*Research Article*

# Evaluation of sealing ability of MTA as a perforation repair material in primary molars using dye extraction method

**Mahmoud A. Abdelmotelb*, Gomaa Y**, Khattab N*** and Ahmed Elheeny A******
* Department of Pediatric and Community Dentistry, Faculty of Dentistry, Minia University.
** Department of Dental Materials, Faculty of Dentistry, Minia University.
*** Department of pediatric and community dentistry, Faculty of Dentistry, Ain Shams University.
****Department of pediatric and community dentistry, Faculty of Dentistry, Minia University.

## Abstract
**Objectives:** The purpose of the study was to evaluate the sealing ability of MTA for furcal perforation in primary molars. **Materials and methods**: artificial furcal perforation of 1.12mm diameter were performed in 40 freshly extracted primary molars and then divided in to 2 equal groups (20 molars per group); group 1, unrepaired artificial perforation (control group) and group 2, artificial perforation repaired by MTA (experimental group) using 1% basic fuchsin dye and UV visible spectrophotometer to detect sealing ability of experimental group versus control group. **Results**: MTA group [0.23±0.025] demonstrated a high statistical significance in comparison with unrepaired group [0.487±0.033] **Conclusion**: MTA has effective sealing of furcal perforation in primary molars.
**Key words:** MTA, Furcal perforation, Primary molars

## Introduction
Preservation of the primary molars with arch integrity and functional efficiency until the scheduled shedding time is one of prime concerns of pediatric dentistry (Elheeny et al., 2019). Pulp therapy including pulpotomy is widely used for management of carious primary teeth (Togoo et al., 2012). While attempting to perform pulpotomy to primary molars, furcal perforation is one of the most challenging procedural accidents that may occur and should be sealed as soon as possible to prevent bacterial invasion at perforation site and subsequent tooth extraction (Akhavan et al., 2014).

Management of furcal root perforation is a challenge requiring prompt and appropriate treatment with suitable sealing materials for favorable prognosis of involved and successor teeth. While a multiple surgical and non-surgical approaches were described for management of furcal tooth perforation, Non-surgical ones were preferred particularly in pediatric dental patients due to lack of surgical accessibility, bad effects in child psychology and liability for successor tooth germ damage (Youssef, 2019).

Regardless to other factors that control the success of furcal perforation repair, root repair material is considered as a main factor which is under control of the operator (Aidasani and Mulay, 2018). Since an ideal perforation repair material should effectively seal the pathways of communication between the root canal system and the periodontal tissues, for an ideal perforation material, the prospect of microleakage must be nil so as to prevent the movement of bacteria and diffusion of bacteria products from the root canal system into the periodontal tissues and vice versa (Ajas et al., 2018).

Literatures mentioned many methods to assess sealing ability of different root repair materials such as dye penetration, dye extraction, fluid filtration, radioactive isotopes, bacterial and protein leakage, neutron activation analysis, artificial caries, scanning electron microscopy, metal solution tracer, reverse diffusion method, air pressure method and electrical conductivity (Kadhim et al., 2015 and Katge et al., 2016).

## Materials and methods
A Proposal of the study was approved from Ethics Committee -Faculty of Dentistry-Minia University and study was performed to be randomized and blinded. After obtaining acceptance from parents or legal guardians for using extracted molars of their children in scientific research, 40 freshly extracted lower primary

second molars were obtained from outpatient clinic of Pediatric Dentistry Department- Faculty of Dentistry- Minia University.

A piece of gauze soaked into 5% sodium hypochlorite was used to remove any soft tissues covering tooth surfaces and any debris were removed with polishing brushes at low speed hand piece. Each tooth was examined with magnifying eye loop to ensure intact crowns and at least 3 mm of roots apical to furcal zone then selected teeth were stored in physiologic saline for less than one month till next step.

Each tooth was prepared for dye extraction method in similar method to Jeevani et al., 2014 & Katge et al., 2016 & Kadhim et al., 2017& Ajas et al., 2018 and Reddy et al., 2019 as following; roots were amputated 3mm apical to furcation area with diamond stone ISO 848-014 then orifices and apical ends were etched with 37% phosphoric acid gel for 30 seconds followed by rinsing and sealing by two adhesive coats of single bond adhesive system cured for 10 seconds and flowable resin composite cured for 40 seconds.

Each tooth was covered completely including cavity walls and pulpal floor with two successive layers of clear nail varnish then prepared molars were divided in to 2 equal groups (20 molars per group); group 1, unrepaired artificial perforation (control group) and artificial perforation repaired by MTA (experimental group).
Teeth of each group were placed into putty silicon impression material which was mixed according to manufacture instructions to provide a set matrix that simulate the bony socket.

Artificial perforation was created in the center of pulpal floor at high speed hand piece accompanied by copious cooling with round bur ISO 801-010 then width of perforation was standardized at 1.21 mm using a manual H files size 80# to D16 position. For group 2, MTA (3 powder : 1 liquid) was mixed into putty form then applied in perforation site and adapted using moisten cotton pellet then stored in 100% humidity for 24 hours.

For microleakage measuring 0.25ml basic fuchsin 1% (1gm in 100 ml distilled water) dye was applied into access cavity of each tooth for 24 hours then each tooth was rinsed under running tap water for 30 minutes and varnish was removed with parker blade #15. Each tooth was placed in test tube containing 1 ml of concentrated nitric acid for 3 days till complete dissolution of the sample.

Content of tubes were transferred to eppendorfs and then centrifuged at 9000 rpm for 6 minutes then 200Ml of supernatant was collected in cuvette and analyzed by ultraviolet visible spectrophotometer at 550nm wavelength with concentrated nitric acid used as blanket.

Data were collected tabulated and analyzed by Statistical Package for the Social Sciences (SPSS) version 20 using t test to compare means and slandered deviation (SD) of two independent groups.

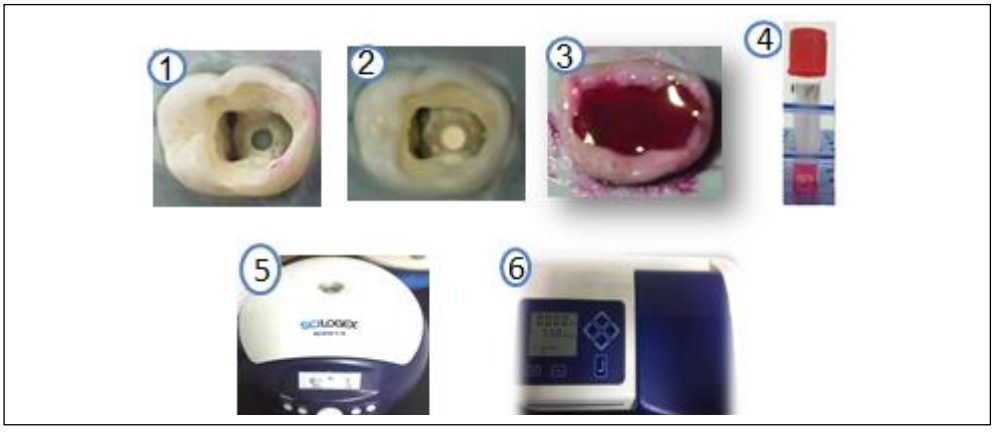


**Figure (1): 1- Artificial perforation, 2-Artificial perforation sealed by MTA, 3- Dye placed into access, 4- Samples placed into nitric acid, 5- Samples centrifuging, 6- Microleakage assessment using UV-visible spectrophotometer**

## Results

MTA group [0.23±0.025] demonstrated higher sealing than unrepaired ones [0.487±0.033] with a high statistical significant difference (Table 1).

**Table (1): Mean and SD of different groups**

| Group | Mean±SD | P value |
|---|---|---|
| **Unrepaired group** | 0.487±0.033 | P = 0.0001 |
| **MTA group** | 0.23±0.025 | |

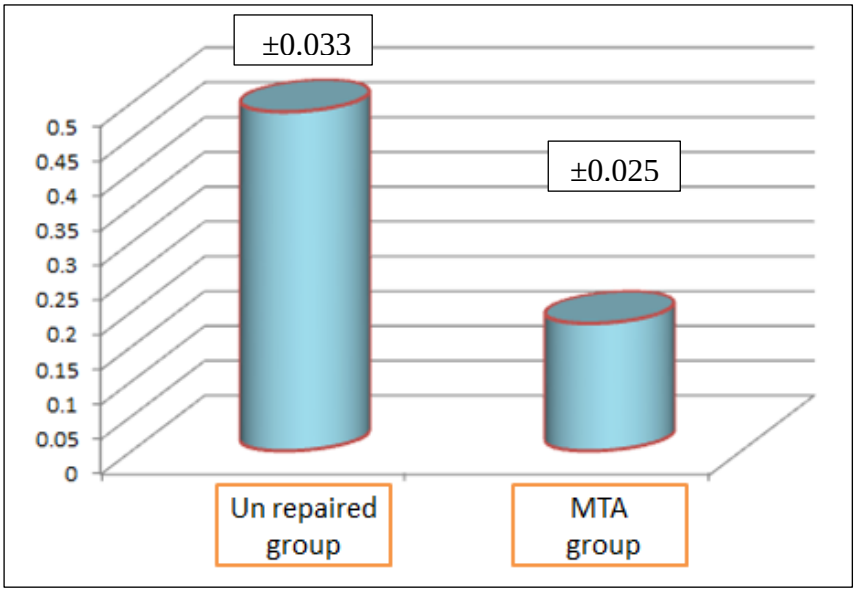


**Figure (2): Means and SD of absorbed light units of different groups**

## Discussion

Since sealing ability of root repair materials was considered as a critical criteria for ideal repair material to prevent bacterial leakage and subsequent consequences (Ajas et al., 2018), sealing ability of the study material were measured and compared with unrepaired perforation (control group).

For standardization of the procedures through the current study definite eligibility criteria were assigned to exclude any confounding factor that may affect accuracy of results as cracks, infarctions and any crown imperfections (Katge et al., 2016) and procedures were performed by single investigator with consideration of the following; sealing of each wall of the tooth, root canal orifices and endings using double layers of clear nail varnish (Reddy et al., 2019) also, standar-dization of the perforation size through using of manual H files (Kadhim et al., 2015).

Dye extraction method were used through the current study as following advantages: (1) materials that can prevent dye penetration (smaller molecules) should be able to prevent bacteria and their byproduct penetration (larger molecules), (2) ease performance, (3) no sophisticated materials or devices required, (4) give similar results as fluid filtration method with advantages of saving much laboratory time, (5) more reliable than dye penetration method as quantitatively measuring the whole dye that was leaked (6) low cost (Yahya, 2015 and Shaheen and Ghoneim, 2018). Basic fuchsin dye was

used rather than methylene blue dye as being more compatible with basic pH of repair materials (Reddy et al., 2019).

Results demonstrated that MTA had better sealing ability than unrepaired perforation with high significant statistical difference. The current study results coincide with results demonstrated by Jeevani et al., 2014, Kadhim et al., 2015 and Ramazani and Sadeghi, 2016 in which different sealing ability assessment methods were used that confirm reliability of this technique in comparing of sealing ability of different root repair materials.

## Conclusion

From the results of the current study authors can conclude that MTA is promising material for furcal perforation repair in primary molars

## Recommendations

More studies are recommended to compare MTA clinical and histological performance in comparison to different root repair materials.

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