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Vital pulp therapy of a complicated crown fracture in a child

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Complicated crown fractures involving pulp exposure typically require root canal treatment (RCT) in mature permanent teeth to prevent irreversible pulpitis or dental pulp necrosis. However, advancements in endodontic biomaterials and magnification have broadened the criteria for vital pulp therapy (VPT) even in fully developed teeth. Preserving pulp vitality provides biological and functional benefits, including proprioception, immunocompetence, and structural integrity.[1] Calcium silicate-based biomaterials enhance healing by facilitating mineralized barrier formation and minimizing bacterial microleakage.[2] This report discussed the successful treatment of a mature maxillary central incisor with a complicated crown fracture using minimally invasive pulpotomy with calcium-enriched mixture (CEM) cement and fragment reattachment.

A 10-year-old girl presented 1-day post-traumatic fall injury. The patient was initially seen by a general dentist, who placed a temporary dressing and referred her for definitive care. Initial periapical radiography showed no fracture line (Fig. 1A), but cone-beam computed tomography (CBCT) imaging identified an oblique fracture extending from the incisal buccal third to the palatal root surface, terminating 2–3 mm subgingivally below the alveolar crest (Fig. 1B–E). Axial CBCT confirmed full pulp involvement (Fig. 1F). Despite the mature apex of the tooth visible on CBCT, the patient's age and the complexity of the fracture warranted an ultraconservative approach to maintain dental pulp vitality and avoid RCT.

Under cotton roll isolation and microscopic guidance, the coronal fragment was gently elevated palatally using a probe (Fig. 1G). A conservative/shallow pulpotomy (~2 mm) was performed with a sterile diamond bur (Fig. 1H). Hemostasis was achieved within 2 min through sterile saline irrigation (Fig. 1I), indicating limited/minimal inflammation. A layer of CEM cement was applied over the exposed pulp and adapted with a dry cotton pellet (Fig. 1J and K). The internal surfaces of the coronal fragment and remaining tooth were etched, bonded, and coated with a thin layer of flowable resin composite. The fragment was repositioned and reattached with gentle finger pressure (Fig. 1L). Composite resin was then used to restore the remaining fractured margins (Fig. 1M). The immediate postoperative radiograph confirmed correct CEM biomaterial adaptation and fragment repositioning (Fig. 1N). The patient was asymptomatic at follow-up intervals of 1 week, 1 month, and 6 months. At the 1-year follow-up, the tooth remained asymptomatic and showed no signs of pathology radiographically (Fig. 1O and P).

This case demonstrates the effectiveness of VPT in mature permanent teeth following trauma, challenging the traditional preference for RCT in such situations.[3] Pulpotomy was successful due to early diagnosis and timely intervention (<48 h post-trauma). The favorable properties of CEM cement, including its sealing ability, antimicrobial activity, biocompatibility, and induction of dentinogenesis, contributed to successful pulp preservation/healing.[4] CBCT was

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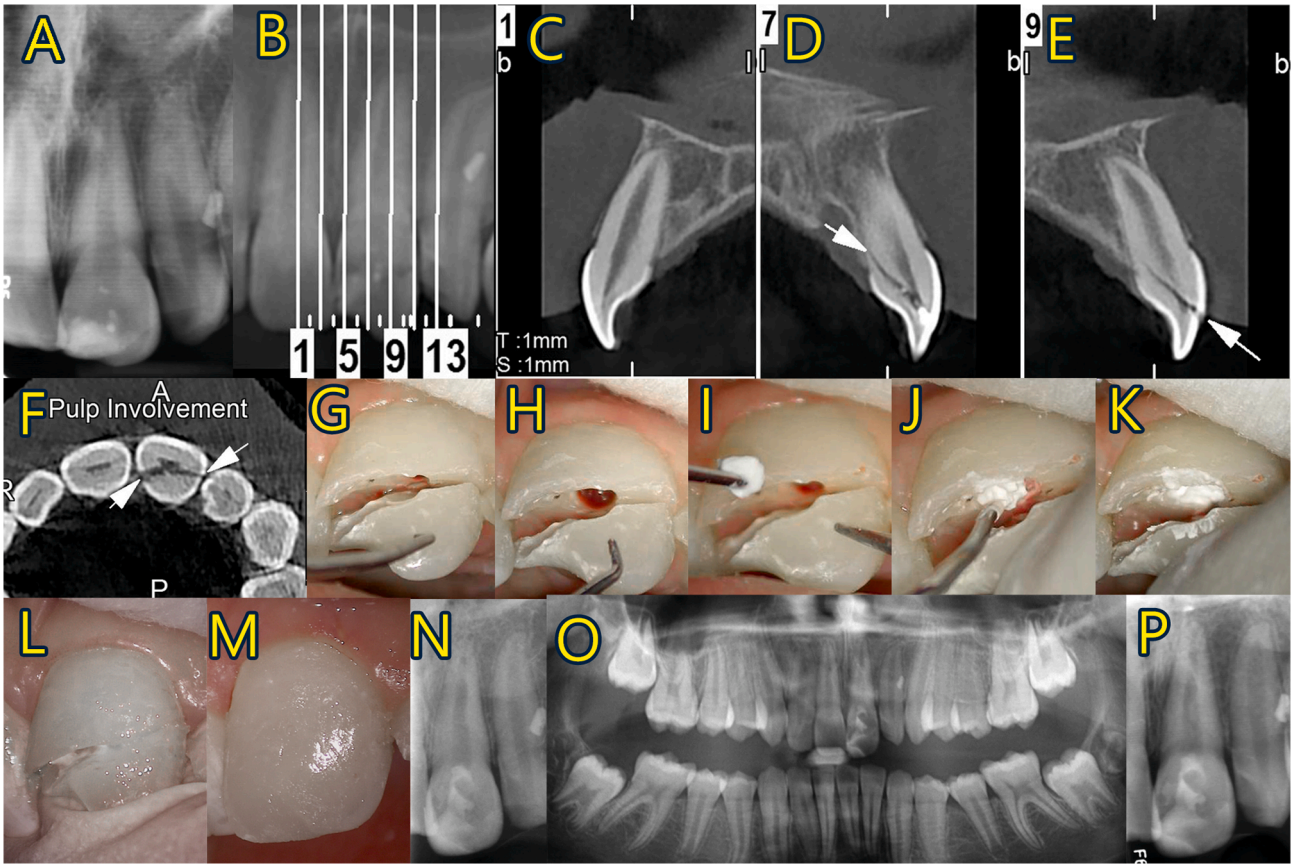

Figure 1 Clinical and radiographic documentation of the case. (A) Initial periapical radiograph: No visible fracture line was detected in the left maxillary central incisor. (B) Cone-beam computed tomography (CBCT) scan: Detailed imaging of the affected tooth for further evaluation. (C) Sagittal CBCT view of the right maxillary central incisor: Intact tooth structure with no signs of pathology. (D and E) Sagittal CBCT views of the left maxillary central incisor: A complicated crown fracture with pulp exposure was observed. The oblique fracture line extended from the incisal third of the buccal surface to the coronal third of the palatal root, ending approximately 2—3 mm below the alveolar crest. (F) Axial CBCT view: Complete pulpal involvement confirmed in the left maxillary central incisor. (G) Clinical photograph: Extensive crown fracture with visible pulp exposure. (H) Minimally invasive pulpotomy: Under magnification and with gentle probing, the coronal fragment was minimally elevated palatally. An approximate 2 mm partial pulpotomy was performed. (I) Hemostasis and material application: After hemostasis (achieved within 2 min using normal saline), pulp coverage was performed using a calcium silicate-based biomaterial. (J) Biomaterial placement: Appropriately mixed calcium-enriched mixture (CEM) cement was inserted into the cavity as per the manufacturer's instructions. (K) Adaptation: The CEM biomaterial was carefully adapted to the cavity walls using a dry cotton pellet. (L) Fragment reattachment: After acid etching, bonding, and placement of a thin layer of flowable resin composite between the fragments, the coronal fragment was gently repositioned and reattached with finger pressure. (M) Final restoration: Lost and fractured crown portions were restored with resin composite to reestablish esthetics and function. (N) Postoperative radiograph: Successful pulp preservation and anatomical reconstruction confirmed. (O and P) One-year follow-up radiographs: Radiographic evidence of continued success of the minimally invasive vital pulp therapy.

essential for accurately diagnosing the extent of the subgingival complicated fracture, which was not visible on 2-dimensional radiographs. The reattached fragment restored esthetics and biomechanical strength, avoiding crown lengthening or tooth extraction.[5] This ultra-minimally/biologically based approach allowed for the maintenance of pulp vitality and restoration of function/esthetics. Minimally invasive pulpotomy using bioactive materials should be considered a valid option for managing mature permanent teeth with complicated crown fractures.

Declaration of competing interest

The authors have no conflicts of interest relevant to this paper.

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NA.

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