

## CASE REPORT

# Vital Pulpotomy on immature lower first permanent molars using Portland cement, a case of failure and success—case report with 2 years follow-up

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**Key clinical message:** While the importance of vital pulp therapy comes from its ability to promote pulp healing allowing the tooth to continue its development and giving the patient a more convenient treatment, dental practitioners should be more aware of the minor mistakes which they might commit during treatment procedures that could reflect negatively on the treatment's outcome. Developing behavior management skills as well as learning from reported mistakes are beneficial to practitioners to provide a more precise and successful treatment.

**Abstract:** Vital pulp therapies are known to preserve tooth development and give pulp tissues a chance to heal. Despite the progress of biocompatible materials used in this field, these treatments are still facing some failure for several known and unknown reasons that might not only be related to the material used. This case report presents and discusses the possible reasons for the success of one vital pulpotomy procedure and the failure of another, both conducted on two immature lower first permanent molars of the same patient, in an attempt to conclude what led to both results.

**KEYWORDS**

immature permanent molars, pediatric dentistry, Portland cement, vital pulp therapy

## 1 | INTRODUCTION

The primary goal of vital pulp therapy is to maintain the integrity and health of the teeth and their supporting tissues while maintaining the vitality of the pulp of a tooth affected by caries, traumatic injury, or other causes. Especially in young permanent teeth with immature roots, the pulp is integral to continue apexogenesis. Therefore, pulp preservation is a primary goal for the treatment of young permanent dentition.<sup>1</sup>

Portland cement has been used as an apical plug material, for perforation repair, pulp capping and pulpotomy on primary teeth in several studies.<sup>2,3</sup> In recent years, PC has aroused great interest in research as an alternative to MTA. The reason for this interest is the same physical and mechanical qualities and at the same time lower cost of PC compared to MTA,<sup>4</sup> but yet no case reports or clinical studies have discussed its application on immature permanent teeth as a vital pulp therapy medicament.

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VPT techniques have the potential to be simple and both cost- and time-efficient. If they are unsuccessful, RCT may still remain a viable treatment option in the future.<sup>5</sup>

Success rates of VPTs have been reported to be comparable at 5 years to conventional pulpectomy and RCT even in teeth with irreversible pulpitis, with the advantage of dentine preservation and that the pulp retains its ability to react to future insults and noxious stimuli.<sup>5</sup>

The European Society of Endodontology have begun a campaign to raise awareness on the efficacy of VPTs following on from the publication of their 2019 position statement, aimed at both specialists and general dental practitioners.<sup>6</sup>

With the ongoing controversies within VPT studies regarding judgment criteria, pulpal status at the time of treatment, optimal treatment technique, and treatment outcomes,<sup>7-9</sup> this case report comes to shed some light on the factors that could possibly go wrong during VPT procedure and lead to treatment failure, giving the readers a chance to avoid these mistakes and increase the treatment's success rate.

This case report aims to present the clinical and radiographic findings of two vital pulpotomy therapies conducted on immature lower first permanent molars of an 11-year-old girl, using Portland cement, with 2 year follow-up, and discuss the possible reasons that led to the failure of one case and the success of the other one.

## 2 | CASE REPORT

An 11-year-old girl was referred to the department of pediatric dentistry at the faculty of dentistry, Damascus University, with no general health issues.

Upon investigation, the girl revealed that she complains of toothache on her lower right side of the jaw while eating, with no pain at night.

### 2.1 | Extraoral examination

Extraoral examination revealed a symmetrical face with no defects or anomalies. TMJ examination showed no

pain or tenderness during function with no deviation of the mandible during mouth opening and adequate lip sealing.

The girl had a high pulse rate of 113 bpm at the first visit indicating the presence of fear and anxiety.

### 2.2 | Intraoral examination

The examination showed the existence of a carious lesion on the lower right first permanent molar, while the lower left first permanent molar exhibited an old faulty class one composite restoration.

### 2.3 | Clinical examination

Both molars showed positive sensitivity to cold test.

### 2.4 | Radiographic examination

A digital X-ray was made for both molars. (Figure 1).

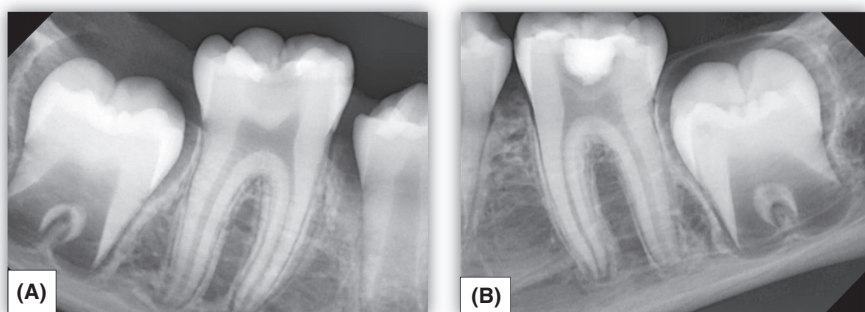
The X-ray of the lower left molar showed recurrent caries under the composite restoration with only a thin layer of intact dentin remaining above the pulp chamber; the tooth also had an open apex.

The radiographic examination of the lower right first permanent molar revealed dentinal carious lesion adjacent to the mesial pulp horn and an open apex root.

## 3 | MANAGEMENT

The treatment plan included the performance of vital pulpotomy using Portland cement on both molars at two different appointments, followed by composite restorations.

Due to COVID-19 spread at that time, personal protective equipment, such as surgical masks, particle filter respirators (P2 or N95), gloves, glasses, face shields, and gowns were used as recommended by the ADA to minimize virus spread.<sup>10</sup> However, the presence of an air



**FIGURE 1** Diagnostic periapical radiography of both lower right first permanent molar (A), and lower left first permanent molar (B) showing the open apices and the absence of any pathological apical radiolucency on both (A) and (B) and the faulty restoration on (B).

purifier device could have been more effective in reducing particles contamination (by 64%–85%) during different phases of dental procedures.<sup>11</sup>

Treatment of the lower right first permanent molar was performed at the first appointment.

The procedure was done as following:

Local anesthesia was provided with an IANB injection using lidocaine 2% with epinephrine 1:100,000.

Isolation was done using rubber dam.

The carious lesion was excavated first. During excavation, the mesial pulp horn was exposed, conforming the accuracy of the diagnosis.

An access cavity to the pulp chamber was completed; the coronal pulp was amputated; and the pulp chamber was thoroughly cleaned with cotton pallets damped with 4.5% sodium hypochlorite.

Hemostasis was achieved using the pressure of saline damped cotton pallets.

Portland cement was mixed to consistency with the previously mentioned anesthetic solution, carried to the pulp chamber using an amalgam carrier, and adapted using wet cotton pallets.

A base layer of glass ionomer cement was placed and adapted using a damp cotton pallet followed by a composite restoration. A different shade of composite was used in order to distinguish the restoration from the dental tissues in case of retreatment. (Figure 2).

The same protocol was followed at the next appointment for the treatment of the lower left first molar after the removal of the old restoration.

## 4 | FOLLOW-UP

A 3 month follow-up showed no clinical or radiographic signs of failure on both molars. However, at 6 month follow-up, a radiographic examination revealed the presence of an apical radiolucency on the distal root of the lower right first permanent molar with no clinical symptoms.

No intervention was made as the girl showed no complaint and the tooth showed no symptoms. Further observation for another year was decided. The lower left permanent molar showed an almost closed apex and no signs of clinical or radiographic failure. (Figure 3 and Figure 4).

A 2 year follow-up showed a complete closed apex of the lower left first permanent molar, which indicates radiological success. However, the lower right permanent molar continued to show apical radiolucency around the distal root, with no clinical symptoms while the mesial root showed a closed apex. The radiolucency on the distal root seemed to be smaller compared to the 6 month follow-up's image, but it could be attributed to the different angulation of the image. (Figure 5 and Figure 6).

Clinical examination revealed no marginal discoloration.

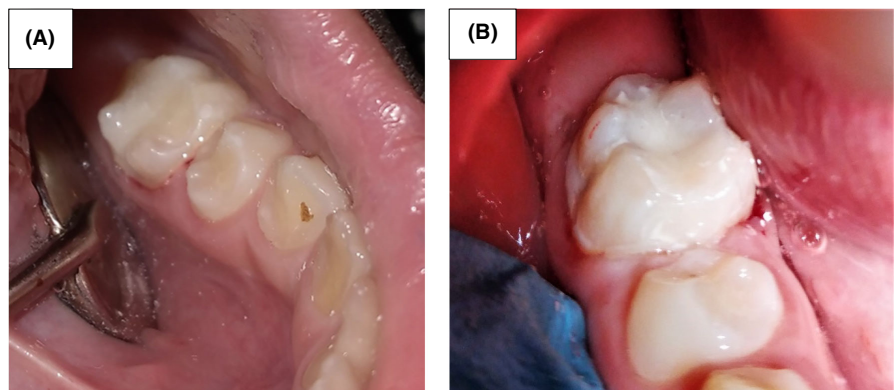
No intervention was decided as the patient showed no signs of irritation or pain. Further observation was taken into consideration.

## 5 | DISCUSSION

Vital pulp therapy (VPT), encompassing direct pulp capping (DPC), partial pulpotomy (PP), and full pulpotomy (FP) procedures, is consistent with contemporary concepts of minimally invasive dentistry and has long been considered a definitive treatment for deciduous teeth with pulp inflammation and for permanent immature teeth diagnosed as having reversible or irreversible pulpitis.<sup>12</sup>

The aim of the treatment after pulp exposure is to promote pulp tissue healing and facilitate the formation of reparative dentin in order to preserve the pulp vitality, promote root development and apical closure, and accomplish complete root canal therapy.<sup>7-9,13,14</sup>

Vital pulp therapy (VPT) procedures involve removal of local irritants and placement of a protective material directly or indirectly over the pulp.<sup>13</sup> Calcium Silicate



**FIGURE 2** Post treatment showing class two composite restoration on lower right first permanent molar (A), and class one composite restoration on lower left first permanent molar (B).

Cements (CSCs), such as Mineral trioxide aggregate (MTA), are the main medicaments used in VPT.<sup>5</sup>

Recently, great interest has been focused on the evolution of Portland cement (PC) as an alternative to MTA, and several studies have compared both materials,<sup>4</sup> but no studies or case reports addressed the use of Portland cement in vital pulpotomy on immature permanent teeth.

PC differs from MTA by the absence of bismuth ions and the presence of potassium ions. Both materials have comparable antibacterial activity and almost identical properties macroscopically, microscopically and by X-ray diffraction analysis.<sup>4</sup>

Taking into account the low cost and apparently similar properties of PC in comparison with MTA, it is reasonable to consider PC as a possible substitute for MTA in endodontic applications.

These treatments must be followed by an overlying tight-sealed restoration to decrease bacterial leakage from the restoration-dentin interface.<sup>8,9,14,15</sup>

Although clinical studies point out that the success rates of VPT in caries-exposed immature permanent teeth might be comparable with the success rate of root canal treatment,<sup>16</sup> the clinicians are less confident about the success of VPT.<sup>9</sup> Some complications may develop after VPT, so patients should be regularly followed up.

Various publications demonstrated that success rates decrease with time.<sup>13-15,17</sup> However, there is no clear explanation for this fact, and further investigations are needed.

According to several authors,<sup>7-9,13,15</sup> clinical and radiographic criteria below are the indicators for successful treatment: Maintenance of pulp vitality, minimum pulp inflammatory responses, absence of postoperative clinical signs or symptoms of thermal sensitivity, pain, or



FIGURE 3 Clinical appearance at 6 month follow-up.



FIGURE 5 Clinical appearance at 2 years follow-up.

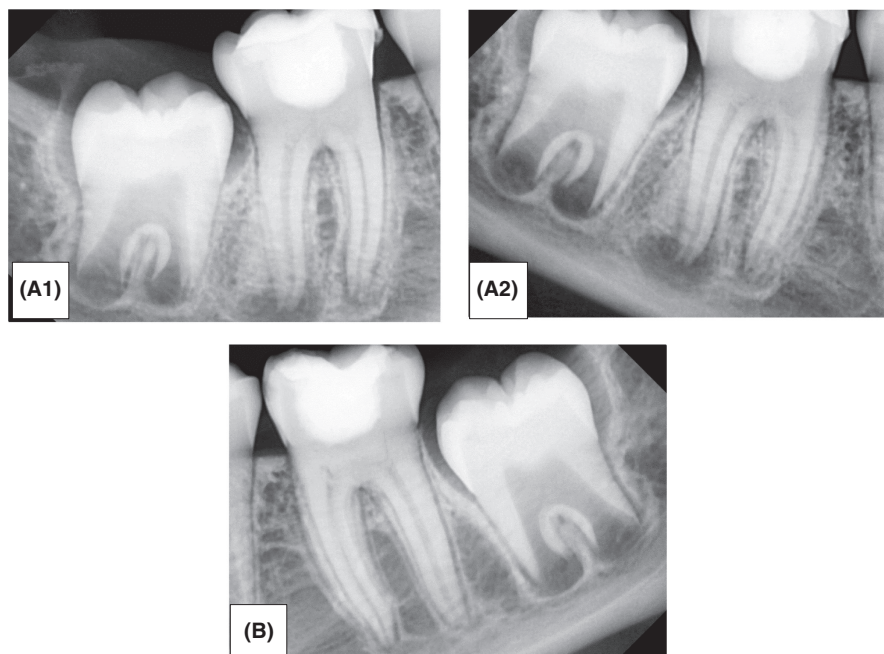
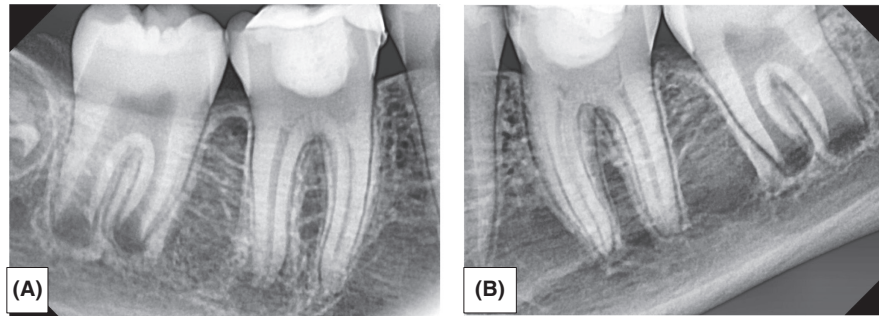


FIGURE 4 Radiographic examination at 6 month follow-up. The presence of apical radiolucency at the distal root of the lower right first permanent molar (A1, A2), almost closed apex of lower left first permanent molar (B), and the formation of dentinal bridge at the orifices of all root canals in both molars (A1, A2, & B).



**FIGURE 6** Radiographic examination at 2years follow-up, showing a smaller apical radiolucency at the distal root and a completely closed apex of the mesial root of the lower right first permanent molar (A). Lower left first permanent molar shows completely closed apices indicating radiological success (B).

swelling, absence of radiographic evidence of internal or external root resorption, Periapical and/or inter-radicular radiolucency, irregular calcification, or other pathologic changes, continuous root development and apexogenesis of teeth with incompletely formed roots.<sup>13,14</sup>

The success of VPTs relies on the ability to control inflammation alongside managing any potential bacterial contamination of the exposed pulp. Unfavorable outcomes might be caused by subsequent infection due to either remaining bacteria or new bacteria from penetrating restoration margins.<sup>15</sup> Having the lower right first permanent molar restored as a class two cavity makes it more susceptible to microleakage as the restoration has a higher risk of curing shrinkage and being exposed to gingival fluids at its margins are both factors that lead to failure.

The location of the exposure is also an important determinant of VPTs prognosis, with better success reported in occlusal rather than proximal exposures. Which could be an additional reason contributed to the treatment failure of the lower right first permanent molar.<sup>5</sup> Edwards et al recommended that in case of an interproximal carious lesion, the periphery of the lesion should be cleared to sound tooth structure, staying away from the pulp. The papillae should then be appropriately managed to allow effective rubber dam isolation before proceeding with caries removal centrally, thereby preventing contamination of the pulp.<sup>5</sup>

Furthermore, the radiographic failure of the lower right first permanent molar could be attributed to many other factors, such as the lack of compliance from the child making it harder to control the working field. At the first appointment, the girl was hesitant and showed signs of fear and anxiety, such as whining and shoulder lifting. The girl questioned every step and needed explanation before allowing the treatment to continue which led to intermittent work and more time consumption, while at the second appointment, she was more relaxed and accepting and did not interrupt the treatment.

Lack of compliance could make isolation harder and puts pressure on the practitioner to shorten the working time in order to preserve the child's patience, leading to

many nonintentional misconducts, such as applying hemostasis for an insufficient period and using the same bur for caries excavation and pulp obturation leading to subsequent contamination.

Using stainless steel crowns could have increased the success rate of the pulpotomy. As stainless steel crowns are considered to protect the underlying pulp against leakage, they are necessary for a long-term success of pulpotomy.<sup>18</sup>

Choosing to restore the molars with composite material was due to the aesthetic needs declared by the patient's parents, taking into consideration the limited extension of the carious lesions rendering both teeth restorable with composite restorations.

Age may also be an important prognostic indicator for the success of VPTs. Teeth may respond differently to VPT depending on their maturity, vascularity, and degree of previous degeneration.<sup>5</sup>

Wrong diagnosis of reversible pulpitis is another reason of treatment failure.<sup>1</sup> However, this is not applicable in this case as both patient investigation and clinical examination were in accordance with reversible pulpitis.

And though a dentinal bridge can be seen formed at the orifice of each root canal,<sup>19</sup> indicating that at some point in the period between the first treatment session and the second follow-up the remaining pulp was vital and responsive to the biocompatible agent placed, but this does not negate that simultaneously there was a necrotizing process undergoing slowly till it finally prevailed.

## 6 | CONCLUSION

With the increasing awareness on the importance of vital pulp therapy which is basically based on applying a biocompatible material over the pulp to promote healing and further development of the tooth, it is not sufficient on its own for the success of the treatment. The knowledge and skills of the dental practitioner as well as the patient's compliance play a big part in providing a precise and successful treatment.

## AUTHOR CONTRIBUTIONS

**Dajma Abed:** Data curation; investigation; methodology; visualization; writing – original draft. **Jamila Bchara:** Investigation; methodology; visualization; writing – original draft. **Nada Bshara:** Project administration; supervision; validation; writing – review and editing.

## ACKNOWLEDGMENTS

Thank you to Reem Sandouk for revising the manuscript.

## FUNDING INFORMATION

The authors declare that no funding was provided to perform the presented study.

## CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interests.

## DATA AVAILABILITY STATEMENT

All data related to this case report are contained within the manuscript.

## ETHICAL APPROVAL

The study was approved by the Research Ethics Committee of the faculty of dentistry, Damascus University.

## CONSENT

Written informed consent was obtained from the parent of the patient to publish this report in accordance with the journal's patient consent policy.

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**How to cite this article:** Abed D, Bchara J, Bshara N. Vital Pulpotomy on immature lower first permanent molars using Portland cement, a case of failure and success—case report with 2 years follow-up. *Clin Case Rep*. 2023;11:e7272. doi:10.1002/ccr3.7272