Evaluation Of Sealing Ability Of Biodentine, MTA Angelus And Zirconia-Reinforced Glass Ionomer Cement For Repairing Furcation Perforations : An In Vitro Study

Dr. Sneha*, Dr. Hemant Asrani, Dr. Manjusha Rawtiya***, Dr. Kumari Sindhu Pravin****, Dr.Karan Asrani*****

*Senior Lecturer, Department Of Conservative Dentistry & Endodontics, Rungta College Of Dental Sciences & Research, Kohka,Kurud,Bhilai, C.G, **Professor, Department Of Conservative Dentistry & Endodontics, Maitri College Of Dentistry & Research Centre, Anjora , Durg,C.G, ***Professor & Hod, Department Of Conservative Dentistry & Endodontics, Shri Yashwantrao Chavan Memorial Medical & Rural Development Foundation's Dental College & Hospital, Ahmednagar, ****Private Practisioner, *****Senior Lecturer, Department Of Conservative Dentistry & Endodontics, Mansarovar Dental College,Bhopal

Abstract: Background: Background and objective: One of the unfavourable outcomes of endodontic treatment is furcal perforation. Materials such as MTA-Angelus, Biodentine and Zirconomer have been recommended for the repair of furcal perforations.In this study we compared the sealing ability of MTA-Angelus, Biodentine and Zirconia-reinforced GIC in furcal perforations using dye penetration method. Material And Methods: Access cavities were prepared in extracted mandibular molars (n= 40) using round bur in a high speed hand piece under water coolant. Perforations were made in the centre of furcation region using 2mm round bur. The teeth were randomly divided into 4 groups based on the material used to seal the perforation: Group I(n= 12) = MTA – Angelus , Group II (n=12)= Biodentine , Group III(n=12) = Zirconomer , Group IV (n= 4) = left unsealed (negative control group).Leakage at the repaired site was then evaluated using methylene blue dye penetration technique under stereomicroscope and data was statistically analyzed. Result: Minimum dye penetration was observed in biodentine followed by MTA, Zirconomer and control group. The results was not statistically significant (p= .08). Conclusion: According to this study, biodentine showed best of the three materials used for furcation repair. [Sneha Natl J Integr Res Med, 2022; 13(4): 18-22, Published on Dated: 10/07/2022]

Key Words: Biodentine, Furcal Perforations, MTA –Angelus, Scanning Electron Microscope, Zirconomer

Author for correspondence: Dr. Sneha, Senior Lecturer, Department Of Conservative Dentistry & Endodontics, Rungta College Of Dental Sciences & Research, Kohka, Kurud, Bhilai, C.G,
E-Mail: snehainair.singh@gmail.com

Introduction: Endodontic perforation is a pathologic or iatrogenic communication between the root canal space and the attachment apparatus. Furcal perforation is an artificial communication between the pulp chamber and the supporting structures of the tooth through the floor of the pulp chamber. During the endodontic treatment, perforation adversely affects the prognosis of endodontic treatment.

Ingle JL reported that root canal perforation as the second most common cause of endodontic failures and it accounts for 9.6% of all unsuccessful cases[2]. It can be repaired using surgical or a non- surgical approach. However the surgical approach is less preferred due to difficulty in obtaining accessibility for repair.

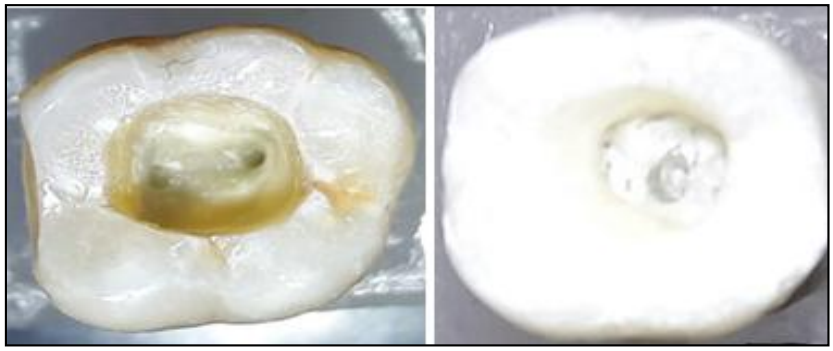
Factors that affect the prognosis of perforation repair includes the level and the location and the size of the perforation, the time delay before the perforation repair and the materials used for perforation repair. Ideally a perforation repair material should be biocompatible, good sealing, non resorbable, radiopaque and bacteriostatic. Various calcium silicate based materials are recommended for the repair of furcal perforations due to their sealing ability, biocompatibility, regenerative capability and antibacterial property.

The material should tightly seal the perforations against microleakage.

Material & Methods: After approval from the institutional ethical committee, a comparative study was carried out in 40 extracted human permanent mandibular molars with intact furcation.

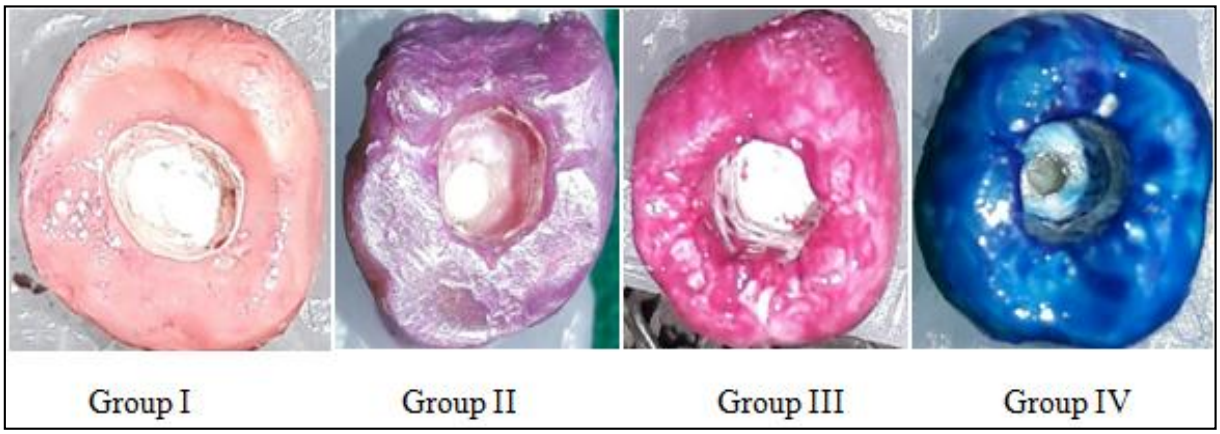
The exclusion criteria included the teeth with extensive caries, teeth with cracks and teeth with fused roots. The samples were stored in 5.25% sodium hypochlorite (neelkanth-Apexicon Dental Product Kerala, India) for 24 hrs for the removal of tissue remnants. After 24 hr, the samples were washed and stored in saline (.9 % w/v Goa Formulations Ltd, Mumbai, India).

Image 1: Access Cavity Preparation **Image 2: Furcal Perforation**



Standard access cavity were prepared in each tooth using a diamond bur and non- end cutting bur in high speed handpiece under water coolant. A 2mm round bur was used to standardize the size of furcal perforation and the furcal perforation was made on the centre of the pulpal floor. After furcal perforation, the teeth samples were randomly divided into four groups: Group I (n= 12) – Perforation repair was done using MTA –Angelus , Group II (n= 12)- Perforation repair was done using Biodentine, Group III (n= 12)- Perforation repair was done using Zirconomer, Group IV (n=4)- Perforation defects were not repaired and thus served as negative control.

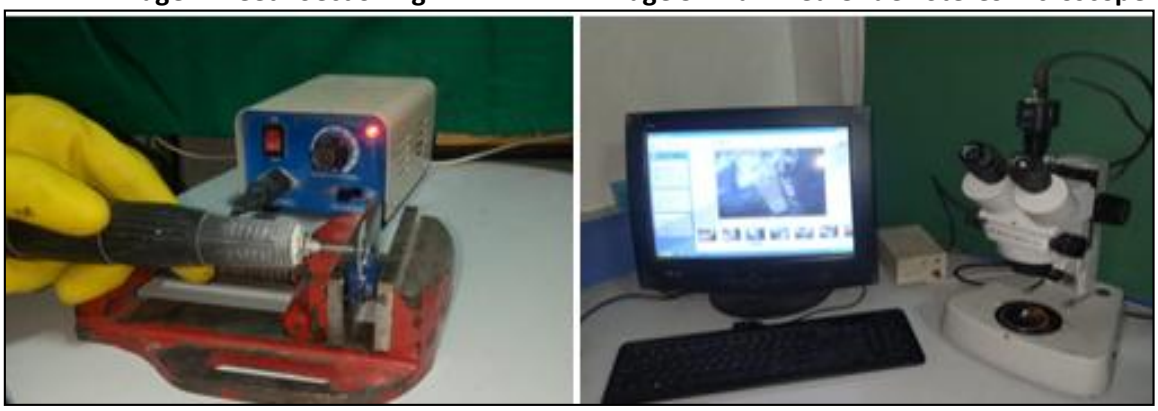
Image 3: Perforation Repair Done



After furcal repair, canal orifices were sealed with temporary restorative material i.e Cavit (Medicept)and nail paint was applied on all samples except for 2mm around the perforation region.

Sample Evaluation: All the teeth were immersed in 2% methylene blue dye for 48h for dye penetration. After 48h, all the samples were cleaned under running water to clear the methylene blue dye. Teeth were dried and all the teeth were sectioned in centre buccolingually using a diamond disc. The sectioned teeth were examined under stereomicroscope (Zenith, Magnus, India) with X 10 magnification for dye penetration.

Image 4: Teeth Sectioning **Image 5: Examined Under Stereomicroscope**



Results: Dye penetrated the whole length of the perforation sites in the negative control group.

Table 1: Criteria For Microleakage Evaluation Of Dye Penetration Along The Repair Material

Score	Details
0	No leakage could be detected
1	Leakage extending LESS THAN 1/2 of the repair material
2	Leakage extending MORE THAN 1/2of the repair material
3	Leakage INVOLVING BASE of the repair material

Table 2: Leakage Scores For The Experimental Groups

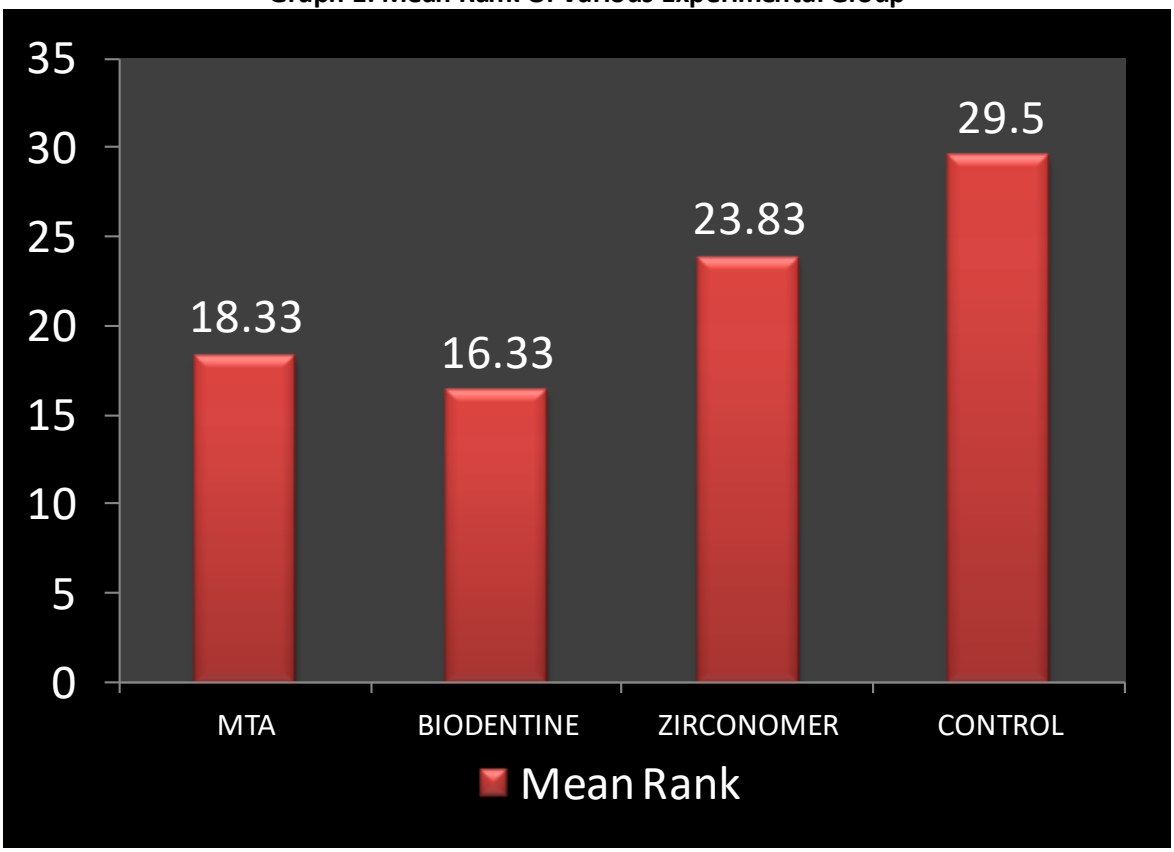
		Dye Penetration				Total
		No Penetration	Dye Penetration Less Than Half	Dye Penetration More Than Half	Dye Penetration Involving Base	
Group	Mta	0	2	5	5	12
	Biodentine	3	1	3	5	12
	Zirconomer	0	0	4	8	12
	Control	0	0	0	4	4
Total		3	3	12	22	40

Table 3: Obtained Data Was Analyzed Using Kruskal-Wallis Test

	Group	N	Mean Rank	P Value
Dye Penetration	Mta	12	18.33	0.08 (Ns)
	Biodentine	12	16.33	
	Zirconomer	12	23.83	
	Control	4	29.50	
	Total	40		

*P Value ≤ 0.05 Was Considered Statistically Significant. There is statistically no significant difference between experimental groups

Graph 1: Mean Rank Of Various Experimental Group



Discussion: The prognosis of furcation perforation depends on time, size, and cause. Good prognosis is seen with small sized perforations and immediate treatment of perforation site, as it reduces the destructive inflammatory response of periodontium.

Favourable prognosis of perforation is seen when it is sealed immediately either iatrogenic or pathologic. Any delay results in infection of perforation wound and delayed healing. In this study, methylene blue dye penetration method was selected to study microleakage because it was easy to manipulate with high degree of staining and a molecular weight even lower than that of bacterial toxins.

MTA and biodentine are hydrophilic endodontic cements; this feature facilitates wetting of dentin, allowed access of cement within gap/spaces associated with the perforation walls and helped the entrance of small cement particles into dentinal tubules. Furthermore, MTA and biodentine in contrast with other dental materials exhibited slight expansion after setting and enhancing adaptation of the biomaterials to the perforation walls. In addition, MTA and biodentine form hydroxyaptite and provide an improved seal at the interface of biomaterials and dentin walls as well as the filling material.

Despite the good physical, biological and hydrophilic properties of MTA, it has some disadvantages such as long setting time, difficult handling of the material. MTA is prepared by mixing its powder with sterile water in a 3:1 ratio, which means any difference in this ratio will compromise its properties, and also it is considered as an expensive material. Biodentine is similar to MTA in basic composition; however it showed better sealing ability than MTA in our study.

Adding calcium chloride to the liquid component decreases the setting time i.e 9 to 12 minutes. The addition of hydrosoluble polymer as “water reducing agents”, help in maintaining the balance between low water content and consistency of the mixture.

Biodentine proves superior to MTA because of ease of manipulation and setting time is faster. The highest microleakage was seen with zirconomer compared to biodentine and MTA, the probable causes could be , the material might be slightly viscous which prevented the material to flow and might have inadequately filled or sealed the perforation.

Conclusion: It can be concluded that biodentine is the best of the three materials used for furcation repair.MTA also provides a good seal when used as a furcation repair material. Zirconomer does not provide a good seal when compared to MTA and biodentine.

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