly divided according to the material used for perforation repair. Group I-positive control, Group II- RMGIC, Group III – White MTA, Group IV– Biodentine. All samples were subjected to retrograde Rhodamine B dye challenge and analyzed under Confocal Laser Microscopy. Results by One-way analysis of variance (ANOVA) showed that RMGIC exhibited highest dye penetration, whereas Biodentine showed lowest dye penetration followed by MTA. Within the limitations of this study, it was observed that Biodentine showed better furcation sealing ability as compared to other repairing materials. The novel furcation repair materials would be a potentially useful in the management of furcation perforation for a surgical or non-surgical endodontic procedures with favourable properties.*

Keywords: *Furcal Perforations, RMGIC, MTA, Biodentine, Rhodamine B dye*

I. Introduction

Maintaining the integrity of the natural dentition is important for proper function and esthetics. Endodontic therapy can play a vital role in achieving this goal. Occasionally mishaps occur during endodontic treatment. One of them is perforation of root canal wall, which can significantly impact the long-term prognosis of the tooth.Perforations can be defined as mechanical or pathologic communications between the root canal system and the external tooth surface.[1] Furcation perforation refers to a mid-curvature opening into the periodontal ligament space and is the worst possible outcome in root canal treatment.[2] Iatrogenic perforation of pulp chamber floor is an undesirable complication in dental practice that can have a negative impact on the treatment prognosis.[3,4] The size and level/location of the perforation as well as the time interval between the accident and its repair will influence prognosis.[4]It has been reported that perforations were the second greatest cause of failure.[5] To prevent bacterial contamination, perforations should be repaired as quickly as possible with a biocompatible material.[6] An ideal perforation repair material should provide an adequate seal, be biocompatible, not affected by blood contamination, not be extruded during condensation, bactericidal, induce bone formation and healing, radiopaque, induce mineralization, cementogenesis and easy in manipulation and placement.[7]Such defects can be repaired both surgically and non-surgically using different materials such as Zinc-oxide Eugenol cement and it's types, Glass ionomer cement, Resin cements, Resin–modified Glass Ionomer cement and Mineral Trioxide Aggregate. However, the divergent outcomes have demonstrated that so far no material has satisfied all the ideal requirements.[8Among the various materials tested, Resin–modified Glass Ionomer cement and Mineral Trioxide Aggregate (MTA) had shown good sealing ability and biocompatibility in many in-vitro and in-vivo studies.[9] In recent years, newer material like Biodentine,[10] have been introduced with the aim of overcoming some of the disadvantages of the MTA, such as the difficulty in handling and long setting time.Thus, the present study is designed to evaluate the sealing ability of Resin

Modified Glass Ionomer Cement, Mineral Trioxide Aggregate andBiodentinein repair of furcation perforations using dye penetration method analyzed under confocal laser microscopy.

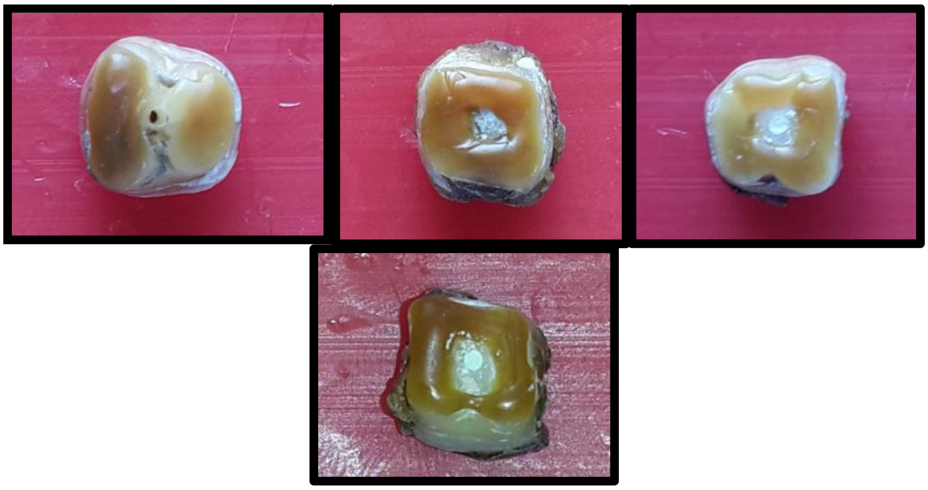
II. Material and methods

Forty extracted human mandibular molars with non-fused and well developed roots were used in this study. Cracked teeth were discarded. After extraction, the teeth were kept in 5% sodium hypochlorite for 30 minutes. Later on, they were washed under tap water to remove all the debris and kept in normal saline until next step. Roots of molars were amputated 3 mm below the furcation area using a tapered diamond bur. Access cavities were prepared in all molars with a round bur #2, then the root canal orifices were located (Fig.1).

Sticky wax was placed over the orifices of each canal and on the sectioned root surface including pulpal floor. It was then coated with two successive layers of varnish in an attempt to increase the marginal seal. To ensure each perforation should centered between the roots, a black marker pen was used to mark the location of the defect. Artificial perforation of 1 mm in diameter was created from the external surface of the tooth with a #2 round carbide bur mounted on a high-speed hand piece with air water coolant(Fig 2). The chambers and perforation of all the samples were flushed with water and dried.


Fig. 1: Access opening Fig. 2: Furcal perforation

Then, the teeth were randomly divided into four groups(Fig3).
Group I: (n=10) perforations left unsealed (Positive control).
Group II: (n=10) perforations repaired with Resin Modified Glass IonomerCement.
Group III: (n=10) perforations repaired with White Mineral Trioxide Aggregate.
Group IV: (n=10) perforations were repaired with Biodentine.

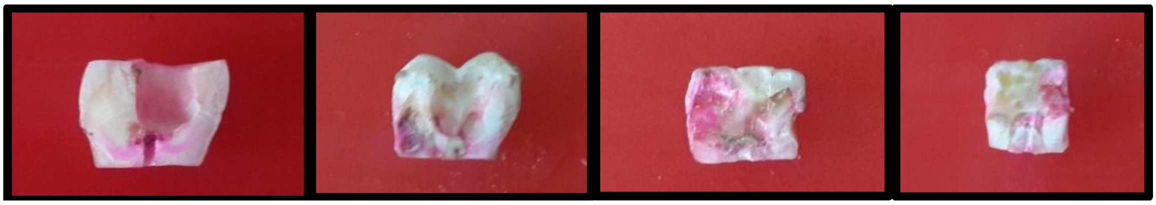


Group I Group II Group III Group IV
Fig. 3: Different groups with perforation repair material

After initial setting of repairing materials, all the samples of each group were placed in separate petri dishes containing Rhodamine B dye such that all the teeth were immersed in dye up to the CEJ for retrograde dye challenge for 24 hrs(Fig. 4). After removal from the dye, teeth were rinsed under running water for 40 minutes and varnish was removed with a polishing disc.

Fig 4: Different samples placed in Rhodamine B dye solution

Using a diamond disc, each tooth was longitudinally sectionedmesiodistally into two halves(Fig 5). The extent of dye penetration was viewed under Confocal Laser Scanning Microscope and oil immersion objectives in conjunction with a green filter (wavelength 546nm). Rhodamine B dye gave a red-orange fluorescence when excited with green light of 546nm wavelength. The amount of dye penetration was measured in µm using the ZEISS LSM IMAGE BROWSER SOFTWARE (Version 4.2.0.121)(Fig. 6).



Group I Group II Group III Group IV

Fig. 5: Longitudinal section of different group

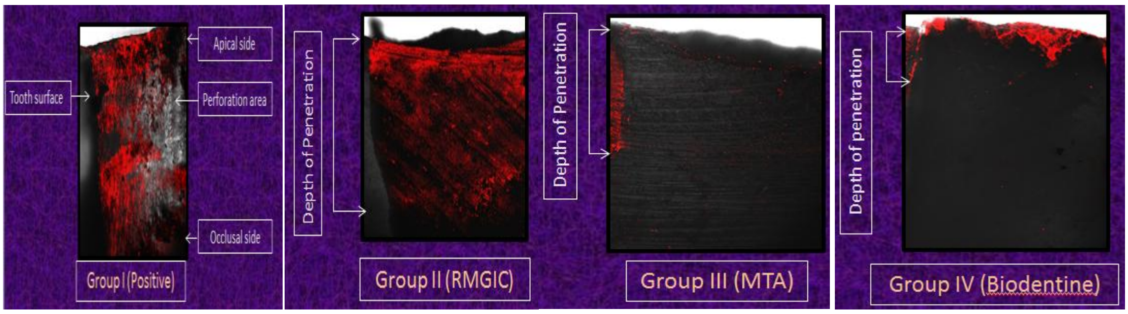


Fig. 6: CFLM images of different groups

III. Results

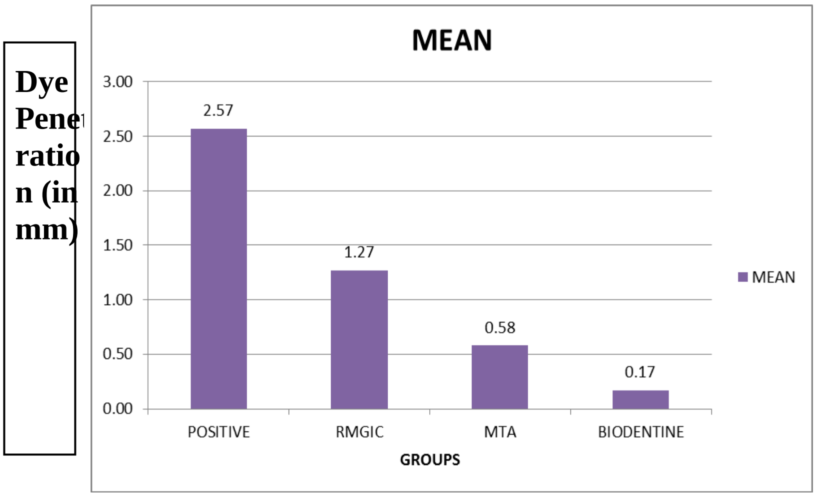
One-way analysis of variance (ANOVA) and Tukey-K test was used for the statistical analysis.
The intergroup comparison of dye leakage in each material are shown in (Table 1) and (Graph 1). There was a dye leakage in all the groups. Group II (Resin Modified GIC) showed highest dye penetration, whereas Group IV (Biodentine) showed lowest dye penetration followed by Group III (Mineral Trioxide Aggregate). Intra group comparison as shown in (Table 2) exhibits that there was a very significant difference in dye leakage among all the groups ($p < 0.01$).

Groups	n	Mean (in mm)	Std. Deviation	Std. Error	P Value
Group I (Positive)	10	2.5700	0.0823	0.0260	<0.01
Group II (RMGIC)	10	1.2700	0.0823	0.0260	
Group III (MTA)	10	0.5800	0.0919	0.0291	
Group IV (Biodentine)	10	0.1710	0.0185	0.0059	

Table 1: Inter group comparison of mean value and standard deviation of dye penetration of all the groups.

Between Groups	Q statistic	p-value	Inference
A vs B	55.0046	0.0010053	** p<0.01
A vs C	84.1994	0.0010053	** p<0.01
A vs D	101.5047	0.0010053	** p<0.01
B vs C	29.1948	0.0010053	** p<0.01
B vs D	46.5001	0.0010053	** p<0.01
C vs D	17.3053	0.0010053	** p<0.01

Table 2: Intra-group comparison of dye penetration of all the groups.



Graph 1: representing the mean values of dye penetration of all the groups.

IV. Discussion

The perforations irrespective of location or etiology may interfere with the prognosis of endodontic treatment. This iatrogenic or mechanical or pathological communication between root canal system and external tooth surface should be sealed with a biocompatible materials as soon as possible.[7]The present study evaluated thesealing ability of Resin modified Glass Ionomer Cement, MTA and Biodentine as furcation repair materials in mandibular molars using a dye penetration method.Dye penetration technique has long been used in endodontics because of its ease of performance and difficulty of other available techniques. Dye penetration methodology was employed in this study, which according to Camps J and Pashley gave similar results to the fluid–filtration technique as both are based on quantitative measurements of liquid passage within interfaces.[12]The use of a dye is regarded as the easiest and most cost-effective method for detecting micro-leakage. Rhodamine B dye was used in our study because it easily allows quantitative measurement of the area of dye penetration by linear measurement methods. In this study,Confocal laser scanning microscopy (CLSM) is used for analysis because it is a simple method to test the adaptation of dental materials to the dentin

It has several advantages such as

• Non-destructive examination of the samples

• Dehydration of samples is not required as drying of samples, which is indispensable for conventional SEM or TEM, is not necessary with CLSM, leading to a decreased risk of shrinking or other drying artefacts

• No specific sectioning technique required: This decreases the possibility of artifacts produced during the preparation of the specimens by dehydration and sputter-coating procedure for SEM evaluation

• Rapid sampling is also available.[13,14,15]

As shown in the results ofthe present study, the newer introduced material (Biodentine) exhibited lowest microleakage because Biodentine is a calcium silicate-based material that has polycarboxylate-based hydro-soluble polymer system described as water-reducing agent to reduce the overall water content of the mix, along with $CaCl_2$ as a setting accelerator.[7]It bonds chemo-mechanically with the tooth along with the formation of tag like structures composed of Calcium or Phosphate rich crystalline deposits which increases over time hence minimizing the gap between tooth and Biodentine.[11]

Biodentine proves to be superior than MTA because Mineral Trioxide Aggregate has certain drawbacks such as difficulty in handling and very slow setting reaction, which might contribute to leakage, surface disintegration, loss of marginal adaptation and disruption in continuity of the material that’s why there is a highrisk of bacterial contamination.[16,17]

Resin modified Glass Ionomer cement can be used as a dentin substitute that has the ability to exhibit chemical bond to tooth structure but the marginal seal is compromised because of its dissolution in tissue fluids and it's being technique sensitivity.[18]A higher percentage of dye penetration in GIC may be due to the polymerization contraction of the material.[19] Contamination of the dentinal surface with excessive moisture, solvent or presence of voids could affect bonding, making it unpredictable under clinical conditions.

V. Conclusion

On comparative evaluation of results of this in vitro study, it was concluded that RMGIC, MTA &Biodentine exhibited microleakage with Biodentine showing the least microleakage of all.This study was a humble effort to evaluate the sealing ability of the newly introduced material Biodentine. However it is still open for further research not only for the sealing ability but also the related physical properties as well as critical manipulative steps.

References

[1] American Association of Endodontists glossary of endodontic terms, 7th ed. Chicago, IL: American Association of Endodontics, 2003.

[2] Sanghavi T, Shah N, Shah RR. Comparative analysis of sealing ability of biodentine and calcium phosphate cement against mineral trioxide aggregate as a furcal perforation repair material: An in vitro study. National Journal of Integrated Research in Medicine 2013;4:56-60.

[3] Adiga S, Ataide I, Fernandes M. Nonsurgical approach for strip perforation repair using mineral trioxide aggregate. J Conserv Dent. 2010;13(2):97–101.

[4] Mente J, Hage N, Pfefferle T, Koch MJ, Geletneky B, Dreyhaupt J, Martin N, Staehle HJ. Treatment outcome of mineral trioxide aggregate: repair of root perforations. J Endod. 2010;36(2):208–13.

[5] Seltzer S. Endodontic failures – an analysis based on Clinical, roentgen graphic and histologic findings. Oral Surg Oral Med Oral Pathol Oral RadiolEndod 1967;34:517-30.

[6] 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.

[7] 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;16:462-5.

[8] El Tawil SB, El Dokkyl NA, El Hamid DA. Sealing ability of MTA versus Portland cement in the repair of furcal perforations of primary molars: A dye extraction leakage model. J Am Sci 2011;7:1037-43.

[9] Torabinejad M, Parirokh M. Mineral trioxide aggregate : A comprehensive literature review-part II : leakage and biocompatibility investigations. J Endod. 2010 Feb;36 (2):190-202.

[10] Goldberg M , Pradelle-Plasse N , Tran XV , Colon P , Laurent P , Aubut V et al. Emerging trends in (bio) material research.- Physico – chemical properties of Biodentine. In: Goldberg M, editor. Biocompatibility or cytotoxic effects of dental composites. 1st ed. Oxford: Coxmoor publishing co;2009.p.181-203.

[11] Pathak S. Comparative Evaluation of Sealing Ability of Root End Filling Materials: An In-Vitro Study. Int J Dent Med Res 2015;1(5):48-52.

[12] 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.

[13] Marciano M, Ordinola Zapata R, CavaliniCavenago B, A. del CarpioPerochina, Monteiro Bramante C, Gomez de Moraes. The use of confocal laser scanning microscopy in endodontic research: Sealer/ dentin interfaces. Microscopy: Science, technology, applications and education. Formatex Microscopy Series 2010;3:566-570.

[14] Bramante CM, de Moraes IG, Bernardineli N, Garcia RB, Pidero CU, Ordinola Zapata R, et al. Effect of sputter coating on cracking of root end surfaces after ultrasonic retrograde preparation: A SEM study of resected root apices and their respective impressions. ActaOdontolLatinoam 2010;23:53-7.

[15] Pioch T, Stotz S, Staehle HJ, Duschner H. Applications of confocal laser scanning microscopy to dental bonding. Adv Dent Res 1997;11:453-61.

[16] Girish CS, Ponnappa K, Girish T, Ponappa M. Sealing ability of mineral trioxide aggregate, calcium phosphate and polymethylmethacrylate bone cements on root ends prepared using an Erbium: Yttriumaluminium garnet laser and ultrasonics evaluated by confocal laser scanning microscopy. J Conserv Dent 2013;16:304-8.

[17] Kokate SR, PawarAM. An in vitro comparative stereomicroscopic evaluation of marginal seal between MTA, Glass Inomer Cement &Biodentine as root end filling materials using 1% methylene blue as tracer. Endod. 2012;2:36–42.

[18] Inoue S, Yoshimura M, Tinkle JS and Marshall FJ (1991). A 24-week study of the microleakage of four retrofilling materials using a fluid filtration method. J Endod, 17(8): 369-375.

[19] Chong BS, Pitt Ford TR, Watson TF. The adaptation and sealing ability of light cured glass ionomer retrograde root fillings. IntEndod J 1991; 24: 223–32.