The Effect of Different Clinical Conditions on Adaptation of Two MTA Forms

(An in vitro study)

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Many kinds of materials have been used in endodontics with continuous development of new materials in an attempt to produce a material having good physical, mechanical, biological and handling properties. One of these is MTA (mineral trioxide aggregate), A newly developed material that has different applications in root canal therapy with reliable outcome and long term prognosis such as pulp capping, lateral root or furcation perforation repair, root end filling, apexification and internal or external root resorption Fig(1). These are all situations that require a material to rely on, providing good sealing ability, biocompatible and non-absorbable.

Unlike zinc oxide-eugenol cement, resin composite and amalgam which causes the formation of fibrous connective tissue adjacent to the bone [(1)], it has been proved to be highly biocompatible being cemento-conductive allowing overgrowth and attachment of cementoblast with little or no inflammation, facilitate regeneration of periodontal ligament (tolerable to the connective tissue) and allow the production of mineralized matrix gene and protein expression that are important for mineralization. Elemental analysis of MTA revealed an overall composition of MTA as: 58.9 % calcium, 20.1 % bismuth, 9.4 % silicon, 2.1 % aluminum, 2.7 % sulphur, 4.4 % iron, with trace amount of chromium, nickel and lead[(2)].

Due to some disadvantages (long setting time, high alkalinity breaking down the protein structure causing weakening of root dentin and high cost), there have been some investigations trying to improve MTA by mixing it with different vehicles other than distilled water.

Such as Chlorhexidine Gluconate: 0.12 % that increases the antimicrobial activity. Bio pure MTAD (mixture of tetracycline isomer, acid and detergent): increases surface roughness and extracted calcium to increase strength and sealing properties. On exposure to different PH during setting there is change in surface hardness being harder on higher PH. Propylene glycol gives similar biological behavior to distilled water but more easily placed into the root canal. Increasing water powder ratio than recommended by manufacturer: increases solubility and porosity and Methyl cellulose 1% and calcium chloride 2% to improve handling characteristics.

Properties of MTA could be affected and altered by the different kinds of materials used during routine endodontic procedures. Sodium hypochlorite and saline used for canal irrigation, calcium hydroxide used for apexification and the blood that could be present due to perforation, improving its properties or decreasing it and this is what was investigated in this study.

Two commercial forms of MTA have been available: ProRoot MTA consists of 75% Portland cement, 20% bismuth oxide and 5% calcium sulfate dehydrate. And Angelus MTA Consists of 80% Portland cement and 20% bismuth oxide with no calcium sulfate dehydrate in an attempt to reduce the setting time (2 hours for ProRoot and 10 min for Angelus).

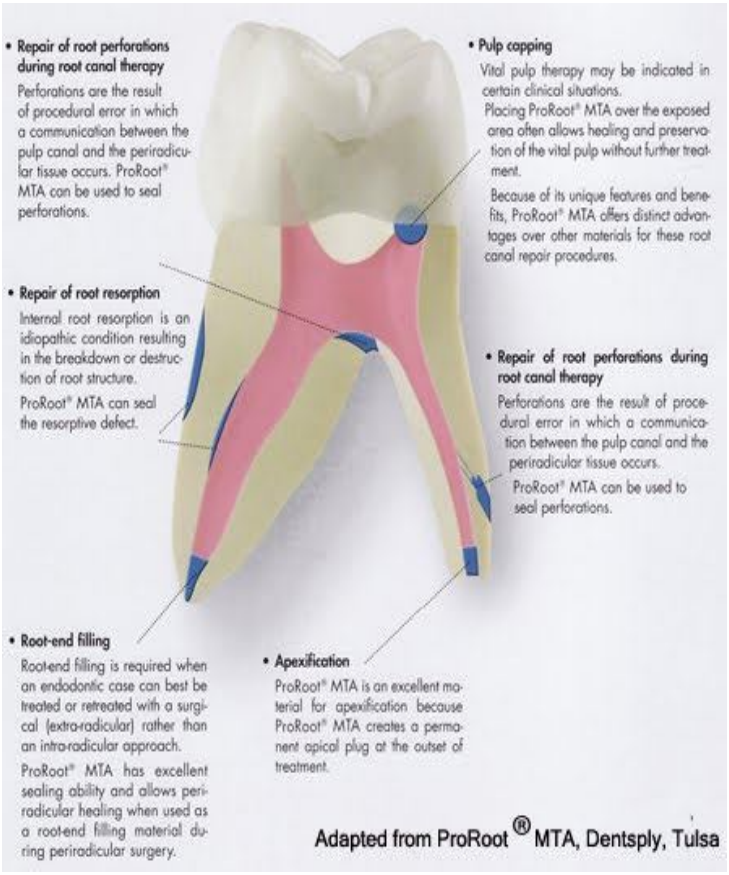

Fig. 1: Uses of mineral trioxide aggregate, (adapted from ProRoot MTA, Dentsply, Tulsa.

The aim of this study was to investigate the effect of blood contamination on mineral trioxide aggregate after irrigation with sodium hypochlorite or saline during furcation perforation repair regarding:

1. Sealing ability.

2. Bond strength (bond strength between MTA and dentin).

We all know that a good access cavity is a main principle for good successful endodontics. One of the iatrogenic problems encountered in endodontics is perforation of the pulpal floor during access cavity preparation. In the past, poor prognosis for strip and furcation perforations was probably due to bacterial leakage or lack of biocompatibility of repair materials. However, the recent development in the techniques and materials such as mineral trioxide aggregate (MTA) has enhanced the prognosis for such cases.

Repairing this perforation has been one of the greatest concerns dentists are trying to deal with, to assure successful endodontic treatment. As furcal and strip perforations are followed by bacterial contamination, periradicular tissue injury, inflammation, bone resorption, periodontal destruction, epithelium proliferation, and periodontal pocket development [(3)]. The principle goal of endodontic therapy is to remove bacteria and seal the root canal to promote osseous healing and regeneration. The ideal characteristics required for perforations repair materials are the same as those needed for all root-end filling materials. An ideal perforation repair material should adhere to and seal the root canal system in three dimensions, be nontoxic, and be well tolerated by the surrounding tissues. It must be dimensionally stable, non-absorbable, and not affected by the presence of moisture.

In addition, it should not corrode and be easily manipulated. Numerous materials have been suggested as perforation repair materials, such as zinc oxide-eugenol, Cavit, amalgam, resin composite, and glass ionomer

Each of these materials has its own effect on the surrounding tissues that will also differ if it has been contaminated.

In this review these effects were investigated & compared to MTA.

I) Materials other than MTA:

A) Sealing ability:

Alhadainy and Himel. (1994) [4], testing the sealing ability and the effectiveness of using plaster of Paris under amalgam and glass ionomer was made in this in vitro study. By preparing 60 extracted human molars, opening an access cavity and drilling a perforation at the furcation area. Teeth were divided into 4 groups: filling them with amalgam alone, amalgam with plaster of Paris underneath, light cure glass ionomer alone and light cure glass ionomer with plaster of Paris underneath. Teeth were immersed in 2 % erythrocin B dye solution for 2 weeks, then longitudinal sections was made to measure dye penetration. The least leakage was in glass ionomer alone followed by glass ionomer with plaster of Paris. And the most leakage in amalgam and amalgam with plaster of

Paris. But there was a benefit that plaster of Paris prevented overextension of the repair filling material with both amalgam and glass ionomer.

Mannocci et al. (1997) [5], Amalgam, IRM, Vitremer, Bisfil, and Ana Norm Liner were evaluated for repair of experimentally induced lateral perforations. Eighty-five sounds, mandibular, and maxillary molars, extracted for periodontal reasons, were selected for this study. The sample teeth were randomly divided in five groups with 15 specimens each. Ten teeth were used as control groups. After the perforations were filled with the above-mentioned materials, the teeth were immersed in a 2% methylene blue solution for 48 h, sectioned, and dye penetration was measured. The results indicated that Bisfil 2 B provided a significantly better seal than the other materials.

Imura et al. (1998) [6], using Indian ink to measure coronal leakage they made this study to investigate the sealing ability of different materials. Making furcation perforation in 90 extracted human lower molars with size 012 round bur in the center of pulpal floor. Repairing them with amalgam, composite resin, calcium sulphate under composite resin and calcium hydroxide under composite resin, immersing teeth in Indian ink for 4 days at 37˚c after covering the whole teeth with nail varnish except the access opening area. Longitudinal sections were made and the dye penetration was measured from the coronal level of the used material to the apical end of the perforation.

All groups showed penetration with various degrees but with no statistical significant difference between them, but calcium sulphate and calcium hydroxide were seen to decrease over-extrusion of composite resin.

Jantarat et al. (1999) [7], one of the most important complications that could occur during endodontic treatment is the furcation perforation especially during access cavity preparation. Also some clinician may face some difficulty in placing the repairing material. So the aim of this study was to discover the effect of matrix placement by testing the sealing ability of amalgam and Ketac silver with and without plaster of Paris as a matrix. Sealing ability was measured by placing Streptococcus sobrinus bacteria in the perforated pulp chamber of extracted human mandibular molars. And the time taken for bacterial growth was recorded in the medium bathing root surface. Finding that plaster of Paris improved the sealing ability of amalgam but not Ketac silver providing the best seal when used alone, but all of the samples showed leakage after 22 days.

Fuss et al. (2000) [8], made an in vitro evaluation for sealing furcation perforation with silver glass ionomer cement. Using 25 extracted intact human teeth, sealing their coronal canal orifices with amalgam, a modified fluid transport system was used to quantitatively evaluate coronal leakage through pulp chamber floor before and after perforation and repair under pressure of 1.2 Atm. Teeth were then disconnected from the system and