ORIGINAL RESEARCH PAPER

Volume - 15 | Issue - 07 | July - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE EVALUATION OF PUSH-OUT BOND STRENGTH OF THREE DIFFERENT FURCATION PERFORATION REPAIR MATERIALS GLASS IONOMER CEMENT WITH 7 % CHICKEN EGG SHELL POWDER, NANO HYDROXYAPATITE, MINERAL TRIOXIDE AGGREGATE AS A PUTTY : AN IN VITRO STUDY

Endodontics

Dr Arti Choudhari*	Postgraduate student, department of conservative dentistry and endodontics Dr HSRSM dental college Hingoli*Corresponding Author
Dr Pawan Darak	Professor, department of conservative dentistry and endodontics Dr HSRSM dental college Hingoli
Dr Sushilkumar Cirigiri	Professor & HOD, department of conservative dentistry and endodontics Dr HSRSM dental college Hingoli.
Dr Arvind burande	Reader, department of conservative dentistry and endodontics Dr HSRSM dental college Hingoli.
Dr Shachi Goenka	Reader ,department of conservative dentistry and endodontics Dr HSRSM dental college Hingoli
Dr Pritesh Soni	Senior Lecturer, department of conservative dentistry and endodontics Dr HSRSM dental college Hingoli

ABSTRACT

AIM:- The Aim of this study was to evaluate the Push-Out Bond Strength of three different Furcation Perforation Repair Materials Glass Ionomer Cement with 7 % chicken egg shell powder, Nano Hydroxyapatite, Mineral Trioxide Aggregate as a putty . **METHODS :-** A total of 60 human extracted molars were collected and divided on the basis of perforation repair materials and blood contamination status (n = 10). All the materials were subjected to universal testing machine to a load cell from 0 N to 100 KN at a crosshead speed of 1 mm/min. **RESULTS :-** For Nanohydroxyapatite , there was no statistically significant difference between blood contamination (2.33 ± 0.27) and no contamination (2.47 ± 0.19) ($t = -1.310$, $p = 0.207$), indicating that blood contamination did not significantly affect its bond strength. In contrast, both GIC and MTA showed significantly higher bond strength in the absence of blood contamination. **CONCLUSION :-** The push-out bond strength was maximum in MTA putty without blood contamination and least for the hydroxyapatite contaminated with blood. A significant difference was found between all the perforation repair materials.

KEYWORDS

Glass Ionomer Cement, Hydroxyapatite, Mineral Trioxide Aggregate, Perforation Repair, Permanent Molars

INTRODUCTION

The perforation refers to an artificial or pathological opening that creates a communication between the root canal system and the surrounding periodontal tissues.[1] Furcation and root perforation are commonly iatrogenic and are a significant cause of endodontic failure, aside from those caused by carious lesions or resorptive defects. [2] An ideal repair material should be non-toxic, biocompatible, bacteriostatic, radiopaque, non-resorbable, easy to handle, and resistant to moisture. Furthermore, it should possess the ability to induce osteogenesis and cementogenesis while ensuring a hermetic seal[3].

The incidence of perforation in endodontic treatment has been reported in range between 2% and 12% .. These defects are frequently observed in multi-rooted teeth, particularly mandibular molars, accounting for approximately 54.31% of cases[4]

Perforation located in the cervical portion of the root or at the floor of the pulp chamber tend to have a poor prognosis due to their close proximity to the gingival sulcus, increasing the likelihood of epithelial attachment loss and bone resorption [5]

If not managed promptly, furcal perforations may lead to complications such as infection, periodontal breakdown, and eventual tooth loss. Therefore, early detection and immediate repair are crucial to preserve the tooth structure and facilitate healing [6].

Mineral trioxide aggregate (MTA), a calcium silicate-based material, is widely used as the gold standard for perforation repair, demonstrating a success rate of approximately 86% .[7]

Blood contamination has been identified as a critical factor influencing the performance of repair materials. It can interfere with their physical and chemical properties, ultimately reducing their effectiveness[8]

Materials and Methodology

A total of 60 extracted mandibular molars human teeth will be selected & teeth will be cleaned using ultrasonic scaler and disinfected by immersing them in 5% sodium hypochlorite solution for 1 hour and will be stored in 0.1% thymol solution until use.

The standard endodontic access cavities will be prepared for all the study groups using ISO size (109/013) straight fissure bur using high-speed water cooled air rotor handpiece.

Then, all the study samples will be marked 4 mm above the pulpal floor with the help of Williams probe and black marker.

After that, the samples will be decoronated 4 mm above the pulpal floor using a water-cooled diamond disk attached to mandrel.

A Perforation will be made in the centre of furcation area from the external surface using an ISO Size (173/016) round bur. Subsequently, the teeth will be mounted in acrylic moulds leaving a 3-mm area at furcation to provide a space for the placement of ABGEL sponge, acting as a matrix to pack materials for the repair of perforated furcation area. After the preparation of study moulds, the samples will be randomly divided into three experimental groups according to type of Perforation repair material (n = 20). Each group then further subdivided into two subgroups (n = 10) on the basis of blood contamination status. The experimental groups were as follows

Table 1 Samples divided into three groups

Groups	Sample size (n)	Materials
Group 1	(20)	Glass ionomer Cement modified with 7% chicken eggshell powder
Group 2	(20)	Nano Hydroxyapatite powder
Group 3	(20)	MTA putty

Subgroup B from each experimental group will be contaminated with freshly drawn human blood using an applicator tip, before the placement of repair material.

The Subgroup A of all the experimental groups will be left uncontaminated. All the study samples will be repaired using the

 PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr

respective Perforation repair materials followed by the placement of moist cotton pellet and were stored in an incubator for 7 days.

The specimens will be subjected to a load using universal testing machine at a crosshead speed of 1 mm/min to check the push-out bond strength.

Statistical Analysis:
The data will be analyzed with ONE WAY ANOVA followed by Kruskal Wallis test under the assumption that data follows normal distribution.

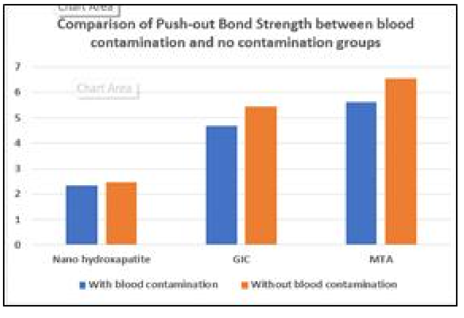
RESULTS-
The push-out bond strength of different perforation repair materials of all the study samples was calculated. Table 2 shows comparison of Push-out Bond Strength between blood contamination and no contamination groups.

Table 2 Comparison of Push-out Bond Strength between blood contamination and no contamination groups

Material	Blood contamination	No contamination	t-value	p-value
Nanohydroxyapatite	2.33 ± 0.27	2.47 ± 0.19	-1.310	0.207
GIC	4.68 ± 0.19	5.44 ± 0.30	-6.891	<0.001*
MTA	5.63 ± 0.19	6.56 ± 0.32	-7.972	<0.001*

DISCUSSION
Endodontic treatment is a complex and technique-sensitive procedure. Various procedures, including access cavity preparation, cleaning, shaping, and debridement, carry an inherent risk of procedural complications such as perforations, instrument separation, and canal transportation [1]

Graph 1 Comparison of Push-out Bond Strength between blood contamination and no contamination groups



Similarly, Marquezan *et al*. (2018) demonstrated that blood contamination negatively affects the push-out bond strength and dislodgement resistance of calcium silicate-based materials [8] Many materials are used for managing perforations, such as glass ionomer and resin-modified glass ionomer, zinc oxide–eugenol, amalgam, calcium hydroxide and composite [9]

Similarly, the study conducted by Singla et al found that the push-out bond strength of MTA was the highest and that of hydroxyapatite for least among all groups. GIC showed a moderate push-out bond strength. The study conducted by Parmar et al indicated that the MTA showed better performance than GIC . [10]

Trace elements of chicken eggshell may improve and promote tissue regeneration. Eggshell powder has been demonstrated in studies to have antibacterial effects against common oral infections . [11]

The present study evaluated the effect of blood contamination on the push-out bond strength of Hydroxyapatite, GIC, and MTA. The findings revealed material-dependent variations in results due to contamination, indicating that blood presence can significantly influence the bonding performance of certain repair materials. [12]

The study conducted by Akcay *et al.* 2016; Lotfi *et al.,* 2013; Roberts *et al.,* 2008 showed similar results that an insufficient seal causes the leakage of the bacteria and their products, which could lead to treatment failure [13]

CONCLUSION –
Within the limitations of the present study, Mineral Trioxide Aggregate (MTA) demonstrated the highest bond strength under both contaminated and uncontaminated conditions, followed by Glass Ionomer Cement (GIC) modified with 7% chicken eggshell powder, while Nano Hydroxyapatite showed the lowest values.

REFERENCES:

1) Singla M, Verma KG, Goyal V, Jusuja P, Kakkar A, Ahuja L. Comparison of push-out bond strength of furcation Perforation repair materials – Glass ionomer Cement Type II, hydroxyapatite, mineral trioxide aggregate, and biodentine: An in vitro study. Contempt Clin Dent 2018; 9:410-4
2) Rahman MMA, Hossain M, Fatema S, Alam MS. Comparative efficacy of mineral trioxide aggregate and biodentine for the repair of pulpal floor Perforation. Bangabandhu Sheikh Mujib Med Univ J. 2018; 11: 295-299.
3) Ali Ismail El-Tahan, Hossam Mohamed Tewfik2, Alaaeldin Hussien Diab3 Sealing Ability and Dislodgement Resistance of Three Materials for the Repair of Furcation Perforation (In-vitro Study)
4) . Das A, Chandak MG, Manwar NU. Nonsurgical management of furcation Perforation: a case report. Clin Dent 2013; 7:33–36. ISSN: 0974-3979
5) Saeed Rahimi, DDS, MSc, * Negin Ghasemi, MSc, † Shahriar Shahi, DDS, MSc, Effect of Blood Contamination on the Retention Characteristics of Two Endodontic Biomaterials in Simulated Furcation Perforations (J Endo 2013;39:697–700)
6) Abraham S, Chandwani ED, Nagmode P, Lokhande N, Badgujar MB, Diggikar K. A Spectrophotometric comparative evaluation of the sealing ability of various Perforation repair materials with a novel eggshell modified GIC. J Conserve Dent Endo 2023; 26:697-701
7) Assmaa M. Askoura1, Abeer A. Elgendy, Ahmed H. Khalaf Evaluation of Sealing Ability of Nanohydroxyapatite and Nano-MTA as Perforation Repair Material: (In-Vitro StUdy) ISSN 2735-023X Vol. 2, No. 2, 129-140, December 2022
8) Flavia Kolling Marquezan1, Patricia Maria Poli Kopper1, Angela Isabel do Effect of Blood Contamination on The Push-Out Bond Strength of Calcium Silicate Cements Brazilian Dental Journal (2018) 29(2): 189-194
9) Singh P, Paul J, Al-Khuraif AA, *et al.* Sealing ability of mineral trioxide aggregate, calcium phosphate cement, and glass ionomer cement in the repair of furcation perforations. *Acta Medica (Hradec Kralove)*. 2013;56(3):97-103
10) Allam G, Abd El-Geleel O. Evaluating the Mechanical Properties, and Calcium and Fluoride Release of Glass-Ionomer Cement Modified with Chicken Eggshell Powder. *Dent J (Basel)*. 2018;6(3):40.
11) .Helal MB, Sheta MS, Alghonemy WY. Comparing the remineralization potential of undemineralized dentin powder versus chicken eggshell powder on artificially induced initial enamel carious lesions: an in-vitro investigation. *BMC Oral Health*. 2024;24(1):1048
12) Sarao SK, Berlin-Broner Y, Levin L. Occurrence and risk factors of dental root perforations: a systematic review. *Int Dent J*. Published online August 20, 2020.
13) Ghasemi N, Reyhani MF, Salem Milani A, Mokhtari H, Khoshmanzar F. Effect of Calcium Hydroxide on the Push-out Bond Strength of Endodontic Biomaterials in Simulated Furcation Perforations. *Iran Endod J*. 2016;11(2):91-95.