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Clinical Out Comes of Partial Pulpotomy in Mature Permanent Molars with Irreversible Pulpitis: A Case Report

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Abstract **Case Report**

Irreversible pulpitis has long been considered a formal indication for conventional root canal treatment. However, recent advances in pulp biology and the development of bioactive materials have challenged this concept, positioning pulpotomy as a conservative alternative for preserving pulp vitality. This report presents clinical cases of mature permanent molars diagnosed with irreversible pulpitis and treated by partial pulpotomy. After achieving controlled hemostasis, a bioceramic material was placed, followed by a definitive coronal restoration. Clinical and radiographic follow-up revealed complete resolution of symptoms and absence of apical pathology, confirming the preservation of pulp vitality. Current evidence suggests that partial pulpotomy in teeth diagnosed with irreversible pulpitis can achieve high success rates when strict clinical protocols are respected. Proper case selection, effective hemorrhage control, and adequate coronal sealing remain critical factors for treatment success. Bioceramic materials play a pivotal role due to their bioactive and antibacterial properties, as well as their ability to stimulate reparative dentin formation. This therapeutic approach aligns with the principles of minimally invasive dentistry and highlights the potential of vital pulp therapy as a predictable treatment option for mature permanent teeth.

Keywords: Bioceramic material, Pulpotomy, reparative dentin, Vital pulp therapy.

INTRODUCTION

Regenerative endodontics has emerged as an essential aspect of modern dentistry, reflecting a shift away from approaches based on systematic root canal treatment. Recent advances particularly in vital pulp therapies, have significantly transformed the management of vital teeth by emphasizing the preservation of pulp vitality whenever possible [1]. Beyond its biological importance, the maintenance of pulp vitality represents a major clinical objective.

Dental pulp plays a fundamental role in dentin formation, immune defense, and tissue repair, thereby contributing to tooth longevity and resistance to microbial challenges. Preserving this vital tissue helps prevent the complications associated with pulpal necrosis while supporting the principles of minimally invasive dentistry and contemporary ethical standards focused on beneficence and patient-centered care [2]. In parallel, the development of bioactive biomaterials, especially tricalcium silicate–based cements, has enhanced the predictability of vital pulp therapy procedures. Techniques such as partial pulpotomy are now considered reliable alternatives to full pulpectomy, owing to their ability to promote pulp healing and reparative dentin formation [2,3].

This report aimes to assess the role of partial pulpotomy in the management of irreversible pulpitis by analyzing its clinical effectiveness within modern minimally invasive dentistry.

CASE PRESENTATION

Case 1

A 17-year-old male patient in good general health, presented in emergency with spontinuous pain related to the tooth 36. Clinical examination revealed that the tooth 36 exhibited a mesial SiSta 2.3 carious lesion. The cold test induced a positive response which persist after removal of the stimulus and positive response to the transverse percussion. Preoperative panoramic radiography showed a mesial carious lesion extending to the inner third of dentin without any signs of periapical pathology. [Fig.1 and 2]

Based on the clinical and radiographic findings, a diagnosis of symptomatic irreversible pulpitis was established. Inferior alveolar nerve block and intra-septal anesthesia were administered. Then, under rubber dam isolation, a complete caries excavation was performed, resulting in pulp exposure. The cavity was disinfected with 2.5% sodium hypochlorite an partial removal of the coronal pulp tissue adjacent to the carious lesion was carried out using a diamond round bur. [Fig. 3a and 3b] Hemostasis was achieved using a sterile cotton pellet soaked in 5% sodium hypochlorite, with bright red bleeding controlled within less than 5 minutes.

Finally, mineral trioxide aggregate [MTA] was deposited under the pulp exposure. [Fig.3a and 3b] A moist cotton pellet then glass ionomer cement were placed as a temporary restoration. Postoperative radiograph confirmed adequate sealing of the pulpal exposure with the capping material. [Fig. 3c]

Seven days later, the tooth was asymptomatic, allowing the removal of the temporary restoration and the placement of a definitive composite resin restoration. [Fig. 4] Clinical and radiographic follow-up at 1 month and 3 months demonstrated the absence of symptoms or radiographic abnormalities. The tooth responded normally to pulp sensibility test, indicating successful preservation of pulp vitality [Fig. 5].

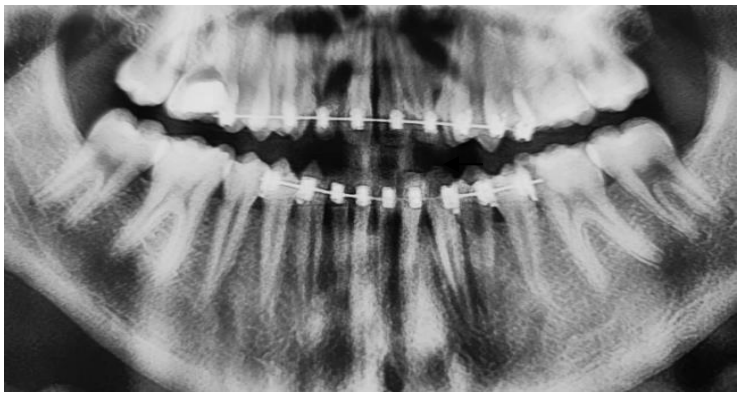

Figure 1: Preoperative radiograph.

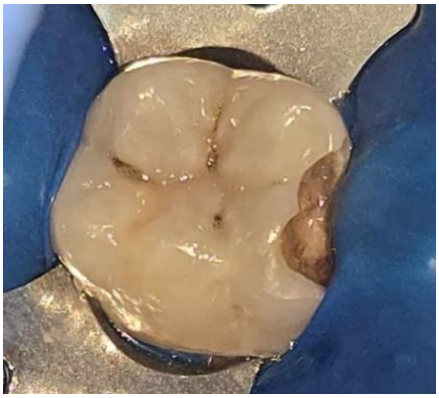

Figure 2: preoperative view.

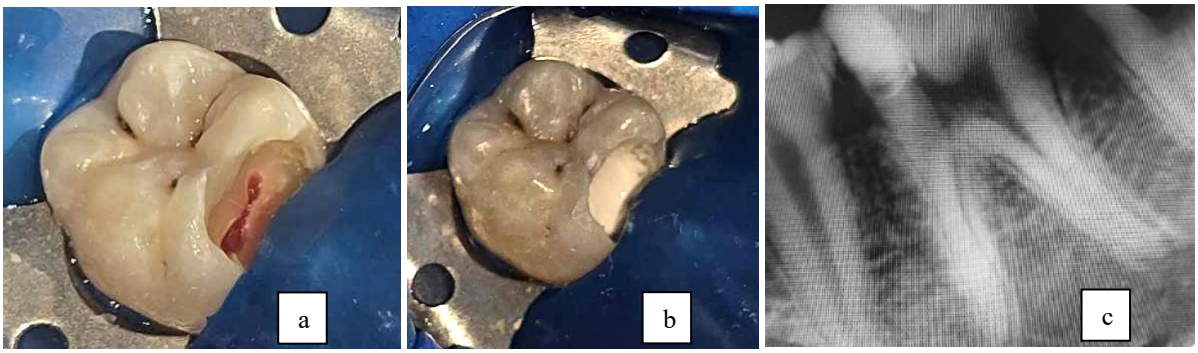

Figure 3: [a] curreting of the carious lesion and partial pulpotomy. [b] pulp capping with MTA. [c] post-operative radiograph

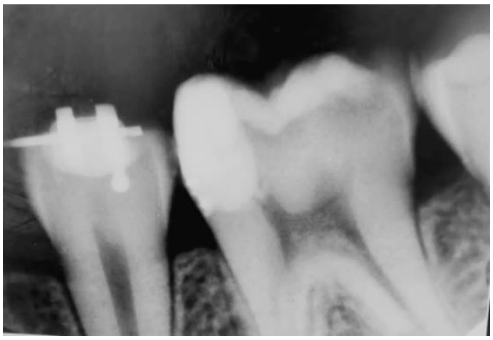

Figure 4: Periapical radiograph at 1 months Follow-up.

Figure 5: Periapical radiograph at 3 months follow-up.

Case 2

A 28-year-old female patient in good general health was referred to the department of conservatrive dentistry and endodontics for the management of tooth 26 presenting recurrent caries under a glass ionomer restoration. The tooth was asymptomatic, while the cold test induced a delayed response. Preoperative periapical radiograph revealed a large pulp chamber without signs of pulpal calcification or retraction. [Fig.6]

Based on the clinical and radiographic findings, a diagnosis of asymptomatic irreversible pulpitis was established. A partial pulpotomy procedure was therefore planned. Periapical anesthesia combined with intra-septal anesthesia was administered, followed by the placement of a well-sealed rubber dam. Complete and careful caries excavation was performed using a round bur mounted on a contra-angle handpiece under copious irrigation, resulting in a pulpal exposure. Partial removal of the coronal pulp tissue adjacent to the carious lesion was carried out using a diamond round bur under continuous irrigation. [Fig.8a] Hemostasis was achieved using a sterile cotton pellet soaked in 2.5% sodium hypochlorite, with bright red bleeding controlled within less than 5 minutes. A layer of mineral trioxide aggregate [MTA] was then placed directly over the pulp tissue, followed by placement of a moist cotton pellet and temporary restoration with glass ionomer cement. [Fig.8b and 8c]

After 7 days, in the absence of clinical symptoms and with a normal response to the cold test, definitive coronal restoration was completed using flowable bulk-fill composite as a dentin substitute covered with a layer of conventional resin composite. [Fig.9]

Clinical and radiographic follow-up at 1 month and 3 months demonstrated absence of symptoms and radiographic abnormalities, with successful preservation of pulp vitality of tooth 26. [Fig.10]

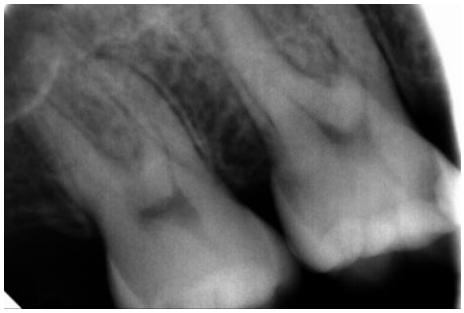

Figure 6: Preoperative radiograph

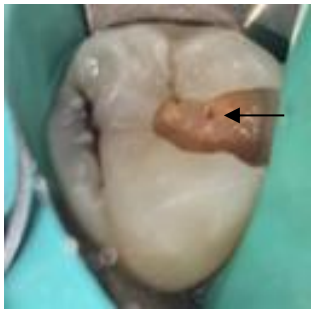

Figure 7: curreting of the carious lesion and pulp exposure

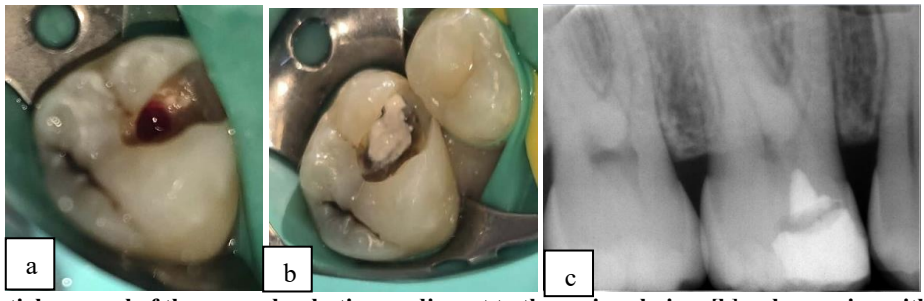

Figure 8: [a] Partial removal of the coronal pulp tissue adjacent to the carious lesion. [b] pulp capping with MTA. [c] post-operative radiograph

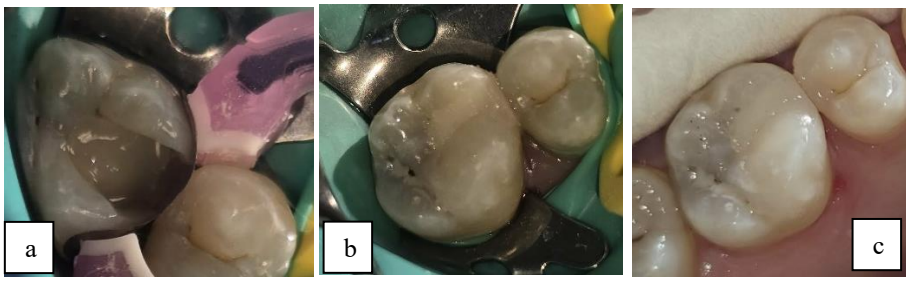

Figure 9: [a] injection of the bulk-fill fluide. [b] restauration with conventional composite resin. [c] post operative view

Figure 10: Periapical radiograph at 3 months follow-up

DISCUSSION

The present case report demonstrated favorable clinical and radiographic outcomes following partial pulpotomy for the management of irreversible pulpitis, with complete resolution of symptoms and maintenance of pulp vitality throughout the follow-up period. Similar findings have been reported by several authors, who demonstrated that pulpotomy can achieve successful healing and long-term preservation of pulpal health, even in teeth diagnosed with irreversible pulpitis [4,5].

Irreversible pulpitis is traditionally considered an advanced stage of pulpal inflammation characterized by extensive tissue damage and spontaneous pain that may radiate to adjacent facial structures.[6] Histologically, it is associated with pulpal disorganization, vascular dilation, focal necrosis, and marked neutrophilic infiltration [7]. Nevertheless, growing evidence suggests that inflamed pulp tissue may retain a significant healing potential when the coronal portion is removed under appropriate clinical conditions. Recent advances in molecular biology have also identified potential biomarkers that may improve the diagnosis of irreversible pulpitis [6].

Although conventional root canal treatment remains the standard therapeutic approach for irreversible pulpitis, vital pulp therapy procedures [VPT] such as partial pulpotomy are increasingly being investigated as conservative alternatives, particularly in young permanent teeth with high reparative potential [6]. The favorable outcomes observed in the present cases further support the growing body of evidence advocating for minimally invasive strategies aimed at preserving pulp vitality whenever possible.

A detailed assessment of the pulp tissue's inflammatory status is essential for the VPT to be successful. However, the correlation between clinical symptoms and the actual histological condition of the pulp remains limited, making diagnosis challenging [8,9]. Since histological examination cannot be performed in routine clinical practice, clinicians often rely on intraoperative findings such as the appearance of the exposed pulp tissue and the time required to achieve hemostasis to assess pulpal inflammation and determine treatment prognosis [10,11]. These clinical parameters are considered valuable indicators for estimating the severity of pulpal involvement and selecting the most appropriate therapeutic approach [12]. For this reason, the use of magnification has been recommended to improve the management of exposed pulp tissue [13]. Examination under an operating microscope allows a more precise evaluation of pulp color, texture, and tissue integrity after pulpal amputation [12].

Although achieving hemostasis is considered essential for the success of vital pulp therapy, several clinical studies have reported no significant relationship between hemostasis time, within a range of 1 to 10 minutes, and treatment outcome [14–16]. However, severe pulpal inflammation may result in persistent bleeding that is difficult to control [17]. In such situations, the treatment plan may need to be modified from partial pulpotomy to full pulpotomy or conventional root canal treatment if adequate hemostasis cannot be achieved [12].

In the present cases, the pulp underlying the amputation site was carefully examined under magnification. The pulp tissue exhibited a healthy appearance with normal color and texture, while bleeding was successfully controlled within a few minutes. Sodium hypochlorite 2.5% was used as an irrigating solution in all cases to facilitate hemostasis and disinfect the pulp wound and cavity. In addition to its strong antibacterial activity, sodium hypochlorite has tissue-dissolving properties that help eliminate necrotic tissue and reduce the need for excessive mechanical debridement [18].

Partial pulpotomy is considered a conservative treatment option when inflammation is limited to the coronal pulp, particularly in young adults with mature teeth and preserved pulp vitality [10]. It is mainly indicated in cases presenting mild to moderate symptoms and when bleeding can be effectively controlled after removal of the superficial inflamed pulp tissue.[4] It requires the removal of coronal pulp tissue partially followed by irrigation with sodium hypochlorite to disinfect the pulp chamber [19]. A capping material, most commonly mineral trioxide aggregate [MTA] or Biodentine®, is then placed over the remaining healthy radicular pulp.

The pulp capping material should provide an effective seal against bacterial infiltration, support healing of the remaining pulp tissue, and exhibit bioactive properties capable of stimulating dentin bridge formation [20]. Calcium silicate-based biomaterials, particularly MTA, have demonstrated superior clinical performance in the management of exposed pulp tissue compared with calcium hydroxide [21,22]. These materials are also associated with the formation of thick and homogeneous mineralized dentin bridges [23]. Furthermore, bioceramic materials have been shown to enhance cellular differentiation, stimulate mineralization, and activate reparative mechanisms within pulpal tissues [24]. In this case report, and due to these biological and clinical properties, MTA was selected as the capping material.

Pulp healing following vital pulp therapy is characterized by resolution of inflammation, preservation of pulp vitality, and formation of reparative dentin, leading to progressive disappearance of clinical symptoms such as spontaneous pain and sensitivity [25]. However, the European Society of Endodontology recommends that outcomes of VPT should be evaluated over a follow-up period of up to 4 years to assess long-term success [13]. In this context, the quality and durability of the definitive coronal restoration play a crucial role in the prognosis of pulpotomy and may represent important predictors of late failure [26,27]. In the present case series, all teeth were immediatly with glass ionomer cement and after 7 days restored with composite resin restorations that remained clinically satisfactory throughout the observation period.

Evidence on the long-term effectiveness of partial pulpotomy in the management of irreversible pulpitis remains relatively limited. Taha at al. reported an 83% success rate for MTA partial pulpotomy in mature permanent teeth with irreversible pulpitis after a 2-year follow-up.[14] Similarly, Careddu et al. observed success rates above 90% when partial pulpotomy was performed on mature permanent teeth diagnosed with reversible and irreversible pulpitis over a 12-month period.[28] These findings suggest promising clinical outcomes, although variability in follow-up duration and study design limits direct comparison between studies.

In conclusion, partial pulpotomy using MTA appears to be a reliable and conservative treatment option for managing mature permanent teeth diagnosed with irreversible pulpitis, particularly when carefully selected clinical criteria are respected. The available evidence, including the outcomes of the present cases, supports its potential to preserve pulp vitality and achieve favorable clinical and radiographic results. Nevertheless, further well-designed clinical studies with larger sample sizes and long-term follow-up are necessary to confirm its predictability and to better define its indications.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Funding statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Trial registration information: Not applicable.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. All procedures performed were part of routine clinical care and in compliance with current standards of endodontic practice.

Consent to participate

Written informed consent to undergo treatment and participate in this report was obtained from the patients.

Consent for publication

Written informed consent for publication of clinical data and images was obtained from the patients. All identifying information has been omitted, and consent forms are retained by the authors.

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