MTA: the new biocompatible material of choice for direct pulp capping in cariously exposed immature teeth with open apex: A case report

Aditi Subodh Jain1*, Pragya Jaiswal2, Vaibhav Sharma3, Apoorva Bhatnagar4, Abhinav Singhal2

1,3,4Dept. of Conservative Dentistry & Endodontics, 2Assistant Professor, Dept. of Conservative, 5Senior Lecturer, Dept. of Pedodontics, Maitri Dental College & Research Centre

*Corresponding Author:
Email: aditijain300789@gmail.com

Abstract

The importance of pulp vitality preservation can never be overstated. Cvek's partial pulpotomy helps to salvage the exposed pulps preventing the need for further endodontic treatment. It is usually undertaken in teeth with open apices or thin dentinal wall to promote root development. MTA is new bioactive cement with dentin-like mechanical properties which can be used as a dentin substitute. It has a positive effect on vital pulp cells and stimulates tertiary dentin formation. In direct contact with vital pulp tissue, it also promotes the formation of reparative dentin and in properly selected cases may contribute to the long-term maintenance of tooth vitality. MTA pulpotomy consisted of pulp tissue removal to a depth of 2 mm, then capping the pulp wound with MTA, followed by immediate restoration. The teeth were assessed clinically through pulpal sensitivity tests and radiographically for periapical healing. At each recall (24 hours, 1 week, 30 days, 3, 6, 12, and 18 months), no spontaneous pain was observed; the pulp showed signs of vitality and absence of periapical radiolucency after 18 months. MTA pulpotomy is recommended as a treatment option for cases of vital pulp exposure in permanent teeth due to carious exposure.

Keywords: MTA, Direct Pulp Capping, reversible pulpitis, Reparative Dentin

Introduction

Pulp integrity of the tooth should be maintained for:
1. Long term survival
2. Retain the tooth as functional unit
3. Withstand heavy masticatory forces

A vital, functioning pulp is capable of initiating several defense mechanisms to protect the body from bacterial invasion. It is beneficial to preserve the vitality of an exposed pulp rather replacing it with a root canal filling material following pulp exposure. Direct pulp capping in cariously exposed pulp of young immature teeth has yielded a markedly high success rate. In 1920, a new era in the treatment of exposed pulp began when Hermann introduced Calcium Hydroxide that induced the bridging of the exposed pulp with reparative dentin.1,2 Both clinically and histologically it has been found to produce satisfactory results in indirect and direct pulp capping. For many decades calcium hydroxide formulations are the best documented and most reliable materials for direct pulp capping and serve as the “gold standard”. Nevertheless, calcium hydroxide has some drawbacks like tunnel defect during dentinal bridge formation, poor bonding to dentin, material resorption and mechanical instability. The high pH (12.5) of calcium hydroxide suspensions causes liquefaction necrosis at the surface of the pulp tissue.3,4

Various competitive substitutes have been introduced in restorative dentistry, out of which MTA, a bioactive cement is comparatively better than others. MTA stands for mineral trioxide aggregate, denoting the three dominant oxides in the material’s composition, namely – calcium, aluminum and selenium. Its particle sizes are strictly controlled during manufacturing, as they all need to be less than 10 microns, so that the material may be completely hydrated. MTA has a similar mechanism of action to Calcium Hydroxide in that the main component of the material, calcium oxide, when in contact with a humid environment, is converted into calcium hydroxide. This results in a high pH of 12.5, making its surroundings inhospitable for bacterial growth, and producing an anti-bacterial effect for a long period of time.

Case Discussion

A 19-year-old female patient reported to our department with the complaint of a pain on consuming hot and cold food stuff only when it was in contact with the exposed tooth. History revealed that patient experienced momentary pain on having cold drinks which was relieved once the stimulus was removed. On examination pulpal involvement was seen in relation to several days of carious pulpal exposure.

MTA pulpotomy in mature permanent teeth following several days of carious pulpal exposure.

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along with gentle application of small sterile cotton pellets for 5 minutes until the bleeding was arrested. Freshly mixed MTA was immediately placed over the exposed pulp, after placing the MTA, the operator laid a flat, water moistened cotton pellet directly over the material and provisionally restored the tooth with unbonded Clearfil Photocore (Kuraray Medical, Okayama, Japan) that was photopolymerized for 60 seconds. In second visit provisional restoration was removed and then finally sealed with direct composite restoration.

Periodic follow-ups were carried out at 24 hours; 1 week; 30 days; 3, 6, 12, and 18 months. The following was checked: Tenderness to percussion, swelling and pain. Electric pulp testing was done after a period of time & Radiographic examination to check for evidence of any root resorption or widening of the periodontal ligament space.

**Discussion**

Direct pulp capping with MTA over a carious exposure in an immature permanent tooth may be a reasonable alternative to root canal therapy or extraction. Various studies on pulp capping have been done on mechanically exposed teeth and mature teeth with good results. Seltzer and Bender have suggested that a mechanically exposed young pulp has a better prognosis because of its repair potential in the absence of contamination when compared with carious exposures which have chronic inflammation secondary to microbial invasion. Bodem et al. found that pulps remained vital after direct capping of cariously exposed primary molar pulp with MTA.

Factors which influence treatment decisions when encountering teeth with pulp exposure include the degree of infection and inflammation of the pulp rather than the size or duration of pulp exposure. For traumatic exposures in young asymptomatic immature teeth, direct pulp cap or partial pulpotomy are the treatments of choice. In contrast, carious process can lead to marked changes within the pulp-dentin complex which can vary considerably depending on the severity of the disease and the age of the pulp. It is generally agreed that larger carious exposures have a poor prognosis due to a more severely inflamed pulp, risk of necrosis and bacterial contamination. Careful case selection and treatment planning is critical for better outcome of treatment rendered.

The histologic extent and degree of inflammation cannot be accurately predicted clinically. The current study included factors that are believed to give indications of the health and healing capacity of pulpal tissue prior to treatment i.e. age of the patient, size of exposure and radiographic appearance. Each of these factors has been cited in the literature as having some relevance in the ability of the pulp to recover from a pulp exposure.

Since years calcium hydroxide is being used for direct pulp capping. MTA has been shown to give better results than calcium hydroxide in direct pulp capping of non-inflamed pulps. Aeinheiti et al. reported less inflammation and thicker dentin bridge with MTA than calcium hydroxide when used as a pulp capping material in human teeth with mechanical pulp exposures. According to Pitt Ford et al. MTA’s superiority could be due to its good sealing ability and biocompatibility. MTA has proven to be one of those very few exogenous materials that is not only well tolerated by connective tissues but also contributes to a bacteria-tight seal.

Optimum hemorrhage control is essential for successful outcome of direct pulp capping regardless of the material used. Sodium hypochlorite (NaOCl) in concentrations 2.5-5.25% when placed on an exposed pulp, in addition to being ideal for hemorrhage control, provides asepsis. NaOCl results in chemical amputation of the blood clot and fibrin along with the removal of
damaged cells and operative debris from the exposed pulp site. Optimum hemostasis will also help to achieve the goal of bacteriostatic seal. Several studies have shown that sodium hypochlorite did not impair or retard the cellular healing of exposed pulps and is not inhibitory to the biologic mechanisms of odontoblastic cell or dentin bridge formation. In addition it can be used for removal of residual microbial flora, which can be a major deterrent in healing of exposed pulp.

Infected dentin in contact with pulp tissue is likely to encourage inflammation and discourage reparative dentin formation. The use of sodium hypochlorite for hemostasis and disinfection is recommended by some authors for MTA pulp caps and is cited by several authors as being critical to the success of this procedure. Others preferred a cotton pellet moistened with sterile saline for this step.

Following a pulp capping procedure, bacterial leakage through the final restoration is considered by some to be more detrimental to outcome than bacterial contamination at the time of the treatment. This finding underlines the need for a good seal in the final restoration after the completion of the pulp capping procedure. For this reason, unbonded Clearfil Photocore was placed above the pulp cap before permanent restoration. Composite restoration was preferred as permanent restoration.

Conclusion

MTA is an interesting and promising material which has the potential of making major contributions to maintain pulp vitality in patients judiciously selected for direct pulp capping. The teeth in which direct pulp capping was carried out were asymptomatic and did not develop any tenderness to percussion. Electric pulp testing revealed vital response at the end of 18 months. Radiographic examination revealed absence of periapical lesion or widening. In both cases a well-defined radio-opaque layer formation was seen on the pulpal aspect adjacent to the layer of MTA suggestive of a calcific barrier and apical closure was also seen. Cvks pulpotomy can be considered a viable treatment option in such cases.

Clinical Implications

Vital pulp therapy using MTA is a treatment option for teeth diagnosed with a condition no more severe than reversible pulpitis.

References

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