Case Report: Immediate pain relief after partial pulpotomy of cariously exposed young permanent molar using mineral trioxide aggregate and root maturation, with two years follow-up [version 1; peer review: 1 approved with reservations]

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Abstract
Carious exposure of immature first permanent molar is a widespread issue faced in paediatric dentistry. This may be the result of the early eruption of this molar, so parents may think it is replicable to the rest of the deciduous teeth. Preserving pulp vitality is the primary goal in treating those teeth to allow maturation of roots both in length and width. Mineral trioxide aggregate (MTA) is considered a perfect dressing material for pulpotomy (both partial and complete) due to its bio computability and sealing property. We present a case that describes treatment and two years follow-up of a symptomatic immature first permanent molar with a deep carious lesion. For treatment, we started with anaesthesia and rubber dam isolation. After that, the carious lesion was removed, and we performed partial pulpotomy, then applied MTA-Angelos on the fresh wound. Moistened cotton then was lightly packed over MTA for 15 minutes to allow initial setting, followed by application of glass ionomer and final restoration with composite. The following day, the tooth was asymptomatic with the patient reporting pain relief. After three months follow-up, the tooth normally responds to thermal test. After 12 months, a periapical radiograph of the tooth showed root maturation, and after 24 months also, the tooth was clinically and radiographically successful. MTA partial pulpotomy should be considered in the treatment of symptomatic young permanent teeth.

Keywords
MTA-Angelus, mineral trioxide aggregate, partial pulpotomy, vital young permanent, apexogenesis, deep caries.
**Introduction**
Symptomatic young permanent first molar is a widespread event, since this is the first permanent tooth erupting in the oral cavity and parents may consider it replaceable as the rest of the child’s baby teeth. The primary goal for treating those teeth is to maintain healthy pulp to allow the root to continue maturation both in length and width.

Partial pulpotomy is considered as promising modality for treatment of immature permanent teeth with carious pulp exposure. This technique consists of excavation of 2–3 mm inflamed coronal pulp tissue, and the remaining pulp is then capped with dressing material that maintains its viability and promotes healing. When comparing partial with cervical pulpotomy, partial pulpotomy preserves the cell-rich coronal pulp tissue, which is necessary for healing, and the formation of dentin bridge in the coronal area. Cervical pulpotomy, on the contrary, removes all the coronal pulp, with an increased risk of cervical fracture due to the loss of physiologic dentin apposition.

In a previous study, partial pulpotomy gave a high clinical success rate (91–93%) in asymptomatic young permanent molars with deep caries. However, some case reports reveal that partial pulpotomy may have good prognosis also in symptomatic teeth. In addition, a randomised clinical trial reported treating molars with irreversible pulps using partial pulpotomy, and the results were promising.

Choice of capping materials or medicaments can have a massive influence on vital pulp therapy success. Mineral trioxide aggregate (MTA) is considered the gold standard of pulp dressing material. MTA provides a long-term seal, acceptable biocompatibility, and dentinal bridge formation. Roberts et al. review in 2008 showed that MTA has excellent potential as a pulpotomy medicament, and can form hydroxyapatite when exposed to physiologic solutions.

This case report presents the treatment of pulpsitis in young permanent molar using MTA-Angelos partial pulpotomy.

**Case report**

**Patient information and clinical findings**
At our Paediatric Dentistry Clinic, Faculty of Dentistry, Cairo University, Egypt, an 8-year-old boy presented with acute provoked pain in the lower right posterior area that lingered after removal of stimulus, and the parent reported the child taking painkillers. No other medical or psychological problems that would affect the dental treatment were found.

**Diagnostic assessment**
Clinical and radiographic examinations showed caries in the lower right first permanent molar approaching the pulp. The molar showed incomplete root formation (Figure 1). The diagnosis was acute pulpsitis at lower right first permanent molar. Partial pulpotomy was proposed to allow root formation.

**Procedure**
We began with the administration of inferior alveolar nerve block (Table 1, item 1), followed by isolation of the tooth using a rubber dam (Table 1, item 2). Removal of caries using a suitable round carbide bur under a copious amount of water coolant was done, then spoon excavator was used to excavate pulp through the exposed part. To control bleeding, gentle flush to the wound with distilled water until bleeding was controlled was performed and a lightly packed cotton pellet was applied. MTA-Angelus (Table 1, item 3) was freshly mixed following manufacturer’s directions immediately before being placed and condensed gently over wet cotton against the fresh pulp wound. Excess material was scraped off the application of moistened cotton for 15 minutes to allow initial setting. Subsequently, a self-cure glass ionomer (Table 1, item 4) was applied as a base material at 2 mm thickness. Final restoration using composite was performed (Table 1, item 5). A periapical radiograph was taken as a baseline record for comparison with follow-up appointments (Figure 2).

**Follow-up and outcomes**
On the following day, a postoperative phone call to the patient’s parents revealed that the patient felt pain relief.

At one week follow-up, the tooth responded to thermal pulpal tests within reasonable limits. After three months, pulpal sensitivity test gave a normal reading, and clinical and radiographic examinations were normal. The patient continues to be asymptomatic and continues to be followed up for another year.

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**Figure 1. Preoperative radiograph showing deep, curious permanent first molar with blunder-bus open apex and no signs of a periapical lesion.**

<table>
<thead>
<tr>
<th>Table 1. Materials used in the process of partial pulpotomy used in a case of acute pulpsitis.</th>
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<tr>
<td><strong>1</strong> Septodont, Scandones® 2% L Mepivacaine HCl. 2% and Levonordefrin 1:20,000 Injection, USP</td>
</tr>
<tr>
<td><strong>2</strong> Roeko Flexi-Dam - Purple Non-Latex Coltène/Whaledent Ltd., UK</td>
</tr>
<tr>
<td><strong>3</strong> Industria de Produtos Odontologicos Ltda, Londrina, Brazil</td>
</tr>
<tr>
<td><strong>4</strong> Riva Self Cure Capsules regular set, A2, and A3, SDI, Cologne Germany</td>
</tr>
<tr>
<td><strong>5</strong> Zhermack SpA - Via Bovazecchino, 100 45021 Badia Polesine (RO), Italy</td>
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followed up every three months with no complaints from the treated tooth for 12 months, and the root showed complete maturation (Figure 3). After that, the patient was lost to follow-up. Twenty-four months later the patient came back to the clinic for treatment of a different tooth, and a lower right first permanent molar examination showed clinical and radiographic success (Figure 4).

Discussion
Partial pulpotomy technique obtains good clinical outcomes with different capping materials. MTA is considered the gold standard for vital pulp therapy. MTA has excellent sealing ability and biological properties that preserve the pulp viability in immature permanent teeth with irreversible pulpitis.

Partial pulpotomy using MTA, as opposed to root canal therapy or apexification, is more conservative and allows root maturation both in length and width, and this was observed in our case report.

Conclusions
MTA-Angelus partial pulpotomy appears to be a successful treatment for symptomatic immature permanent teeth with deep caries and vital pulps. However, we recommend conducting more clinical studies with a large sample size and longer follow-up period to validate our observations. Partial pulpotomy technique should also be tested in older ages with mature roots.

Consent
After the full explanation of the procedure, written informed consent was taken from the parent of the child.

The patient’s mother gave written informed consent for the publication of this case report and any associated images.

Data availability
All data underlying the results are available as part of the article and no additional source data are required.

Grant information
The author(s) declared that no grants were involved in supporting this work.

References

Figure 2. Radiograph immediately after partial pulpotomy procedure is taken as a baseline record.

Figure 3. Twelve months follow up radiograph showing root maturation.

Figure 4. Twenty-four months follow up radiograph showing normal periapical area and root.


Open Peer Review

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This case report described success of partial pulpotomy with MTA-Angelus in irreversible pulpitis teeth of 8 years old child.

However, the background of the case's history, diagnostic tests, treatment given and outcomes were not described in sufficient detail.

- What kind of stimulus produce the pain in this patient? (cold water, sweet?)
- Was the pain lingering?
- What kind of pain killer did the child take? Did it help with the pain?
- Any sensibility tests (Cold or EPT test) was performed before treatment?
- These information will lead to the diagnosis of the tooth. The diagnosis should be consistent throughout (acute pulpitis vs irreversible pulpitis).
- The tooth should be diagnosed before prior to the treatment.
- What type of pulp exposure? Carious, mechanical?
- How big was the exposure type?
- How long did you control the bleeding?
- At three months, pulpal sensitivity test was the EPT test? Please specify.
- At 24 months, please be more specific of clinical and radiographic success. Please address in discussion.
• The histology of irreversible pulpitis that allows the success of partial pulpotomy.

• MTA should not be described as a "perfect" dressing material. It has both desired properties and drawbacks. Besides, biocompatibility and sealing ability, other good biological properties (antibacterial, induce reparative dentin formation, less inflammation compared to calcium hydroxide, etc.) should also be described. Drawbacks should also be described (long setting time, discoloration, poor strength in early phase, etc).

• Why did you choose to use glass ionomer on top of MTA?

There are several misspellings.
• carious not curious.

• blunderbuss not blunder-bus.

• biocompatibility not bio computability.

• MTA-Angelus not Angelos.

References

Is the background of the case's history and progression described in sufficient detail?
Partly

Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?
Partly

Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?
Partly

Is the case presented with sufficient detail to be useful for other practitioners?
Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Vital pulp therapy.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.
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