

## A Comparison between Amalgam and MTA in Repairing Furcal Perforation

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### Abstract:

**Objective:** The purpose of this study was to investigate the histological response to deliberate perforation repaired using amalgam or MTA either immediately or with delay on cats' molars.

**Materials and Methods:** Twenty-eight molar teeth from four cats were used in this experimental randomized study. After preparing the access cavity, the floor of pulp chambers were deliberately perforated with a round bur No. 5. The teeth were randomly divided into four groups of seven. In groups one and two, the perforation was immediately sealed with amalgam and MTA, respectively. In groups three and four, the perforations were left exposed to saliva for six weeks and then sealed with amalgam or MTA. The animals were sacrificed four months later and the specimens processed. The samples were blindly examined for inflammatory reaction and healing process under light microscope. The data were analyzed with Mann-Whitney U and Fisher exact tests.

**Results:** The type of the materials used has no significant effect on the severity of inflammation; while, immediate or delayed repair of furcal perforation has, and immediate application of, MTA produced less inflammation than that of amalgam ( $P < 0.05$ ). No differences were found in vasodilatation, abscess formation or healing process between the immediate and the delayed repair groups ( $P = 0.13$ ).

**Conclusion:** MTA is a more suitable material than amalgam for perforation repair, particularly when used immediately after perforation.

**Key Words:** Inflammation; mineral trioxide aggregate; Dental Amalgam

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### INTRODUCTION

Root perforation is one of the procedural accidents occurring because of misdirecting the bur during or after access preparation. In a study on endodontic failures, Ingle stated that perforations were the second greatest cause of endodontic failures [1].

Seltzer et al [2] showed that furcal perforation results in peri-radicular breakdown and eventual loss of periodontal attachment usually

leading to loss of the tooth. His findings depicted the prognosis of furcal perforations to be poor and suggested that immediate repair of perforation results in a better prognosis.

Many different materials, such as Cavit, Zinc Oxide-Eugenol, Calcium Hydroxide, Amalgam, Gutta-Percha, Tricalcium Phosphate, and Hydroxyapatite have been used so far to repair perforations, among which amalgam has been the most widely used one [3,4].

El Deeb et al [3] found that in dogs the use of amalgam in furcal perforation was superior to Cavit or Calcium Hydroxide. Harris [5] reported 89% favorable responses with the use of Cavit as a repair material. Zinc Oxide-Eugenol and reinforced Zinc Oxide Cements like Super EBA have been studied for the purpose [6].

Clinical reports indicate that furcal perforations have usually been treated conservatively [7] and histological studies have often demonstrated unfavorable tissue response at the treatment site [8]. In the case of any lesion on bifurcal perforation, the aim is to reestablish tissue attachments, which has proved to be extremely difficult to achieve with currently available materials.

Mineral Trioxide Aggregate (MTA) was developed at Loma-Linda University and used ever since to seal any communication between the tooth and external surfaces. Considering its sealing ability and the histological findings, it claims to be an appropriate material for sealing furcal perforations [9-11].

Lee et al [12] compared amalgam, IRM, and MTA in repairing experimentally created root perforations. The results showed that MTA had significantly less leakage than IRM and amalgam [12]. It also showed the least over-filling tendency while IRM showed the least under filling tendency.

Nakata et al [13] evaluated the ability of MTA and amalgam to repair furcal perforation in extracted human molars. Their findings

showed that eight of the 18 amalgam samples leaked, whereas none of the 18 MTA samples did. MTA was significantly better than amalgam in preventing the leakage of *F. nucleatum* past furcal perforation repairs.

The purpose of the present investigation was to examine the histological response to deliberate furcal perforation repaired using amalgam or MTA immediately and after contamination with saliva.

## MATERIALS AND METHODS

Twenty-eight molar teeth from four cats were used in this experimental randomized study. X-rays from the lower and the upper jaws were taken after the animals received general anesthesia using ketamine hydrochloride (10 mg/kg) and Xylezine (1 mg/kg).

After preparing the access cavity, furcal perforations were created one millimeter in diameter using a round bur. The teeth were randomly divided into four groups of seven.

In groups one and two, perforations were immediately sealed with amalgam (Sinaloy, Iran) and MTA (ProRoot, Dentsply) respectively. In groups three and four, perforations were left open to salivary contamination for six weeks before repair with amalgam or MTA.

After confirmation of the apical lesions by periapical x-rays the furcal area was irrigated with saline and filled with amalgam or MTA. All access cavities were sealed with amalgam.

The animals were sacrificed with vital perfusion four months later and the jaws were kept

**Table 1.** Distribution of samples according to material type and inflammatory reaction.

Materials tested	MTA				Amalgam			
	delayed		immediate		delayed		immediate	
	%	n	%	n	%	n	%	n
None	0.0	0	42.9	3	14.3	1	14.2	1
Mild	0.0	0	28.6	2	0.0	0	28.6	2
Moderate	28.6	2	0.0	0	28.6	2	0.0	0
Severe	71.4	5	28.6	2	57.1	4	57.1	4
Total	100	7	100	7	100	7	100	7
Mann-Whitney U Test	Z = -2.13, P = 0.03				Z = -0.56, P = 0.56			

n=number

in 10% formalin for 10 days. Then the samples were decalcified with 5% Nitric Acid, dehydrated with alcohol, and embedded in paraffin. Six-micron sections were prepared from the samples, stained with H&E, and examined under a light microscope (Ziess, Germany).

The healing process, presence of inflammatory cells, vasodilatation and abscess formation were assessed blindly by a pathologist and the data were analyzed with non-parametric Mann-Whitney U and Fisher Exact tests.

## RESULTS

We found that the type of the material used has no significant effect on the severity of inflammation while immediate or delayed repair of furcal perforation demonstrated a significant effect on the matter ( $P=0.03$ ) and, concerning that, MTA produced less inflammation than amalgam when immediately applied (Table 1). In addition, there was no healing in 85.7% of the delayed MTA group (Table 2).

There was a statistically significant relationship between the materials used and the time of application ( $P<0.05$ ) and in those cases where MTA was used immediately after perforation the result was better than amalgam. There was no edema in 70% of MTA cases and in less than 60% of amalgam ones.

In addition, there was no abscess formation in 85.7% of the immediate MTA samples and in 50% of the immediate amalgam ones. Necrosis of bone, resorption of cementum and sequester formation were observed in most of the delayed repair samples. Histological tissue reactions to amalgam and MTA in the immediate

and the delayed repair groups were studied as well.

## DISCUSSION

According to the results of the present study, there was significantly less inflammation in groups in which the perforation was sealed immediately and MTA was found to cause less inflammation than amalgam but the difference was not statistically significant ( $P>0.05$ ). Our experiment was very similar to that of Ford et al [11] in which they examined the histological response to the materials (amalgam and MTA) used for sealing the perforations made in the furcal area of the mandibular teeth of dogs. They noted inflammation in all the samples with immediate application of amalgam. In contrast, in the MTA group, only one of the six samples had inflammation and cementum was formed on the rest of the samples. In the delayed amalgam group, most samples showed inflammation; however, in the MTA delayed group, only three of the seven samples were free of inflammation.

All immediate MTA samples showed moderate to severe inflammation, contradicting what Ford et al [11] found in their study. They showed that MTA does not set in low PH and suggested if pH has to be changed in the inflamed lesion, it is better to apply Ca(OH)<sub>2</sub> or MTA for a week before permanent restoration could be done. We did not follow this guideline and in our findings there was no statistically significant relationship between the type of the materials and the time of application; although, in those cases in which MTA was

**Table 2.** Distribution of samples according to material type and healing process

Materials tested	MTA				Amalgam			
	delayed		immediate		delayed		immediate	
	%	n	%	n	%	n	%	n
Not healed	85.7	6	42.9	3	57.1	4	42.9	3
Healed	14.3	1	57.1	4	42.9	3	57.1	4
Total	100.0	7	100.0	7	100.0	7	100.0	7
Fisher's Exact Test	P = 0.13				P = 0.59			

n=number

used immediately after perforation the result was better than amalgam. There was no edema in 70% of the MTA cases and in less than 60% of the amalgam ones.

In addition, there was no abscess formation in 85.7% of the MTA and in 50% of the amalgam cases. Necrosis of bone, resorption of cementum and sequester formation were observed in most samples and in the majority of the delayed MTA cases, sequester formation and cementum resorption were observed.

In cases of immediate application of MTA, the healing process including granulation tissue and fibrosis were observed with no deposition of cementum over MTA. In the present study, a period of four months was considered enough to observe the healing process in the perforation area. Corcoran et al [14] observed complete bone regeneration sixteen weeks after standard periapical surgery in rhesus monkeys.

In our study, in most samples bone necrosis, resorption of cementum and sequester formation were observed and only two samples showed osteoid and granulation tissue. Also in the delayed MTA group, more sequester and cemental resorption was obvious while only one sample showed granulation tissue and fibrosis. Holland et al [15] conducted a study to observe the healing process of intentional lateral root perforation repaired with MTA. Their findings depicted no inflammation and deposition of cementum over MTA in the majority of the specimens.

In a long-term study, Main and associates found that MTA provides an effective seal of root perforation and promises the improving prognosis of perforated teeth that would otherwise be compromised [16].

## CONCLUSION

Based on the results of this study it seems that when a perforated site is immediately sealed with either MTA or amalgam, the prognosis is more promising and in that case, MTA shows

better results than amalgam. However, statistically, there was no difference between immediate usage of amalgam and MTA.

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