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# Partial Pulpotomy in Mature Maxillary Permanent First Molar with Symptomatic Irreversible Pulpitis: A Case Report

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## ABSTRACT

Partial pulpotomy is the preferred treatment for maintaining the health, integrity of teeth and their supporting tissues by preserving the vitality of the tooth by removing only the degenerative and irreversibly inflamed part of the coronal pulp and leaving the healthy and vital pulp tissue. Coronal pulpotomy is a vital pulp therapy that removes 2-3 mm of the exposed pulp tissue from the coronal pulp portion and filling it with a pulp capping material to heal the pulp wound and to promote healing and preservation of pulp vitality. This case report describes a clinical management of pulpal exposure on a mature maxillary first molar treated by partial pulpotomy with proper clinical and radiographic diagnosis with a follow-up of one year. This article demonstrates that partial pulpotomy can replace conventional invasive endodontic treatment if the prognostic factors are favorable.

**Keywords**

Vital pulp therapy, Partial Pulpotomy, Mineral trioxide aggregate, Symptomatic Irreversible Pulpitis

## INTRODUCTION

Vital pulp therapy is a biological approach that can be used to treat permanent teeth with irreversible pulpitis which removes inflamed pulpal tissue from the coronal pulp chamber and covering it with a

biomaterial inorder to provide healing. It can be either remove 2-3 mm of the exposed pulp (partial pulpotomy) or removes the entire coronal pulp (complete pulpotomy) depending on the caries progression and vitality of the tooth. The range of VPT procedures includes direct pulp capping, indirect pulp capping, partial pulpotomy and complete pulpotomy. For tooth with traumatic pulp exposure, reversible pulpitis and asymptomatic carious exposure , partial pulpotomy can be an effective treatment for the mature permanent teeth. Partial pulpotomy may be more successful treatment in younger adults than in older adults as teeth in older adults has less blood supply and is more fibrous, that can make a successful outcome less likely. Pulpotomy is better than conventional root canal treatment in terms of preserving vitality of the teeth and proprioception and maintaining neurosensory ability.

Partial pulpotomy (Cvek's Pulpotomy) technique has been used until 1983 with a mixture of calcium hydroxide to initiate reparative dentin formation by controlling infection and to stimulate the wound healing process[1]. In the past decade, Mineral trioxide aggregate (MTA) became popular for maintaining the healing of the pulp tissues as it provides good sealing ability, biocompatibility, and low cytotoxicity and even induces odontoblast to form a hard barrier [2,3]. MTA was first described by Dr Mahmoud Torabinejad in 1993 in the dental scientific literature [4]. Historically, partial pulpotomy has been widely used in immature permanent teeth (with open apices) as part of apexogenesis to maintain root development. However, with advances in materials like MTA and bioceramics, it has become a viable treatment option even for mature permanent teeth with localized pulpitis. By preserving the vital pulp, partial pulpotomy minimizes the need for more invasive procedures such as root canal therapy and promotes natural healing processes like the formation of reparative dentin. For the long-term prognosis of the vital pulp therapy appropriately selecting agents and techniques, and preventing future bacterial contamination are critically important [5].

Radiographic findings play a crucial role in diagnosis, treatment planning and post -operative evaluation. Before and after the procedure, specific radiographic changes are expected to assess the success and healing of the pulp and surrounding tissues. Radiographs such as periapical or bitewing images are typically used for these evaluations. In some cases, cone-beam computed tomography(CBCT) may be utilized for more detailed visualization of pulp tissue, root development and periapical health.

A study was conducted on human permanent molars comparing MTA and Calcium Hydroxide as a pulp capping material in the year 2003 [6], revealed that thicker bridges were formed in each of the MTA samples, the presence of an odontoblastic layer was frequent, and some of the few samples had hyperemia. On the contrary, Calcium Hydroxide does not adhere to dentine and it has the tendency to dissolve over time, so that it lacks the ability to seal and tunnel defects in dentine bridges under Calcium Hydroxide can act as pathways for microleakage. Indeed, the results showed that inflammation was seen more frequently with greater severity, no odontoblastic layer was formed, and necrosis was also more frequent in calcium hydroxide samples.

The outcome of partial pulpotomy using MTA compared with calcium hydroxie in mature cariously

exposed permanent molars were studied and recorded by Taha and Khazali [7] . They found a statistically significant difference between MTA and Calcium hydroxide with success rates of 83% vs 55% at 1 year, 85% vs 43% at 2 years respectively. Ideal pulpotomy materials should provide effective bleeding control, antibacterial and should preserve the viability of the remaining pulp tissue. Sodium hypochlorite (NaOCl) is preferred in Vital Pulp Therapy studies due to its hemostatic and antibacterial properties [8, 9].

MTA due to its good sealing ability, biocompatibility, and high antimicrobial activity, is widely used as a pulp capping material in pulpotomy treatments. Furthermore, MTA contributes to tertiary dentin formation by stimulating odontoblasts [10]. This case report documents a successful treatment outcome of partial pulpotomy procedure with MTA capping technique in a maxillary first molar with a deep carious lesion and without any radiographic evidence of periapical changes.

**CASE REPORT**

A 22-year-old female patient presented to the department of conservative dentistry and Endodontics, complained of spontaneous pain in the upper left quadrant and severe pain that persisted after having hot drinks. On clinical examination, showed a large carious lesion affecting the distal surface of the maxillary left permanent first molar (tooth 26) was identified (Figure 1). Periodontal probing revealed no abnormalities, sinus tract and swelling was not identified surrounding the affected tooth. Tooth was non tender on percussion and palpation.Patient complained of pain while having food. Pulp vitality test was performed using cold test (Endo Ice; Coltene, Altstätten, Switzerland), thermal test and EPT. The response was reproduced on cold testing. Extraoral examination revealed no facial asymmetry or swelling was associated with the involved tooth. Patient had no medical history and was not under any medication.

On radiographic examination, showed an extremely deep proximal carious lesion which was approaching the pulp and there was no evidence of periapical changes associated with the involved tooth (Figure 2). Therefore Clinical, radiographic, and pulp sensibility examination results led to the diagnosis of symptomatic irreversible pulpitis without apical periodontitis for the present case. The treatments options of pulp space therapy and vital pulp therapy were explained to the patient. Based on the clinical assessment and discussion with the patient, a decision was made to treat the tooth with VPT, depending on the health of the pulp tissue . The patient was aware that if VPT was not indicated, then endodontic therapy would be initiated on the visit. The patient was signed the written informed consent after a detailed explanation of the procedure.

**Figure 1:** Preoperative clinical view of tooth 26

**Figure 2:** Preoperative radiograph of tooth 26

After local anaesthesia using 2% Xylocaine with 1:80,000 adrenaline and under rubber dam isolation, the deep proximal caries and remaining infected dentine were removed using a size #3 carbide round bur (SS White Burs, Inc., New Jersey; USA) mounted in a high-speed contra-angle handpiece with water coolant, the tooth was cleaned with 5.25% sodium hypochlorite. Access cavity was gained using a size #3 carbide round bur, de-roofing the pulp chamber and cavity refinement was done using an Endo-Z bur (Dentsply Maillefer, U.S.A).

**(a)**

**(b)**

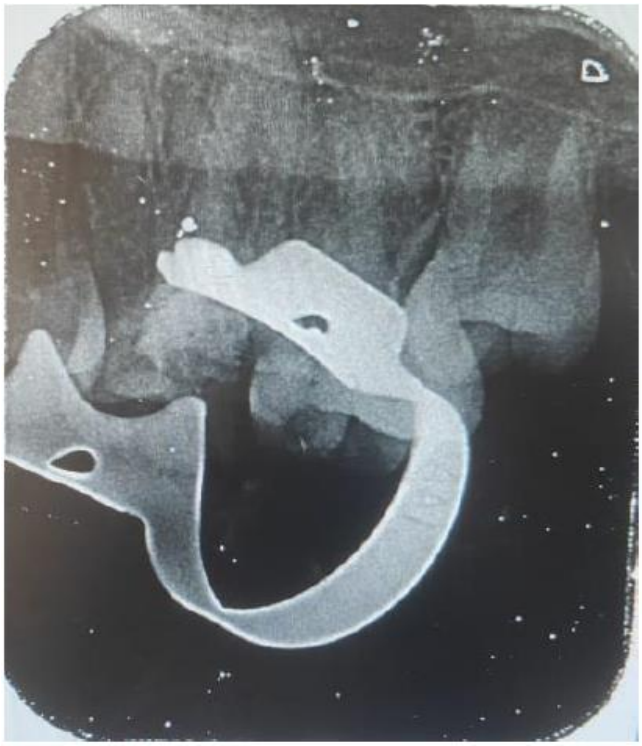
**Figure 3: (a) A clinical photograph showing the pulp chamber after excavation of the coronal pulp (Access opening) (b) Clinical photograph showing the pulp chamber after achieving hemostasis.**

Coronal pulp of 2 to 3 mm was removed and the cavity was rinsed using 2.5% NaOCl solution, and the pulp tissues were evaluated. A cotton pellet soaked in 2.5% NaOCl was applied for 2 minutes inorer to achieve hemostasis. Remaining inflammed coronal pulp tissue was removed using a sterile sharp spoon excavator.

Subsequent examination of the pulpotomy site revealed healthy pulp tissue with blood clot (Figure 3 (a) and (b) ). The MTA powder (MTA, Angelus, Londrina, Brazil) was dispensed into a dappen dish and a drop of sterile water was then gradually incorporated into the powder in a ratio of 3:1 powder to liquid and was mixed with a spatula till full wetting

of the powder particles. Freshly mixed MTA was placed on the exposed pulp tissue of 2-3 mm deep cavity (Figure 5) following the manufacturer's instruction, with the help of plastic instruments and burnisher followed by placement of temporary restoration with zinc polycarboxylate for two weeks and MTA placement was confirmed with the help of a radiograph(Figure 6).

**Figure 4:** Clinical photograph showing pulp chamber after application of MTA



**(a)**

**(b)**

**Figure 5:** (a) and (b) Radiographic images showing placement of MTA on the pulp chamber

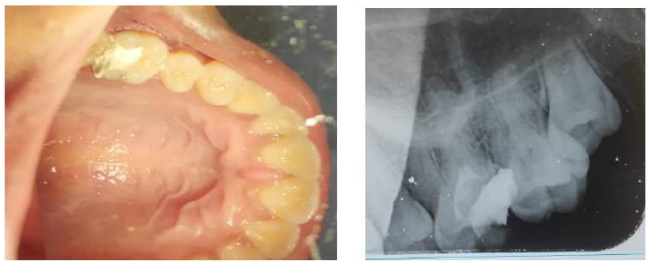
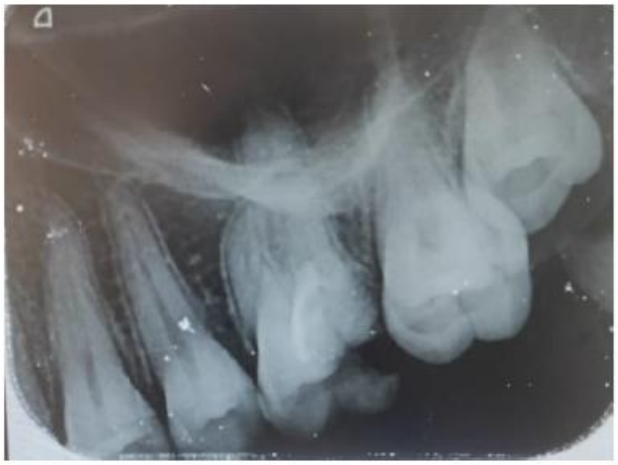


**Figure 6:** (a) Cinical photograph and (b) radiographic image showing placement of temporary restoration (zinc polycarboxylate cement)

After the two weeks of follow up, the temporary restoration was replaced by permanent restoration. RMGIC (resin modified glass-ionomer cement (Fuji II LC; Japan)) was applied and restored the cavity with direct resin composite (TetricCeram, Ivoclar Vivadent) (figure 8).A post-operative intraoral periapical radiograph was taken at baseline (Figure 7(b)) on the same day inorder to confirm MTA placement in the pulp horn and the composite restoration.

**(a)**



**(b)**

**Figure 7:** Clinical and radiographic images after 2 weeks of recall (a) clinical image of confirmation of MTA on the pulp chamber after removal of temporary restoration (b) radiographic image shows the MTA on the pulp chamber

Patient was recalled for the follow-up examinations at 3,6 and 12 months clinically and radiographically. On the follow-up visit, the patient did not report any pain or discomfort.

**(a)**

**(b)**

**Figure 8:** (a) Clinical photograph showing postoperative composite restoration (b) post operative radiographic image of permanent restoration

**DISCUSSION**

Partial pulpotomy is a vital pulp therapy procedure that involves removal of a small portion (approximately 2-3mm) of inflamed coronal pulp tissue beneath the exposure to preserve the vitality of the remaining pulp [11]. In the present case, tooth 26 (maxillary first molar) presented with carious pulp exposure but showed signs of pulp vitality and controlled bleeding, suggesting that the inflammation was limited to the superficial pulp tissue. As the superficial layer of infected tissue was removed, partial pulpotomy is the first treatment choice for carious pulp exposure [12,13]. Therefore partial pulpotomy was considered a conservative and appropriate treatment option to maintain pulp vitality and normal tooth function. The clinical studies about the success of partial pulpotomy procedure in carious pulp exposure, and more long-term data are needed even when there are symptoms of irreversible pulpitis are low [13-15].

After removal of the inflamed pulp tissue, hemostasis was achieved, which is an important indicator of healthy remaining pulp. A biocompatible pulp capping material such as MTA and Biodentine were placed over the pulp inorder to promote hard tissue formation and dentin bridge formation. These materials provide good sealing ability, biocompatibility and stimulate reparative dentin formation. The carious exposure with symptomatic irreversible pulpitis were well managed by the removal of coronal pulp tissue either partially or completely [8].

Studies have shown that partial pulpotomy has high success rates when proper case selection, aseptic technique and good coronal seal are achieved. Preservation of pulp vitality helps to maintain proprioception, nutrition and defense mechanisms of the tooth, which contributes to long term prognosis .Regular clinical and radiographic follow up is necessary to evaluate the success of the treatment.

Successful outcomes are indicated by absence of pain, normal pulp vitality and absence of periapical pathology.

In response to pulpal inflammation, vascular and cellular reactions take place, which would lead to vasodilatation, causing an increase in blood vessel permeability, leading to the accumulation of leukocytes and the migration of neutrophils from the blood vessels to the injury site. Complement components are triggered in the presence of antigen-antibody complexes. Histologically, under penetrating caries, exposed pulp exhibits microabscess formation[16).

Calcium hydroxide has been used in vital pulpotomy for many years to cause a coagulation necrosis, which include a low-grade irritation that leads to differentiation of the undifferentiated pulp cells. These undifferentiated pulp cells synthesize predentine that is subsequently mineralized, while the coagulated tissues are calcified[17]. MTA is one of the materials of choice which has been suggested for use in vital pulpotomy treatment, with a reparation mechanism in which the natural mechanism for repairing the tooth itself by forming a new hard tissue bridge (dentin bridge) over the exposed pulp which is similar to that of calcium hydroxide. When MTA compared with calcium hydroxide, MTA produces significantly more dentinal bridging in a shorter period of time with significantly less inflammation and also provides a hard setting, non-resorbable surface without the presence of tunnels in the dentine barrier[18,19,20].

Mineral Trioxide Aggregate is a hydraulic cement which sets in the presence of moisture, with an excellent seal, bioactivity, and has good physical characteristics [21]. Multiple studies reported a high success rate of MTA capping in adult pulpotomy [22-24].

Hemostasis in pulpotomy means stopping bleeding from amputated coronal pulp before placing the medicament and restoration. Proper hemostasis indicates that the remaining radicular pulp is healthy enough to keep the tooth vital. However, even after attempted hemostasis with a cotton pellet saturated with 2 mL 2% NaOCl or saline, if one or more pulp stumps keep bleeding, a superficial radicular pulpotomy can be carried out, whereby more inflamed tissue is removed from the canal up to 3–4 mm from the radiographic apex [25,26]. Baume et al. in 1971, introduce radicular pulpotomy as a treatment option for vital pulps under specific conditions (category III pulps). The technique involved removing up to 3–5 mm of radicular pulp from the apex using cylindrical reamers, followed by immediate root canal filling. Histologically, this method promoted healing through osteopontin deposition, calcific sealing, and fibrosis without inflammation[27].

Enodontic therapy has been considered as a treatment of choice for permanent teeth diagnosed with Symptomatic Irreversible Pulpitis. RCT is a reliable way to eliminate pulp infection in patients diagnosed with Symptomatic Irreversible Pulpitis, where the remaining healthy pulp is also removed [28]. Thus, the potential of the pulp repair and immune defense mechanism is completely lost. Over time, with the development of materials and techniques and a better understanding of the healing ability of the pulp, Vital Pulp Therapy has been practiced as an alternative to Root Canal Treatment [29]. Since the bacteria are one of the main causes of irreversible pulp disease, the present study evaluated the procedure for MTA

pulpotomy in which different hemostasis and disinfection protocols were applied in patients with Symptomatic Irreversible Pulpitis. MTA pulpotomy of permanent teeth with symptomatic irreversible pulpitis showed a high success rate clinically and radiographically in the present study [8, 30].

Hemostasis is one of the critical steps that affects the success of pulpotomy treatments. Clot formation in the exposed pulp area prevents direct contact with the pulp capping material and pulp tissue [31]. Therefore, effective hemostasis, and a proper coronal seal are the most important factors for long term success of partial pulpotomy with symptomatic Irreversible Pulpitis.

With the development of hydraulic calcium silicate materials like MTA, plays an important role in better understanding of pulp biology, pulp regeneration, and vascularization, coronal pulpotomy has been recommended as a definitive treatment in permanent teeth even with irreversible pulpitis [32,33]. In pulpotomy, Resin Modified Glass Ionomer Cement functions as a sealing base with minimal marginal leakage over the pulp medicament to protect the pulp and support the final restoration. The final restoration was done with composite resin, which provided compressive and tensile strength, restore function, esthetics and maintain a bacterial seal.

**CONCLUSION**

MTA pulpotomy is a highly effective treatment for permanent teeth with Symptomatic Irreversible Pulpitis in maintaining the vitality of the radicular pulp after removal of the inflamed coronal pulp tissue with a high success rate and long term prognosis. With excellent biocompatibility, superior sealing ability and capacity to stimulate dentin bridge formation, MTA promotes pulp healing , regeneration and vascularization. When the pulp is vital and the infection is limited to the coronal portion, partial pulpotomy is a preferable and conservative alternative to root canal treatment, as it preserves pulp vitality and maintains the natural structure and function of the tooth.

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