



## EVALUATION OF MICROLEAKAGE USING ROUTINE IRRIGATING SOLUTIONS ON MINERAL TRIOXIDE AGGREGATE AS A PERFORATION REPAIR MATERIAL: AN IN VITRO STUDY.

Medical Science

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### ABSTRACT

**Aim:** To evaluate the microleakage using routine irrigating solutions on Mineral Trioxide Aggregate used as a perforation repair material. **Study Design:** Pulp chambers of 80 extracted human molars were accessed, after which standardized diamond bur-cut perforations were created in the center of the pulp chamber floor. Then the perforations in all the samples were repaired with MTA and irrigated with irrigating solutions viz NaOCl, EDTA & MTAD. The samples were coated with a nail varnish and allowed to dry. The samples were then submerged in 2% methylene blue dye for 1 week at room temperature and then analyzed under a microscope. **Results:** EDTA and MTAD showed the most microleakage **Conclusion:** Microleakage of the dye between MTA and the dentinal wall was seen in all groups irrespective of the irrigating solutions used.

### KEYWORDS

#### Aim:

The aim of the present study is to evaluate the microleakage using routine irrigating solutions on Mineral Trioxide Aggregate used as a perforation repair material.

#### Introduction:

Iatrogenic furcal perforation is an unfortunate incident that can occur during root canal therapy or after preparation of multi-rooted teeth. It may be caused due to a pathological process such as caries, internal/external resorption or it may occur at any time during endodontic treatment or during post placement. However, perforation of the furcation area occurs more often during the access preparation in an effort to locate a root canal orifice.

#### Perforations in the furcal area are treated conservatively or surgically.

The most favorable prognosis seems to have the nonsurgical intermediate repair with an appropriate restorative material. The ideal repair material should provide an adequate seal, be compatible, and possess the ability to induce osteogenesis and cementogenesis. Many materials have been used for this purpose, including amalgam, Cavit, IRM, Super-EBA, Glass Ionomer cements and resins. Among them, the use of Mineral Trioxide Aggregate (MTA) has been clearly suggested by most clinicians due to its sealing ability, marginal adaptation and biocompatibility. Following the repair of furcal perforations, endodontic treatment has to be performed with various irrigation solutions to clean the root canal system. This procedure causes inevitable contact of endodontic irrigants with the site and material of furcal repair.

In contrast to the well-documented chemical and morphological effects of routinely used irrigants (e.g., sodium hypochlorite [NaOCl] and ethylene diamine tetra-acetic acid [EDTA]) and relatively newer irrigation solutions like MTAD on root dentin and smear layer, little information exists with regard to the influence of these solutions on the integrity and sealing properties of repaired furcal perforations.<sup>8</sup>

In the light of these observations, the aim of this study was to evaluate the microleakage using different irrigating solutions on mineral trioxide aggregate used as a perforation repair material.

#### Materials & Method:

80 human permanent mandibular molar teeth that had been extracted for periodontal reasons were selected. The teeth were cleaned of debris by placing them in hydrogen-peroxide for 30 minutes and then were stored in fresh saline until use.

#### Inclusion Criteria:

- Non-fused roots
- Well developed roots

#### Sample Preparation:

The teeth were accessed and root canals were negotiated. A furcal perforation was created perpendicular to the center of the pulp chamber floor using a straight bur (MANI SF-11) in an air rotor, which determined the diameter of the perforation (1.1 mm). The length of perforations is equivalent to the dentin and cementum thickness.

A saline moistened cotton pellet was placed in the furcation area, which acted as a stop for the repair material. Then the perforations in all the samples were repaired with Mineral Trioxide Aggregate. Mineral Trioxide Aggregate was mixed according to the manufacturer's recommendations, placed in the perforation using Schilder Pluggers (Osung, Korea), and compacted flush with the chamber floor using the same Schilder Pluggers (Osung, Korea). A saline-moistened cotton pellet was placed over the Mineral Trioxide Aggregate. All the samples were stored at 100% humidity at 37°C for 24 hours.

#### 80 teeth were randomly divided into 4 groups as follows:

**GROUP I:** The pulp chamber was gently irrigated with 10 ml of 5.25% NaOCl for 10 minutes. (n=20)

**GROUP II:** The pulp chamber was treated as for group I, followed by a gentle flush with 5 ml of 17% EDTA for 1 minute. (n=20)

**GROUP III:** The pulp chamber was treated as for group I, followed by a gentle flush with 5 ml BioPure MTAD for 1 minute. (n=20)

**GROUP IV:** No irrigant was used (n=20)

After receiving the irrigation regimen, the cavities were gently irrigated with 10 mL distilled water to neutralize the prolonged effect of irrigants. The samples were coated (except in the pulp chamber area) with a nail varnish and allowed to dry.

The samples were then submerged in 2% methylene blue dye for 1 week at room temperature. Following which the samples were washed under running tap water. The samples were then cut longitudinally parallel to the long axis of the tooth in bucco-lingual direction, using a diamond disc. The sections were then evaluated for leakage, under a stereomicroscope at 10 X magnification and the amount of microleakage was then measured using the following formula:

Microleakage X 100

Total Length

The data thus obtained was subjected to statistical analysis and was analyzed using one-way ANOVA test for significance with Bonferroni corrections.

**Results:**

Descriptive statistics were expressed as mean ± standard deviation (SD) for each group. Between and within group differences in the microleakage after irrigating with different irrigating solutions was analyzed using one way ANOVA test of significance with Bonferroni correction. In the above test, p value less than or equal to 0.05 (p≤0.05) was taken to be statistically significant. All analyses were performed using SPSS software version 17.

**Table no. 1: Evaluation of the microleakage in furcal perforations repaired by MTA after irrigating with Sodium Hypochlorite.**

	Total length (in microns)	Micro leakage (in microns)	Percentage of microleakage
Mean	2291.90	418.64	18.20
Standard Deviation	329.81	89.77	4.03

**Table no. 2: Evaluation of the micro leakage in furcal perforations repaired by MTA after irrigating with EDTA**

	Total length (in microns)	Micro leakage (in microns)	Percentage of microleakage
Mean	1898.60	424.93	22.96
Standard Deviation	415.90	116.52	3.50

**Table no. 3: Evaluation of the micro leakage in furcal perforations repaired by MTA after irrigating with MTAD.**

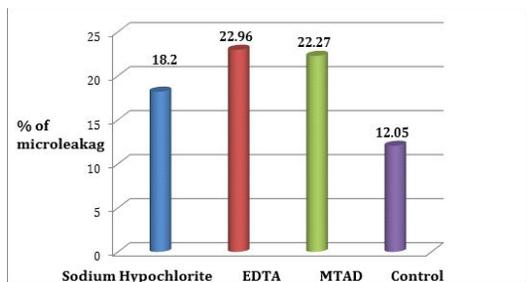
	Total length (in microns)	Micro leakage (in microns)	Percentage of microleakage
Mean	2035.50	449.28	22.27
Standard Deviation	219.94	52.14	2.67

**Table no. 4: Evaluation of the micro leakage in furcal perforations repaired by MTA in the control group (no irrigant).**

	Total length (in microns)	Micro leakage (in microns)	Percentage of microleakage
Mean	1978.30	234.70	12.05
Standard Deviation	191.24	61.34	2.76

**Table no. 5: Comparison of the micro leakage in furcal perforations repaired by MTA after irrigating with Sodium Hypochlorite, EDTA and MTAD irrigating solutions.**

	(GROUP I) NaOCl	(GROUP II) EDTA	(GROUP III) MTAD	(GROUP IV) Control group
Percentage of microleakage (mean)	18.20	22.96	22.27	12.05
P value (One way ANOVA test)	<0.001*			



EDTA≈MTAD> Sodium Hypochlorite > Control group, p <0.001\* P≤0.05 is statistically significant.

**Discussion:**

An ideal endodontic repair material ideally would adhere to tooth structure, maintain a sufficient seal, be insoluble in tissue fluids, dimensionally stable, non-resorbable, radiopaque, and exhibit biocompatibility if not bioactivity. A number of materials have

historically been used for perforation repair, such as amalgam, zinc-oxide-eugenol cements, composite resin, and glass-ionomer cements. There are various other materials also that were or are still used for perforation repair. Apart from the sealing ability of the material being the prime criteria for selection, their extrusion into the furcation area becomes a critical factor in determining their success.

Unfortunately, none of these materials have been able to satisfy the total requirements of an ideal material.

MTA has been known to seal of the pathways of communication between the root canal system and external surface of the tooth. MTA powder consists of fine hydrophilic particles that set in the presence of moisture. Hydration of the powder results in a colloidal gel with a pH of 12.5 that solidifies to a hard structure. The sealing ability of MTA has been shown to be superior to that of other materials like amalgam or Super-EBA. Histological studies show that there is not only a re-establishment of normal periodontium, but there is also a cementum build-up over the material. The cementum attaches itself directly to MTA even when the material has extruded into the furcal defects.

Following the repair of furcal perforations, various irrigating solutions are to be used to clean the root canal system. This procedure causes inevitable contact of irrigants with the site of furcal repair. In contrast to the well-documented chemical and morphological effects of routinely used irrigants (e.g., sodium hypochlorite and EDTA) and relatively newer irrigation solutions (e.g., BioPure MTAD) on root dentin and smear layer, little information exists with regard to the influence of these solutions on the integrity and sealing properties of repair materials used to seal the furcal perforations.

All these irrigating solutions are bound to cause some amount of microleakage. Microleakage has been defined by Sidhu and Henderson as “the clinically undetectable passage of bacterial fluids, molecules and/ or ions between the cavity wall and the restoration material applied to it. Many techniques have been devised to test the sealing properties of dental materials both in vivo and in vitro.

The use of organic dyes as tracer is one of the oldest methods of assessment of microleakage. Many dyes have been used to study microleakage which include Methylene blue dye, Aniline dye, eosin dye, etc. And so in our study we used the dye penetration method.

The most popular dye solution has been Methylene blue. Advantages of aqueous methylene blue dye are that it easily penetrates the water compartment of the tooth, does not react with the hard tissue, and is readily detected under visible light.

Our results are in accordance with the study performed by Andersen M et al. according to which the NaOCl solution has a nonspecific proteolytic effect that can effectively remove organic components from root canals and dentinal tubules. Also, in our study no irrigating solution was used in the control group, which suggests that there was no smear layer removal as well as no effect on the repair material (MTA).

The results of this study indicate that treatment of MTA repaired perforations with calcium-depleting final irrigants such as EDTA or BioPure MTAD have detrimental effects on the seal offered by Mineral Trioxide Aggregate (MTA).

Owing to the acidic pH, the solubility of these repair materials may increase, which, in turn, might adversely affect their sealing abilities. Presumably, dye leakage occurred through these microgaps.

**Conclusion**

**Within the constraints of this in vitro study, we can conclude:**

1. Microleakage of the dye between MTA and the dentinal wall was seen in all groups irrespective of the irrigating solutions used.
2. The NaOCl group showed lesser leakage compared to NaOCl + EDTA and NaOCl + MTAD group.
3. NaOCl + EDTA and NaOCl + MTAD groups did not exhibit much variation in their leakage.
4. The group where no irrigating solution was used showed the least amount of leakage.
5. Hence, this study proved that irrigating solutions do affect the sealability of MTA, when used as a furcation perforation repair material.

6. When irrigating solutions are to be used, than NaOCl should be preferably used to achieve lesser microleakage and better sealability.

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