MINERAL TRIOXIDE AGGREGATE. A BETTER PULP-CAPPING MATERIAL. REVIEW AND CASE REPORT.

Sasidhar N *

** Professor, Department of conservative Dentistry and Endodontics, Dr. Sudha Nageswara rao Institute of Dental Sciences, Gannavaram, Andhra Pradesh.*

ABSTRACT

Pulp capping is defined as the placement of a dental material over an exposed pulp to initiate the formation of irritation dentin at the site of injury. Classically, different formulations of calcium hydroxide have been used. Today, a newer material is advocated for vital pulp therapy, mineral trioxide aggregate (MTA). It is proved that the exposed dental pulp has the capacity to heal when micro leakage and bacterial contamination are prevented. An effective pulp-capping material should be biocompatible, osteoinductive and it should provide a biological seal and prevent bacterial leakage.This article describes these properties of MTA and a case report of direct pulp capping with MTA in a molar.

KEY WORDS; ***MTA, Direct pulp capping***

INTRODUCTION

Trauma and caries are two common causes of pulpal exposure. In many clinical situations, during tooth preparation and removal of decayed dentin, it is possible that the dental pulp be exposed accidentally. Several investigators have demonstrated that the exposed dental pulp has the capacity to heal when micro leakage and bacterial contamination are prevented - Pulpal vitality maintenance not only increases the survival rate of a tooth but also saves patient's and practitioner's time. Therefore, it is a prudent clinical practice to maintain the pulp vitality to the maximum extent, by placing an effective pulp capping material like MTA over exposed pulp, which will provide a biological seal, and prevent bacterial leakage.

Review of literature

A wide array of materials has been used for direct pulp capping. Many authors[1] believe that calcium hydroxide remains the standard material for pulp capping. In fact, calcium hydroxide has been the most time tested candidate for capping of pulp exposures. It has been speculated that the high alkalinity of Ca (OH)2 was responsible for producing a zone of necrosis just below the material interface at the exposure site[2].The necrotic tissue is removed by phagocytes and replaced by granulation tissue, along with an invasion of pioneer fibroblastic cells from which new odontoblastoid cells are thought to be developed. This results in formation of a new dentin bridge[3]. However, calcium hydroxide shows many disadvantages[4] when used as a pulp capping agent such as tunnel defect and inflammation of the pulp.

A mineral trioxide aggregate (MTA) was developed at Loma Linda University in 1990s as a root end filling material. The use of MTA as a root-end filling material was identified because the material is hydraulic cement that sets in the presence of water. A patent was taken out for MTA in 1995 by Torabinejad & White.

MTA consists of 50–75% (wt) calcium oxide and 15–25% silicon dioxide[5]. These two components together comprise 70–95% of the cement. When these raw materials are blended they produce tricalcium silicate, dicalcium silicate, tricalcium aluminate and tetracalcium aluminoferrite. On addition of water the cement hydrates to form silicate hydrate gel.

This material was studied in a series of in vivo and in vitro investigations by various researchers [6,7,8]. MTA displays excellent low levels of micro leakage when placed into extracted teeth.

MTA has been recommended for vital pulp therapy, root end filing, apexification, and perforation repair.[9]
Histological findings in dogs have confirmed that this material has great potential to facilitate tissue healing[10].
Many teeth showed necrosis and inflammation in their histological specimens. Therefore, in judging the efficacy of a material as a pulp capping agent, it is important to determine the presence or absence of inflammation (type and severity) and necrosis, in addition to calcified bridge formation [11].
Presence of imperfections in many bridges made us to question the concept of dentin bridges. Studies have shown that calcified bridge is more consistent and thicker when MTA has been used as the pulp capping material in comparison with calcium hydroxide .[12]

Cox and associates[13] have shown that healing is more dependent on the capacity of the capping material to prevent bacterial micro leakage rather than the specific properties of the material itself. They have shown that space between restoration and the cavity walls could be a pathway for bacterial leakage and failure of a case. Therefore, if a tight seal is achieved and reasonable material is selected, mature dental pulp will be able to differentiate into the specific cell lineage forming tubular dentine.
However, Calcium hydroxide is a soluble material and can not produce a tight seal against microleakage.[14]
Junn DJ, McMillan P, Bakland LK, Torabinejad M[15] selected 53 teeth that had deep caries with vital pulpal tissue and no prior restorations. Caries were removed under magnification and NaOCl was used to obtain hemostasis within a short period of time (1 to 10 min.). 1.5-3.0mm thick layer of MTA was placed over the exposure. The teeth were restored provisionally with un bonded resin restoration. At a subsequent visit, the teeth were restored with a bonded restoration. Over a 9 year period of observation, the authors found that 49 of 53 had a favorable outcome on the basis of radiographic appearance, subjective symptoms & cold testing. All teeth (15 of 15) in younger patients with open apices showed completed root formation apexogenesis.
It has been shown that MTA is an insoluble material and can provide tight seal which could prevent bacterial access to the pulp tissues. The reparative dentin is consistently more uniform and thicker under MTA compared with calcium hydroxide. In a published study it has been shown that MTA was a considerably better material than calcium hydroxide in maintaining the integrity of the pulp. [16] It has been tated that MTA, because of its high PH, especially when freshly mixed, will cause denaturation of adjacent cells and tissue proteins. This denaturation includes a few bacteria that might be present in the wound area. As the materials set, the PH changes and the cell injuries subside[17] unlike calcium hydroxide, where cell injuries persist for a longer time.
Tziafas D and associates[18] conducted a in vivo study to assess the pulpal cell response and the onset of reparative dentine formation after capping application of MTA in mechanically exposed pulps and found deposition of hard tissue of osteotypic form in all teeth in direct contact with the capping material and the associated crystalline structures. Formation of reparative dentine (tubular matrix formation in a polar predentine-like pattern by elongated polarized cells) was consistently related to a firm osteodentinal zone. This study concluded that MTA is an effective pulp-capping material, able to stimulate reparative dentine formation by the stereotypic defensive mechanism of early pulpal wound healing.
Although pulpotomy with calcium hydroxide, has shown to be more promising clinical results, pulp capping with using MTA is recommended for many better reasons.
First, it is not important that the pulp wound bleeding should be completely stopped prior to placing the MTA. As a matter of fact, the presence of a small amount of blood provides
necessary moisture for setting of the material and has been shown to work as well as any other fluid[19].
Secondly, it is not necessary to re-enter the pulpotomy site later to remove the pulp capping material, as it has been recommended for calcium hydroxide pulpotomies by Cvek[20]. MTA does not appear to deteriorate and disintegrate with time, thus space for micro leakage does not develop as it does with calcium hydroxide.
Thirdly, previous research has shown that the pulp responds favorably to the protection provided by an MTA layer. Nair et al [21] reported that MTA resulted in less pulpal inflammation and more predictable hard tissue barrier formation in permanent teeth in comparison to hard-setting calcium hydroxide.

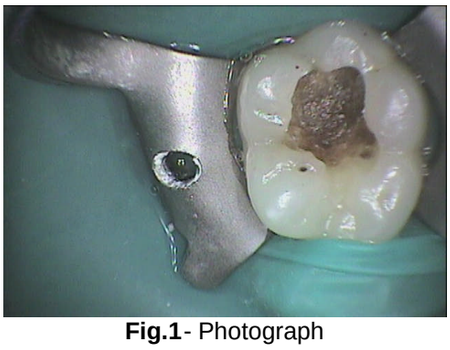

Fig.1- Photograph

Fig.2- Pre operative radiograph

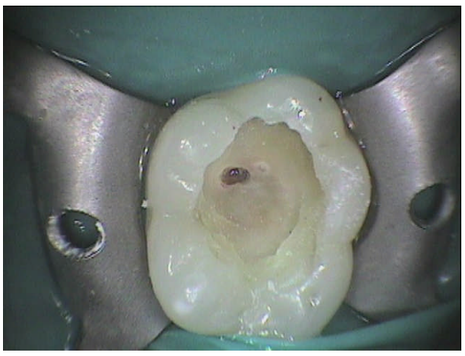

Fig.3-Photograph after caries excavation

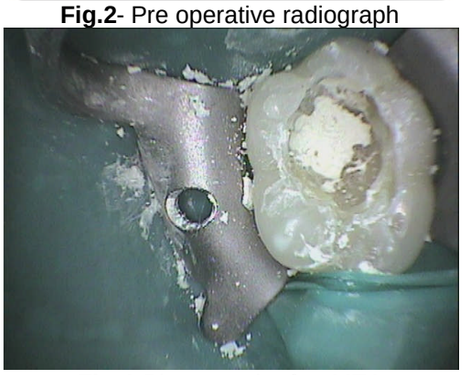

Fig.4-Photograph after MTA placement

Fig.5. Radiograph after MTA placement

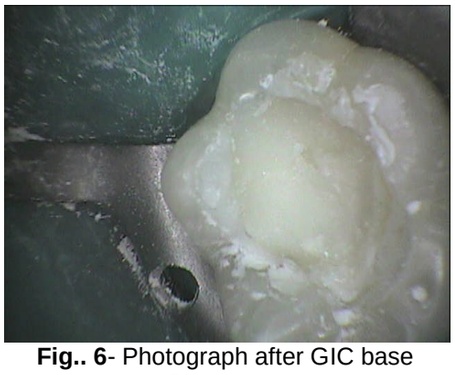

Fig.. 6- Photograph after GIC base Placement

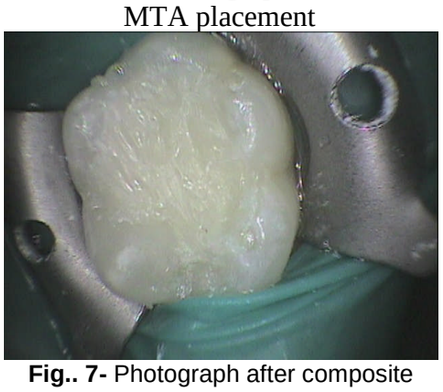

Fig.. 7- Photograph after composite restoration

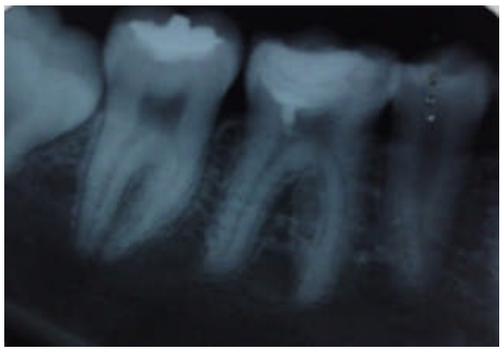

Fig.. 8-Photograph of radiograph after 6 weeks

Case Report.

A male patient aged 28, reported to Department Of Conservative Dentistry and Endodontics with history of pain in left lower jaw at posterior region for a week. Patient was suffering from pain for few seconds when he got exposed to cold or hot.

On clinical examination there was caries with moderate extension in mandibular left first molar (Fig.1).On radiographic examination revealed a radiolucency into dentin and was closely approximating pulpal space (Fig.2). There were no radiographical changes in pulpal space or periodontal space. Peri apical area was normal.

On thermal and electric pulp testing the mandibular left first molar gave an exaggerated response for few seconds, after which it was normal. Patient had no signs of apical periodontitis, allowing the clinician to arrive a conclusion of "reversible pulpitis" in relation with mandibular first molar.

Excavation of caries with a sharp excavator under rubber dam, resulted in a small pink pulpal exposure of 1mm diameter (Fig..3). Bleeding was controlled by placing a small cotton pellet dipped and squeezed of excess of sodium hypochlorite for 2minutes. Patient had little pain and sensitivity. After correlating all these findings, direct pulp capping with MTA was planned.

Procedure:

Pro Root MTA powder (0.25gram) was mixed with distilled water, in 3:1 ratio, into a smooth creamy paste and was placed over pulpal exposure (Fig..4). Moist cotton pellet was placed over which IRM was done and radiograph was exposed (Fig..5). Patient was recalled on next day. After removal of IRM and cotton pellet it was found that MTA was hard enough to plan a glass ionomer restoration, Fuji II GIC base (Fig.6) and composite restoration (Z 350 3M) was given as per the manufacturers recommendation (Fig. 7).

Patient was asymptomatic at his next visit, after 6 weeks, pulp vitality tests gave a normal response and no radiographic changes (Fig..8) were observed. Patient was kept under long term observation.

CONCLUSION

Many are reluctant to perform direct pulp capping procedures due to unpredictable outcomes with traditional materials like calcium hydroxide. MTA may be a more predictable and successful material for direct pulp capping teeth with a pulpal condition no more severe than reversible pulpitis, because of its advantages like cell adherence & growth, increases in alkaline phosphatase/ osteocalcin, interleukin production, promotes PDL attachment & cementum growth, dentinal bridge formation, antimicrobial activity, minimal micro leakage, cementoconductive, non toxic and non-mutagenic properties.

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Corresponding Author :

Dr. sasidhar M. D.S.,
Professor
Department of Conservative Dentistry & Endodontics,
Dr. Sudha Nageswara rao Institute of Dental Sciences, Gannavaram,
Andhra Pradesh., India.
Email: duhitadent@gmail.com
Ph: 91-944-036-4064.