

Case Report

Hemisection of an immature mandibular first permanent molar with vertical root fracture: preserving arch space and supporting second premolar eruption

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ABSTRACT

Vertical root fracture (VRF) in an immature permanent tooth is uncommon and presents a treatment challenge, particularly in a growing child where premature tooth loss may compromise arch integrity and eruption of the succeeding dentition. A male child in the mixed dentition period presented with a grossly carious mandibular left first permanent molar with chronic hyperplastic pulpitis. Further clinical and radiographic evaluation revealed a VRF involving the mesial root. Considering the developing dentition and the importance of preserving the first permanent molar, complete extraction was avoided. Hemisection was performed with removal of the fractured mesial segment and preservation of the healthy distal segment, followed by MTA apexification, obturation, and definitive restoration. At 6 months, the patient remained asymptomatic with satisfactory clinical and radiographic healing, while the mandibular second premolar continued to erupt through the space created by hemisection and progressed toward a favourable position. This case highlights hemisection as a conservative, developmentally oriented approach for preserving a functional portion of an immature permanent molar while maintaining arch space and facilitating favourable eruption of the successor premolar.

Keywords: Hemisection, Vertical root fracture, Immature permanent molar, MTA apexification, Arch space preservation, Premolar

INTRODUCTION

The mandibular first permanent molar is a strategically important component of the developing dentition, contributing to the establishment of occlusion, posterior arch stability, and the eruption of succeeding permanent teeth. Its premature loss may disrupt the local eruption environment, promote undesirable tooth movement, and compromise arch space. Recent systematic evidence indicates that spontaneous space closure following first permanent molar extraction is less predictable in the mandible and is influenced by the developmental stage and position of the succeeding permanent teeth.^{1,2} Accordingly, preservation of the tooth, or of a maintainable portion of it, may be particularly valuable in

a growing patient when biologically and restoratively feasible.

Vertical root fracture (VRF) remains a challenging diagnostic and therapeutic condition because its clinical presentation may mimic other pulpal or periapical pathoses, while conventional radiography may fail to demonstrate the fracture consistently.^{3,4} When a fracture is confined to a single root of a multirrooted tooth and the remaining segment has a favourable periodontal, endodontic, and restorative prognosis, hemisection may provide a conservative alternative to complete extraction. Systematic evidence supports root-resection and hemisection as viable treatment options in appropriately selected molars, although long-term outcomes depend

substantially on case selection and subsequent endodontic, periodontal, and restorative management.⁵

The present case is noteworthy for the convergence of three clinically relevant considerations: VRF confined to the mesial root of an immature mandibular first permanent molar, preservation and rehabilitation of the unaffected distal segment, and subsequent favourable eruption of the mandibular second premolar. Rather than treating hemisection solely as a means of retaining tooth structure, this case demonstrates its potential developmental value in preserving posterior arch space and maintaining a favourable eruption pathway for the successor tooth.

CASE REPORT

An 8-year-old male child in the mixed dentition period presented to the Department of Paediatric and Preventive Dentistry with dull pain in the lower left posterior region for approximately 1 year. The medical history was non-contributory. Dental history revealed a long-standing carious lesion involving the mandibular left first permanent molar (36), associated with overgrowth of soft tissue from the exposed pulp chamber. Extraoral examination revealed no clinically significant abnormality, while intraoral examination showed a grossly carious 36 with proliferative pulpal tissue extending from the pulp chamber (Figure 2A). Based on the clinical presentation, a provisional diagnosis of chronic hyperplastic pulpitis was made. Given the patient's developmental stage and the strategic position of 36 within the developing dentition, a detailed clinical and radiographic assessment was performed, with particular attention to root development, the condition of individual roots, furcation status, and the relationship of 36 with the developing mandibular second premolar (35). Radiographic examination demonstrated incomplete root development with open apices (Figure 1A). Following removal of the hyperplastic pulpal tissue, further clinical and multi-angulated radiographic evaluation demonstrated a longitudinal fracture extending along the mesial root (Figure 1B). The mesial root and its associated coronal segment were deemed unrestorable, whereas the distal segment remained clinically and radiographically suitable for preservation. These findings prompted consideration of a conservative treatment approach aimed at eliminating the affected segment while preserving the healthy portion of the tooth.

Differential diagnosis

The initial clinical findings were suggestive of chronic hyperplastic pulpitis. Following removal of the hyperplastic tissue, further clinical and radiographic evaluation revealed a longitudinal fracture involving the mesial root. A cracked tooth was considered in the differential diagnosis; however, the extent and location of the fracture were consistent with a vertical root fracture confined to the mesial root.

Final diagnosis

Chronic hyperplastic pulpitis associated with an immature mandibular left first permanent molar complicated by a vertical root fracture involving the mesial root.

Treatment

The treatment objectives were to eliminate the fractured mesial segment, preserve the healthy distal segment, manage the immature apex of the retained root, restore function, and maintain the posterior arch space required for favourable eruption of the developing mandibular second premolar (35). The furcation was identified clinically and marked on the occlusal surface to guide the sectioning procedure. Under local anaesthesia and continuous saline irrigation, a vertical cut was made through the crown and interradicular region using a surgical fissure bur to completely separate the mesial and distal segments. The fractured mesial root with its associated coronal portion was subsequently mobilised and removed as a single segment using a periosteal elevator. The sectioned surfaces were carefully inspected and smoothed, and haemostasis was achieved with a pressure pack. The distal segment was clinically intact and was therefore preserved (Figure 1C).

Considering the immature apical anatomy of the retained distal root, treatment selection was informed by the guidance reviewed by Murray for the management of immature permanent teeth. As the retained root was non-vital and had adequate dentinal wall thickness, MTA apexification was selected to establish a predictable apical barrier. Following canal disinfection, MTA was placed as an apical barrier approximately 1 week after hemisection. After adequate setting of the apical barrier, the canal was obturated with gutta-percha, and the retained segment was definitively restored with Porcelain fused to metal crown (PFM) (Figure 1E and Figure 2B). This approach allowed preservation of the remaining tooth structure, re-establishment of occlusal function, and maintenance of the posterior space required for continued eruption of the mandibular second premolar.

Outcome and follow-up

The patient was followed clinically and radiographically for 6 months following hemisection, MTA apexification, obturation, and definitive restoration. Postoperatively, the surgical site healed uneventfully, and the retained distal segment remained clinically functional. At the 6-month evaluation, the patient was asymptomatic, with no pain, tenderness, swelling, sinus tract formation, or abnormal mobility. Clinical examination demonstrated satisfactory periodontal and restorative status of the retained segment. Radiographic assessment showed favourable periapical healing, with no evidence of new or persistent periapical pathology and preservation of the integrity of the retained distal root (Figure 1E). Of particular developmental

significance, the mandibular second premolar (35) was observed to continue erupting through the space created by removal of the mesial segment of 36 and was progressing towards a favourable position within the dental arch, without apparent clinical obstruction or

eruption disturbance (Figure 1E, Figure 2C). Overall, the 6-month follow-up demonstrated satisfactory clinical and radiographic healing of the retained segment, with continued favourable eruption of the mandibular second premolar.

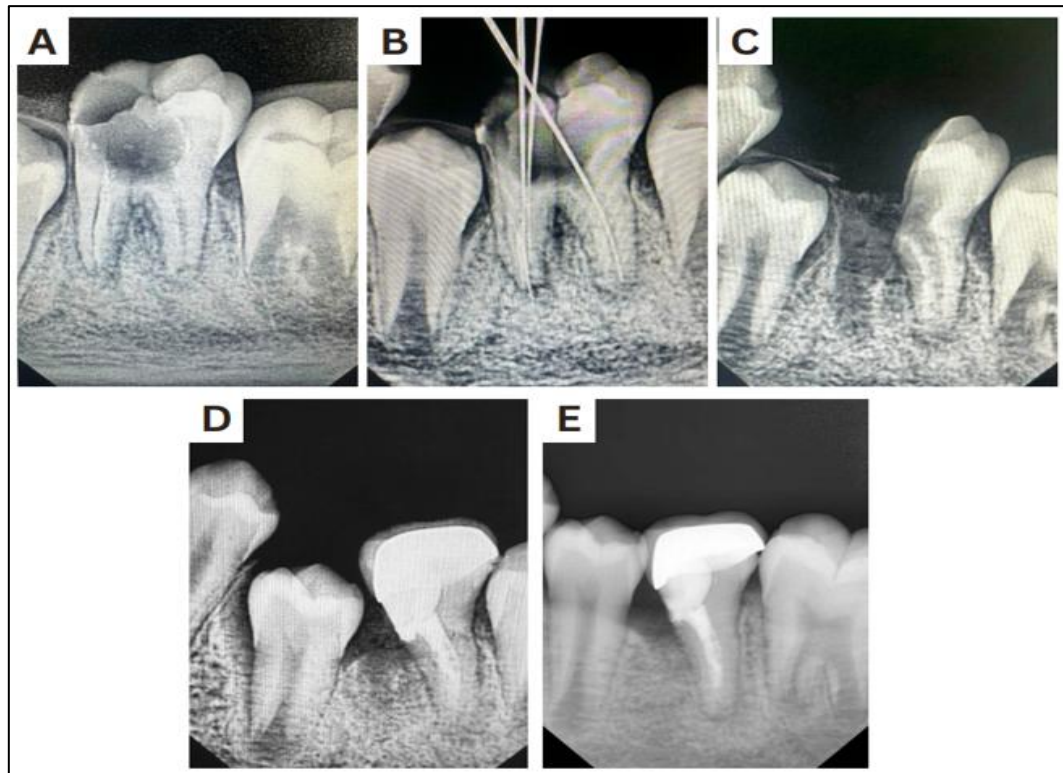


Figure 1: Radiographic sequence. (A) Preoperative periapical radiograph showing the grossly carious mandibular left first permanent molar (36) with incomplete root development and open apices; (B) diagnostic periapical radiograph obtained following removal of the hyperplastic pulpal tissue, demonstrating the longitudinal fracture involving the mesial root of 36; (C) post-hemisection periapical radiograph showing removal of the fractured mesial segment and preservation of the distal segment of 36; (D) one-month follow-up periapical radiograph showing complete obturation of the retained distal root canal and MTA apical barrier, with definitive restoration of the coronal portion of the distal segment, and satisfactory early periapical healing; (E) six-month follow-up periapical radiograph showing satisfactory periapical healing of the retained distal segment and continued eruption of the mandibular second premolar (35) into the space created by hemisection.

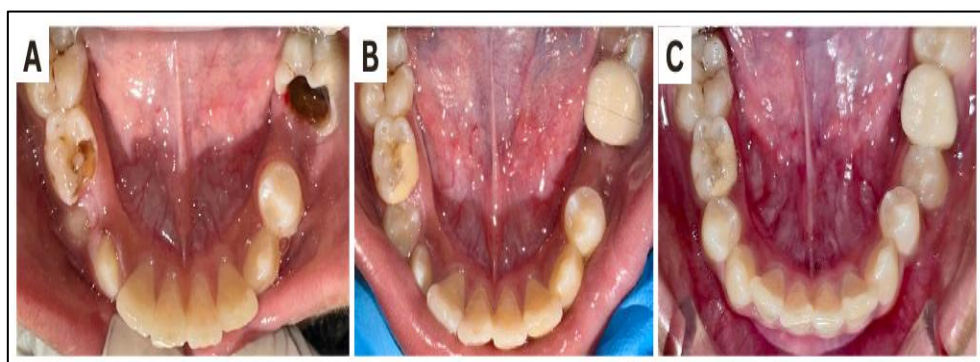


Figure 2: Clinical sequence. A. Preoperative intraoral view showing the grossly carious mandibular left first permanent molar (36) with proliferative pulpal tissue. B. Postoperative clinical view following hemisection and definitive restoration of the retained distal segment. C. Six-month clinical follow-up demonstrating satisfactory clinical status of the retained segment and continued eruption of the mandibular second premolar (35).

DISCUSSION

Management of a compromised mandibular first permanent molar in a growing child requires consideration of both disease control and the consequences of treatment for the developing dentition. The mandibular first permanent molar contributes to posterior occlusal stability and provides a positional reference for the eruption and alignment of the succeeding teeth. Consequently, its premature loss should not be viewed simply as extraction of a non-restorable tooth, particularly during the mixed dentition period when the surrounding dentition is still undergoing active development. Early extraction of a first permanent molar has been associated with reduction of post-extraction space, mesial movement of adjacent teeth, and other changes in the developing occlusion; however, the extent of these effects is influenced by the developmental stage of the succeeding teeth, and spontaneous closure is subsequently less in the mandible than maxilla.^{1,7}

In the present case, complete extraction would have resulted in loss of the unaffected distal root and its associated coronal structure and would have altered the local space available for the developing mandibular second premolar (35). Preservation of a maintainable portion of 36 was therefore considered advantageous for maintaining posterior arch space and minimising disruption of the eruption environment.

The diagnostic sequence in the present case also influenced treatment planning. The patient initially presented with chronic hyperplastic pulpitis, and the vertical root fracture was identified only after removal of the hyperplastic pulpal tissue and further clinical and radiographic assessment. VRF can be diagnostically challenging because clinical findings may be non-specific and conventional radiographs may not consistently demonstrate the fracture, particularly when the fracture plane is unfavourably oriented.³ Once the fracture was identified as being confined to the mesial root and the distal segment was found to be clinically and radiographically maintainable, a hemisection became a feasible alternative to complete extraction.⁵

Because the retained distal root had an immature open apex, treatment selection required a choice between apexification and regenerative endodontic procedures, both recognised options for immature permanent teeth.⁶ Regenerative endodontics was not pursued because the retained root was non-vital with an established periapical diagnosis rather than an early, minimally infected pulp, and MTA apexification offered a more predictable and immediate apical barrier appropriate to the compromised presentation. MTA apexification was therefore selected on this basis, followed by obturation and definitive restoration of the retained segment, allowing re-establishment of occlusal function alongside preservation of the posterior eruption space for 35. In addition to retaining part of the natural tooth, preservation of the

distal segment maintained the local eruption space for 35. At 6 months, 35 continued to erupt through the space created by removal of the mesial segment and progressed towards a favourable position. A paediatric case reported by Prabhu and Munshi similarly demonstrated eruption of a second premolar following hemisection of a mandibular first permanent molar.⁸ However, in the present case, no active orthodontic or surgical guidance of the premolar was undertaken; therefore, the finding is best interpreted as a favourable eruption response associated with preservation of the eruption environment rather than as proof of active guided eruption.

The present findings are consistent with, and extend, existing case-report literature. Prabhu and Munshi reported hemisection of a mandibular first permanent molar in a child with a vertically impacted second premolar, with adequate space subsequently available for eruption Kurtzman.⁸ described hemisection as an alternative to extraction in a vertically fractured mandibular molar, and Anitha and Rao reported retention of a mandibular molar following hemisection of a fractured mesial root with preservation of the healthy distal root.^{9,10} These reports, however, generally involved mature roots and did not specifically address apexification of an immature retained segment; follow-up in these series was similarly limited to the short-to-medium term, comparable to the 6 months reported here. The present case therefore adds to this literature by integrating resective, endodontic, restorative, and developmental considerations, specifically apexification of an immature retained root alongside documented favourable eruption of the successor premolar within a single, immature-molar VRF presentation, an intersection that appears infrequently described.

At 6 months, 35 continued to erupt through the space created by removal of the mesial segment and progressed towards a favourable position, consistent with the eruption response described by Prabhu and Munshi.⁸ This finding should, however, be interpreted as a favourable eruption response associated with preservation of the eruption environment, rather than evidence of a causal or guided effect, since no active orthodontic or surgical guidance of the premolar was undertaken. The relatively short follow-up similarly limits conclusions regarding the long-term periodontal, restorative, and structural survival of the retained segment, and longer-term clinical and radiographic review will be required to confirm the stability of both the retained molar segment and the final eruption and occlusal position of 35.

The principal clinical significance of this case is therefore not hemisection alone, but the preservation of a maintainable portion of an immature first permanent molar at a critical stage of dental development. Selective removal of the fractured mesial segment allowed preservation of the healthy distal portion while maintaining the posterior space and eruption environment of the developing second premolar. The subsequent

favourable eruption of 35 provides clinically relevant support for considering tooth-preserving strategies that account for the developing dentition when complete extraction might otherwise be performed. Nevertheless, the observed eruption cannot establish a causal relationship with hemisection, and longer-term clinical and radiographic follow-up is required to assess the periodontal health, structural integrity, restorative stability, and final eruption and occlusal position of the successor tooth

CONCLUSION

This case demonstrates a conservative approach to vertical root fracture involving a single root of an immature mandibular first permanent molar. Hemisection allowed removal of the fractured mesial segment while preserving and rehabilitating the healthy distal segment. Importantly, preservation of the remaining tooth portion maintained the posterior arch space and provided a favourable eruption environment for the developing mandibular second premolar, which continued to erupt into an appropriate position during follow-up. Thus, in carefully selected young patients, hemisection may serve not only as a tooth-preserving procedure but also as a developmentally oriented strategy to minimise disruption of the developing dental arch and support favourable eruption of the successor tooth. Longer-term follow-up is required to confirm the stability of this outcome.

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