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Endodontics

EVALUATION OF PUSH OUT BOND STRENGTH OF MTA AND LIGHT CURE MTA USED FOR FURCAL PERFORATION REPAIR: AN IN-VITRO STUDY

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ABSTRACT **Background:** MTA has been well known as one of best material for perforation repair since the time it was introduced. Light cure MTA has been recently introduced and the capability of this resin based MTA in push out bond strength for furcal perforation repair has been evaluated in this study to evaluate its efficacy as perforation repair material. **Aim:** to evaluate push out bond strength of MTA and light cure MTA in furcal perforation repair. **Materials And Method:** the study sample comprised of 24 human mandibular molar teeth. Teeth were submerged in modeling wax, and traditional access cavities were prepared in each tooth using a round bur and a non-end cutting bur with a high-speed handpiece. Furcal perforations were created at the center of the pulpal floor of each tooth using a 0.5 mm round bur. The teeth were then randomly assigned to two experimental groups of 12 specimens each, based on the sealing materials: Group A used MTA, while Group B used light-cure MTA. After the perforations were repaired, the samples were stored in a closed container for 24 hours to allow the cements to set completely. After this period, the samples were cross-sectioned and mounted in acrylic blocks to assess push-out bond strength using a universal testing machine. **Results:** the overall results showed that push out bond strength of light cure MTA is superior to MTA in furcal perforation repair. Data was statistically significant (The p value is less than 0.0001) **Conclusion:** light cure MTA shows better push out bond strength in furcal perforation repair as compared to conventionally used MTA.

KEYWORDS : furcal perforation, MTA, Light cure MTA

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] Perforation might occur during preparation of access cavities, post space or may occur as a result of extension of internal resorption into peri-radicular tissues.[2] It should be sealed immediately using a biocompatible material resistant to forces which are applied during restorative procedures and functional activities as it is of paramount importance for the overall prognosis of root canal treatment. Therefore, it is important to evaluate push-out bond strength of perforation repair material.

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.

The push-out test is an efficient and reliable method, where a gradually increasing pressure is applied to materials until debonding occurs.

MATERIALS AND METHOD

The study was approved by the institutional review board (24/11/2023), (2023-24/1176).

Study Design: this study was a cross sectional study conducted on extracted teeth.

Inclusion Criteria: Extracted human mandibular molar teeth with mature apices.

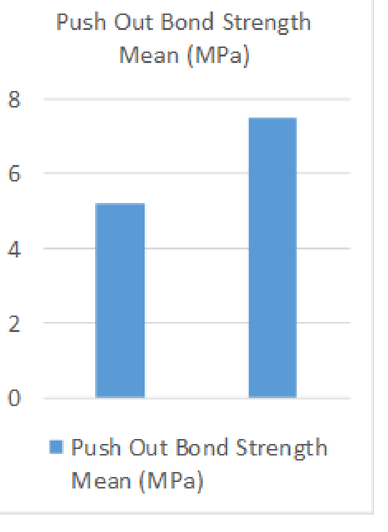
Study Size: sample size was determined based on similar study conducted by Pradnya Nagmode et al in 2023 with α error at 0.05 and power of study being 0.90.

24 extracted human mandibular molar were selected as per the inclusion criteria and were stored in thymol. Access opening was performed using endo access burs (dentsply) and Endo Z bur (SS White), perforation of size 0.5mm was made in the furcation area using a round bur. The samples were then divided equally into two groups (n=12 each). Following which, perforation repair was carried out in group A by MTA (Dentsply Pro root MTA) and in group B by light cure MTA (Dentigrate, Dentact Solutions Private Limited, India). Moist cotton was placed in sample where pro root MTA was used. After 24 hours the samples were longitudinally sectioned and taken for push out bond strength evaluation using Universal Testing Machine.

Statistical Methods

The data was entered on the excel sheet which was transferred to IBM statistical software for social sciences (SBSS) Software version 21.00. The data was checked for normality using Kolmogorov- Smirnov test. The results showed that the data followed normal distribution. The p value is less than 0.0001 which makes it statistically significant.

	A (mean & SD)	Unpaired t test	P value, significance
Group A (Pro root MTA)	5.20 (0.4)	11.90	p< 0.0001
Group B (Light cure MTA)	7.51 (0.54)		



DISCUSSION

A perforation, irrespective of location or etiology, hampers the prognosis of endodontic therapy. 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.[3,4] Factors determining the prognosis include size and location of the defect, time, duration of exposure to contamination, the material used to repair it, the possibility of sealing the perforation and the accessibility to the main canal. Finally, interval between perforation and repair is one of the critical factors for success.[4,9,10,11]

Plethora of materials have been used in past for perforation repair such as Indium foils, Amalgam, IRM, Cavit, GIC, Light cure GIC, etc. with the introduction of MTA by Torabinejad in 1992, new arena of calcium silicate based materials made their way into endodontics.

Ideal requirements of root repair material includes-[5]

- It should provide adequate seal.
- It should be biocompatible.
- It should have ability to produce osteogenesis and cemento-genesis.
- It should be bacteriostatic, and radiopaque.
- It should also be beneficial to use a resorbable matrix in which a sealing material can be condensed.
- It should be relatively inexpensive.
- It should be non-toxic, non-cariogenic and easy to place.
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None of the materials currently available are ideal, but MTA seems to fulfil most of the criteria.

MTA consists of fine hydrophilic particles of Tricalcium silicate, Tricalcium aluminate, Tricalcium oxide, Silicate oxide, calcium sulphate dihydrate, tetracalcium aluminoferrite and small amounts of mineral oxides (bismuthoxide). It has a mean setting time of 165±5 minutes. It stimulates cementoblasts to produce matrix for cementum formation and is biocompatible with the periradicular tissues thus shows a superior sealing ability when used for perforation repair. Several studies have demonstrated that it's excellent sealing ability and biocompatibility.[6] Using different leakage approaches, fluid filtration technique, dye-leakage model, bacterial leakage model, and dye-extraction leakage method, MTA experimentally showed better sealing ability than other materials, such as amalgam, zinc oxide-eugenol cement, resin-modified glass ionomer cements.[7]

At 24 h MTA has the lowest compressive strength (40 MPa) among the amalgam, Super-EBA, and Intermediate Restorative Material (IRM) but it increased after 21 days to 67 MPa, therefore, it should not be placed in functional areas, because of low compressive strength. However, clinical case reports in which MTA has been used to repair furcation perforations with both clinical and radiographic success have also been reported at long-time follow-up.[8,9] The current literature also favors the use of bioactive endodontic cements such as MTA for the repair of perforations to maximize the chances of long-term success. One of the drawbacks, is that it is known to cause discoloration of the tooth structure over time as well as the long setting time.[10,11]

A number of new bioactive endodontic cements have been introduced to the market in recent years. These have also shown promising results without the complication of tooth discoloration,[13,14] although long-term studies compared with MTA are lacking.[12] One of them being light cure MTA.

Incorporating light-curable resins has been proposed for many materials, such as the resin-modified glass-ionomer cement, to reduce their setting time as well as enhance their mechanical properties. MTA incorporated with light-curable resin will have a shorter setting time, extending its therapeutic use and allowing it to be used in wet and blood-contaminated surgical sites. According to a 2010 study by Ricci Vivan et al., light-cured MTA cement had lower solubility values (0.10 percent), as a result of its quick setting.[15]

Dentigrate Light-cure MTA, the calcium silicate-based material employed in this study, is a single-paste calcium silicate-based material recommended by the manufacturer for use as a pulp capping, perforation repair material, as well as a cavity liner under all filling materials. The polymerizable component's setting reaction is light-activated. The improved sealing ability could be attributed to the material's flow, which allows for quicker application and immediate setting.[16]

In the current study, light cure MTA and MTA were used for furcal perforation repair. Since the perforation were small, matrix was not used. Blood contamination also plays a role in setting of these materials, hence results may vary under presence of blood.

CONCLUSION

To conclude, light cure MTA shows better push out bond strength in furcal perforation repair as compared to conventionally used MTA in this research. Various factors such as presence of blood or usage of matrix might play a role in variations. Further studies are required for better understanding of the new light cure MTA for usage in patients.

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