Section A-Research paper
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Comparative evaluation of push out bond strength of Light cure MTA, BIO MTA+, Light cure Glass Ionomer in furcal Perforation with and without blood contamination: An in-vitro study

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Abstract

Aim- To Compare and evaluate push out bond strength of Light cure MTA, BIO MTA+, Light cure Glass Ionomer in furcal Perforation with and without blood contamination in extracted mandibular 1st molar teeth.

Methods and materials- In present study two groups were created based on contamination or non-contamination with blood, and further subdivided according to Light cure MTA, BIO MTA+, Light cure Glass Ionomer materials which were used. Perforations were filled with the test materials and placed in Humidifier at 37°C and 100% relative humidity for 7 day. Push out bond strength was calculated on Universal testing machine.

Statistical analysis- Intra-group comparison was done using one way Anova test and inter-group comparison was done using unpaired t – test.

Results- The lowest (5.02 MPa) bond strength value was recorded in group Light cure MTA with blood contamination, where as highest (23.31 MPa) bond strength value was recorded in group Light cure GIC without blood contamination. The group of BIO MTA+ showed intermediate values.

Conclusion- Within its limitations, the study showed blood contamination decreased the Push out bond strength of materials and Light cure GIC has excellent Push out bond strength compared to other test materials.

Keywords- Light cure MTA, BIO MTA+, Light cure Glass Ionomer

INTRODUCTION

An endodontic perforation is an artificial opening created by clinician in the tooth or its root during access opening, shaping, and debridement or by biologic events like caries or

pathologic perforation, resulting in a communication between the root canal and periodontal tissue.[1,2,3]

It is important that perforation repair materials should have good adaptability to prevent microleakage.[4] Perforations should be immediately sealed using a biocompatible material resistant to dislodging forces which are applied during restorative procedures and functional activities. Therefore, it is important to evaluate push-out bond strength of perforation repair material. [5,6]

Plethora of perforation repair materials have been used, but ideally they should be biocompatible, bacteriostatic, radiopaque, non-toxic, non-carcinogenic, possess the ability to induce osteogenesis and cementogenesis and can tolerate moisture. Sealing of the perforation with perforation repair material is of paramount importance for the overall prognosis of root canal treatment. [1,7,8]

Various techniques have been applied to ascess the fracture resistance of repair materials along with their ability to prevent microleakage. The push-out test is an efficient and reliable method, where a gradually increasing pressure is applied to the three materials in presence and absence of blood contamination until debonding occurs.

In view of this, the aim of the present study was to evaluate the pushout bond strength of Light cure MTA, BIO MTA + and Light cure Glass Ionomer cement in furcal perforation with and without contamination.

MATERIALS AND METHOD

Total of 48 human mandibular first molar teeth were used in the present study. The institutional ethics committee of Bharati Vidyapeeth (Deemed to be University) Medical College and Hospital, Sangli (BV(DU)MC & H/Sangli/ IEC/ Dissertation 2021- 22/D-51) has approved the present study.

The inclusion criteria consisted of no carious lesions, no shape or size anomalies, no fused roots, mature apices, and no previous root canal treatments. The extracted teeth were cleaned using ultrasonic scaler to remove any soft tissue remnants and stored in Thymol 0.1% solution solution until use. The extracted teeth were decoronated at

the cemento-enamel junction using a Diamond disk under water cooling and were mounted in acrylic molds, leaving a space of 3 mm under the furcal area for further placement of Ab Gel which acts as a matrix for packing materials during furcal perforation repair.

Perforations were created using Round carbide bur, size 4 perpendicular to the furcal floor and parallel to the tooth axis. A periodontal probe was used to measure penetration depth. Samples less than 2 mm in depth were excluded, while those with greater depth were ground using a diamond disk. All the samples were rinsed with distilled water to remove debris produced during the procedure. A piece of Ab Gel was packed under the furcal area.

Samples were assigned to two groups based on contamination or non-contamination with blood, and further subdivided according to materials which were used.

Group A Non contamination with blood , subdivided as Group A1- Light cure MTA, Group A2 - BIO MTA+ ,Group A3 - Light cure Glass Ionomer, Group B contamination with blood, subdivided as Group B1- Light cure MTA, Group B2 - BIO MTA+, Group B3 - Light cure Glass Ionomer.

To simulate contamination, a 21-gauge needle with syringe was used to inject the perforation cavities with blood, provided by the researcher and this 3ml blood was used immediately before the procedures, no anticoagulant substance was used. In Group B, excess blood was removed with paper points, without touching the walls of the perforated dentin.

Both Group A and Group were filled with the test materials using carrier and condensed as per manufacturer's instruction. Cotton pellets, wet with normal saline, were placed over the reparative material in each tooth. All samples were kept in Humidifier at 37°C and 100% relative humidity for 7 days, after which they were subjected to a push-out test.

PUSH-OUT TEST

The push-out test were conducted using a universal test machine (ACME, India). The material placed in the perforation cavity were subjected to a load at a crosshead speed of 1 mm/min in the apical direction and parallel to the long axis of the tooth, using a cylindrical plunger with 1.0 mm diameter, until dislodgement occurs. The maximum load applied to dislodge the reparative material were recorded in Newtons.

The push-out bond strength were calculated in MPa using this formula:

(Force needed to dislodge the material) / (π × diameter of perforation site × height of perforation) where, $\pi = 3.1416$

STATISTICAL ANALYSIS

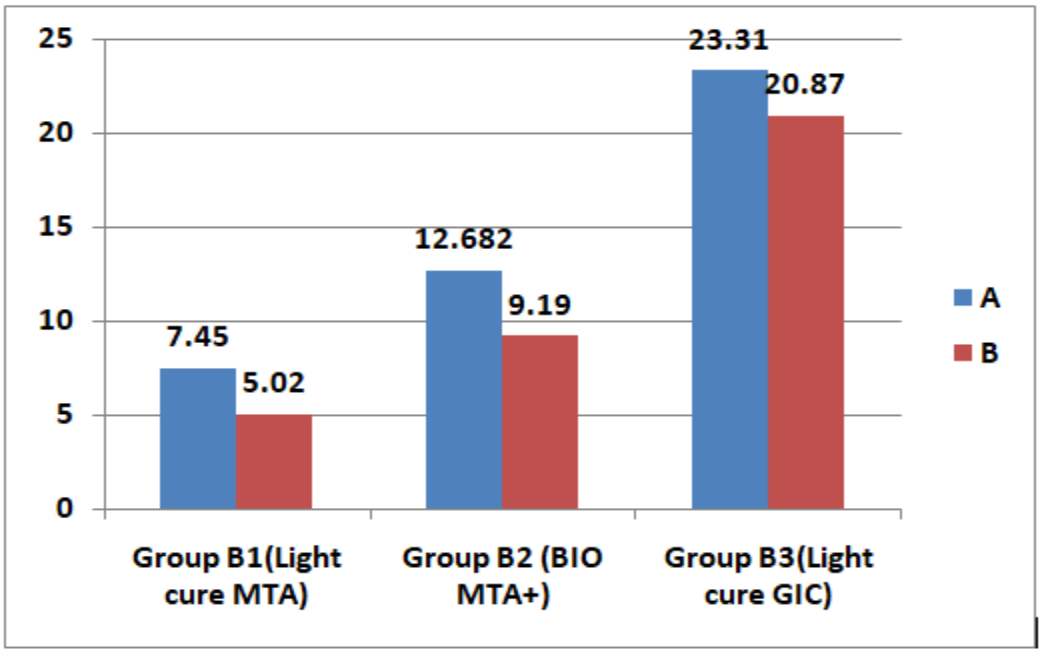
Statistical analysis was performed using Statistical package of social sciences (SPSS) version 21 for windows (SPSSInc Chicago, IL). Descriptive statistics was performed in terms of mean, standard deviation. Data normality was checked by using Shapiro - Wilk test. Overall inter-group comparison among groups was done using unpaired t -test and one way Anova test was used for pairwise Intra-group comparison.

RESULTS

Inter-group comparision shows highly significant value in all three groups(P< 0.001)

Table 1: Intergroup comparison of push out bond strength of Light cure MTA (B1), BIO MTA (B2), Light cure GIC (B3) respectively in furcal perforation after contamination without blood (Group A) and with blood (GroupB)

	A (Non contamination with blood) Mean (SD)	B (Blood Contamination) Mean (SD)	Unpaired t test	P value, Significance
Group B1 (Light cure MTA)	7.45 (0.57)	5.02 (0.51)	t = 8.914	p < 0.001**
Group B2 (BIO MTA+)	12.682 (0.62)	9.19 (1.06)	t = 8.015	p<0.001**
Group B3 (Light cure GIC)	23.31 (1.19)	20.87 (0.91)	t = 4.576	p< 0.001**



Inter group comparison

The highest (**23.31** MPa) bond strength value was recorded in group Light cure GIC without blood contamination, where as lowest (**5.02** MPa) bond strength value was recorded in group Light cure MTA with blood contamination. The group of BIO MTA+ showed intermediate values.

DISCUSSION

The second greatest cause of treatment failures during endodontic procedures is cited as Perforation. It accounts for 9.6% of the total endodontic failures and hence necessitates immediate treatment for a favorable prognosis.[9]

Regeneration of healthy periodontal tissues against the perforation without inflammation or loss of periodontal attachment is the aim of perforation management. But in case of periodontal breakdown, it is important to re-establish tissue attachment. Therefore, the ability to seal the perforation and re-establishing a healthy periodontal ligament are important factors deciding success of perforation repair.[1]

An ideal perforation repair material should resist dislocation under mechanical forces such as condensation forces and when the tooth is under function activities. [8,10,11,12]

Push-out bond strength test measures the interfacial shear strength developed between two surfaces, evaluating information about the adhesive property of the test material and its resistance to dislodgement.[7]

The push-out test evaluates the bonding perforation repair material to root canal dentin. This test can provide a more accurate and better estimation of bonding strength compared to the conventional shear test because the fracture occurs parallel to the dentin-bonding interface, thus making it a true shear test. The advantage of this method over tensile and shear strength tests are that it is less sensitive to small variations among specimens and to variations in stress distribution during load application, and it is easy to align samples for testing. Push-out test is also said to more closely simulate clinical conditions.[11,12]

To overcome the drawbacks of previously used materials, present study evaluated and compared push out bond strengths of Light cure MTA, BIO MTA+, Light cure Glass Ionomer cement in furcal Perforation with and without blood contamination.

Blood consists of different cells and proteins, such as albumin, which interferes with bonding by can occluding the dentinal tubules and gaps between the repair material and dentin walls.[5,8,13,14] Results obtained in the present study indicated that the mean push-out bond strength was significantly higher in Light cure GIC without blood contamination group than the other groups.

Light-cured glass ionomer consists of small, hydrophilic, non-aqueous resin particles combined with a photo initiator and glass powder formulation. Added advantages of this material are its insolubility in oral fluids, high strength, reasonable adhesion to tooth structure, and dual cure properties. Light cured glass ionomers also provides the following benefits: low thermal expansion, low cure shrinkage, and extended fluoride release as found in traditional glass ionomers. Its setting is fast and controllable, as the material polymerizes with visible light. This improved performance and reduced messy handling. Even an inexperienced individual will appreciate the less demanding handling of a light cured glass ionomer. In addition, sealing and resistance to micro-leakage are best provided by material through chelation, chemically bonds to both enamel and dentin (Mount, Hume, 1998), while biocompatible nature of the material has been proven (Human, Love, 2003).[15,16]

Superior bond strength values of Light Cure GIC could be be justified by well-known moisture-resistant property this cement since moisture control is often compromised and hard to be controlled in Root perforation.[14] There are some drawbacks of using MTA: difficulty in manipulation and handling requires both time and practice, setting time of around four hours. In supra-crestal perforations the material may be washed away before it has set. Both white MTA and grey MTA could discolour the tooth and compromise aesthetics.[8,17,18]

Based on its biologic compatibility, clinician can include light cured glass ionomer material in his or her armamentarium for the treatment of endodontic perforations, especially when more suitable materials such as MTA are unavailable. Economically the glass ionomer material has a significant advantage over MTA and it should, therefore, be of beneficial to many clinicians.[19]

The present study suggests that blood contamination of perforation cavity while

placing perforation repair materials, decreased Push-out bond strength. So it is suggested that Haemostasis should be achieved before placement of perforation repair materials into perforation cavity, for better strength, adaptation, sealing of materials

CONCLUSION

Perforation repair is a time consuming and technique sensitive process to the dentist.
So through knowledge regarding its restorability is essential which includes knowledge of size, site, time of perforation and various recently introduced materials being used.
Perforation should be immediately sealed with a biocompatible material. The bond strength of furcation perforation repair material to dentine is important for maintaining the integrity of the seal in the furcation area. A furcation perforation repair material should have enough strength against which intracoronal restorative material could be condensed safely.
Hemostasis should be considered an important stage in perforations because contamination with blood has a deleterious effect on the bond strength of biomaterials to dentin.

Within the limitations of the study, it was concluded that:

1. Push-out bond strength was maximum in Light cure GIC followed by BIO MTA+ and Light cure MTA.
2. Blood contamination decreased the Push out bond strength of these materials.
3. On the basis of the results of this study, Light cure GIC has excellent Push out bond strength, which should be used with internal matrix to repair furcal perforations.
4. In future, further studies should incorporate use of LC GIC in clinical situations to asses the final outcome

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