IEJ
Iranian Endodontic Journal

Endodontic and Orthodontic Management of a Fused Mandibular Incisor and Supernumerary: A Case Report

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Article Type: **Case Report**

Received: 10 Jul 2026
Accepted: 13 Aug 2026
Published: 25 Aug 2026
Doi: *10.22037/iej.v21i1.49822*

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Abstract

Dental fusion is a rare anomaly that can present unique challenges with clinical treatment. This report outlines a case of an 11-year-old who presented with fusion of a mandibular lateral incisor with a supernumerary. At presentation, the teeth were fully mature and normally responsive to pulp sensibility testing. Assessment with CBCT confirmed that the majority of the root canal system and pulp chambers were separate, with a single point of communication between both tooth units in the mid-crown. Removal of one of the teeth was requested to facilitate the patient's orthodontic treatment plan, and this was carried out with hemi-sectioning of the teeth, followed by vital pulp therapy of the exposed root canal systems of both teeth. At subsequent review, the tooth with the largest pulpal exposure was chosen for extraction, and the remaining tooth was recontoured for aesthetics. The teeth were subsequently aligned orthodontically. The patient was reviewed at 2.5 years, 3.5 years, and 9.5 years and was asymptomatic, with continued pulpal responsiveness and radiographically normal tissues.

Keywords: Fusion; Hemi-section; Mineral Trioxide Aggregate; Vital Pulp Therapy

Introduction

Fusion is a dental developmental anomaly where two or more separately developing tooth germs combine [1]. Fusion can clinically present as a wide tooth [2], typically with a groove within the crown of the tooth, which can extend into the root. This groove can present a challenge periodontally and make the tooth susceptible to dental caries [2, 3].

Fusion is a rare dental anomaly, with a reported prevalence ranging between 0-0.27% of permanent teeth [4-7]. Whilst the prevalence is higher in the primary dentition, it is less commonly observed in the permanent dentition [6]. A similar anomaly, gemination, can clinically present [6, 8]. Gemination, however, occurs as a consequence of a single enamel organ attempting to divide, which results in the formation of a tooth with a single root, enlarged pulp space, and an atypical crown. A geminated tooth is commonly referred to as a 'double tooth' [9]. The prevalence of supernumerary teeth is estimated to be 1.2% [10], with mandibular lateral incisors making up approximately 1.2-4.8% of supernumerary teeth [10-12]. Fused supernumerary teeth are rare, with few case reports involving mandibular anterior teeth [13-15].

One approach to managing fusion is hemi-section and subsequent removal of one of the teeth. Where possible, it is ideal to maintain vitality of the remaining tooth. Modern vital pulp therapy (VPT) techniques, involving biocompatible and reparative materials, can provide predictable management when pulpal exposures occur. Management of the remaining structure, both restoratively, periodontally, and orthodontically, requires a multi-disciplinary approach. The following report presents a case of successful multi-disciplinary management of a fused tooth with long-term follow-up.

Case Report

An 11-year-old Caucasian male attended an endodontist for management of the mandibular left lateral incisor (tooth #32, FDI notation) in September 2014. Tooth #32 appeared to be wide compared with the adjacent teeth, with a visible groove within

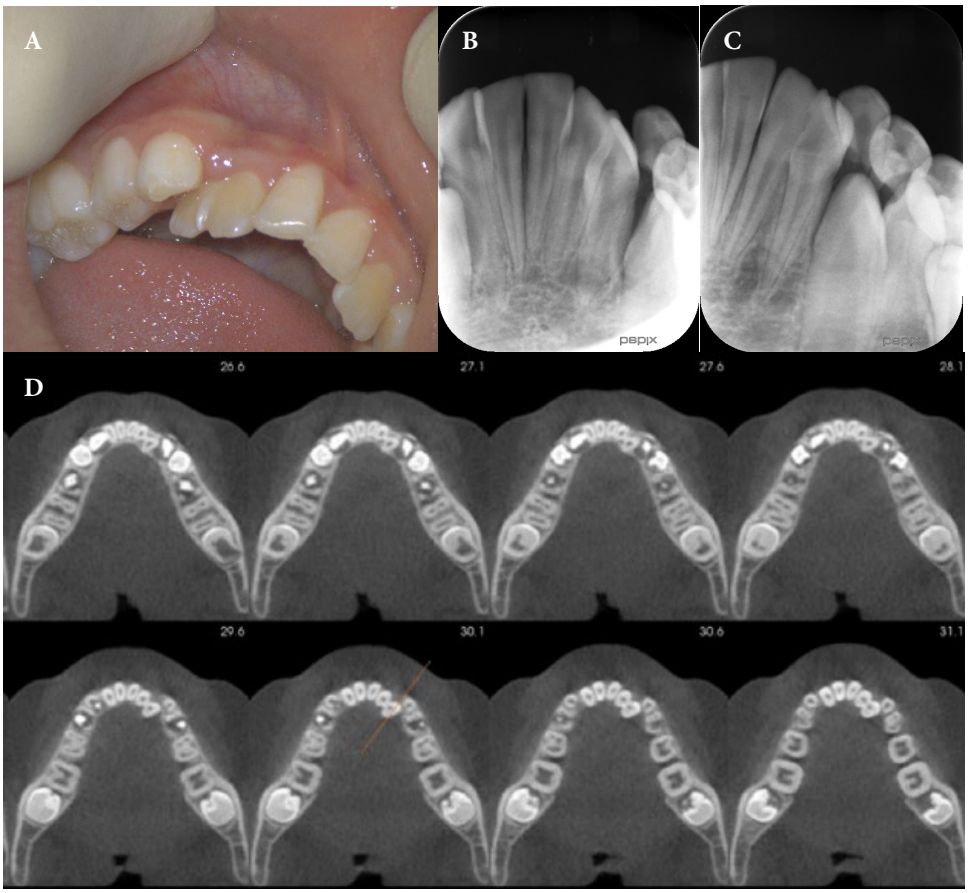

Figure 1. *A)* Pre-treatment intra-oral photography of fused tooth #32; *B)* Pre-treatment intra-oral radiography of fused tooth #32; *C)* Pre-treatment intra-oral radiography of fused tooth #32; *D)* Pre-treatment CBCT assessment of tooth #32, highlighting the fusion of the roots and minimal pulpal communication between the mesial (32M) and distal (32D) aspects of the fused tooth

the crown buccally. Clinical testing found the tooth to be normally responsive to pulp sensibility testing with cryogenic spray (Frostbite, Australian Dental Manufacturing). Intra-oral radiographs were taken on the date of examination, and the patient was referred to an external facility for a cone-beam computed tomography (CBCT) (I CAT FLX, Imaging Sciences International, Hatfield, PA, USA) (Fig. 1). The CBCT confirmed that tooth #32 had separate roots and were merged at the crown level. The root canal systems of both teeth were separate, except for a small region of communication in the mid-crown, before separating again into distinct pulp chambers. A diagnosis of dental fusion was made, and counting of the dentition revealed the fusion to involve tooth #32 and a supernumerary, denoted as the mesial (32M) and distal (32D) aspects of the fused tooth.

There was uncertainty as to which fused segment would be ideal to retain to facilitate the orthodontic treatment plan. After discussion with the patient's orthodontist, a joint decision was then made to perform hemi-section of the 32M and 32D and perform VPT to the exposed pulp tissue of both segments, and the choice of which segment to retain would be based on how each part of tooth #32 responded to VPT. Possible complications were discussed with the patient and his parents, including the possibility of discolouration and future endodontic retreatment. The option of extraction and replacement was also discussed with the patient's parents; however, it was deemed ideal orthodontically to retain at least one tooth segment if possible.

Endodontic treatment

Endodontic treatment was performed in January 2015. Local anaesthesia and nitrous oxide sedation were used. The 32M and 32D were sectioned, with pulp exposures occurring in both teeth. VPT was performed for both teeth, with MTA (Angelus, Londrina, Brazil; Clinician's Choice, New Milford, CT, USA) being placed over the pulps (Fig. 2A). Glass ionomer cement (Riva Pink Protect, Riva Bleach Protect SDI, Australia) was placed over the MTA, followed by resin composite (3M ESPE Filtek Supreme Ultra Universal Restorative, St. Paul, MN, USA, shade A2E). The patient returned one week later for further polishing of the composite restorations. The importance of oral hygiene was reinforced at each subsequent appointment.

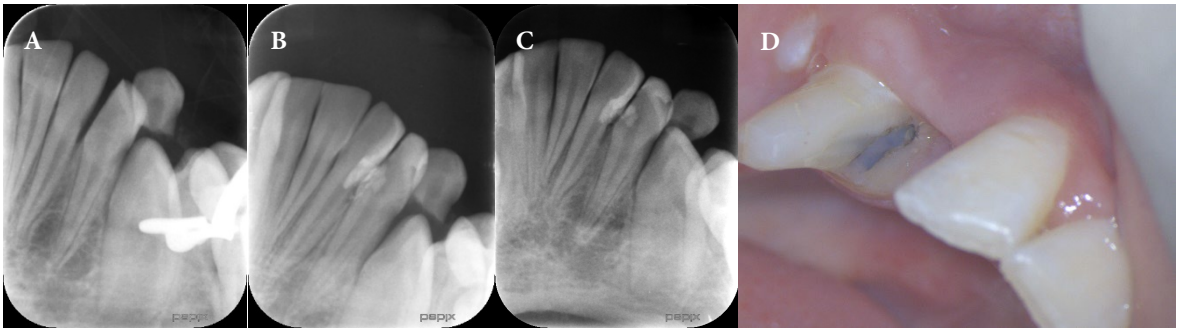

Figure 2. *A*) Mid-treatment radiograph showing the hemi-section of the 32M and 32D; *B*) Immediate post-operative radiograph; *C*) Four-month review radiograph; *D*) Five month review intra-oral image of the retained 32D following removal of the 32M, displaying discolouration around the composite repair

The patient returned for initial review appointments in May and June 2015 (Fig. 2B). Both the 32M and 32D remained normally responsive to pulp testing. Both teeth, however, displayed a degree of discolouration (Fig. 2C). Due to the larger pulp exposure in the 32M, it was decided to extract this segment prior to his orthodontic treatment.

Orthodontic treatment

Initial orthodontic examination had been completed prior to endodontic management of tooth #32. The patient had a Class II skeletal malocclusion with maxillary deficiency. Dental examination revealed a Class II molar relationship and Class II division II incisal relationship, with a deep overbite and moderate crowding in the mandible. The overjet was 5 mm, with narrow archforms. Mahony cephalometric analysis, a variation of Jefferson's cephalometric analysis [16], revealed a mild skeletal Class II relationship with a retrognathic mandible (skeletal type IIB), retroinclined incisors, decreased maxillary length and a reduced lower facial height.

After discussion of treatment options, orthodontic treatment commenced following endodontic intervention, employing a slow palatal expander appliance and fixed braces (0.022 slot, Damon PSL; Ormco, Glendora, CA, USA). Treatment proceeded smoothly and was completed in 29 months. At the conclusion of treatment, a fixed lingual wire (V-loop) was used for retention, with a removable Hawley retainer for the upper arch.

Review

Clinical and radiographic reviews were completed in May 2017 (2.5 years), June 2018 (3.5 years) and May 2024 (9.5 years) following VPT (Figs 3A-C). The 32D remained normally responsive to pulp sensibility testing and has continued to be asymptomatic; however, discolouration was noted at the final review appointment. The apical tissues remained normal, both on intra-oral radiography and CBCT assessment (Morita 800×, 40×40 mm ^{2} limited view) (Figs. 3D & 3E). The patient's general dentist had completed a full composite veneer for tooth #32.

Discussion

Dental fusion in mandibular anterior teeth is rarely reported [17, 18], with "double teeth" more commonly reported in maxillary anterior teeth [3]. Fusion is rarely reported in posterior teeth [19, 20]. Whilst fusion is most commonly noted in the primary dentition, it can be an indication of anomalies being present in the permanent dentition [21].

Radiographic examination is essential to determine if the anomalous tooth arose due to gemination or fusion, as they can present similarly on clinical examination. Counting the dentition can normally help determine if a 'double tooth' is due to fusion or gemination. However, in this presented case, it was made more complicated by the presence of the supernumerary, which had fused with tooth #32. It was impossible to determine the relationship between the root canal systems of both segments based solely on intra-oral radiography, necessitating the need for CBCT assessment. Treatment planning for the case depended on the relationship of the root canal anatomy of both tooth segments, as if there had been no communication between the root canal systems, hemi-section could have avoided endodontic treatment. As pulpal exposure was guaranteed due to the root canal systems merging at a single point, this permitted a more accurate discussion with both the patient and his parents, as well as the orthodontist, regarding appropriate treatment options for tooth #32.

Nitrous oxide was used as an adjunct to reduce anxiety and assist with anaesthesia during the procedure. Nitrous oxide is a safe and effective means of improving compliance with treatment in the dental chair in paediatric patients, without having to resort to general anaesthesia [22, 23].

Ozden *et al.* [24] performed hemi-section of a fused maxillary right central incisor with a supernumerary after confirming the root canal systems of both teeth did not join, maintaining normal function and pulpal health of the remaining tooth. This assists with treatment planning, prior to initiating any treatment, and can allow for planning the hemi-section in such a way to minimize

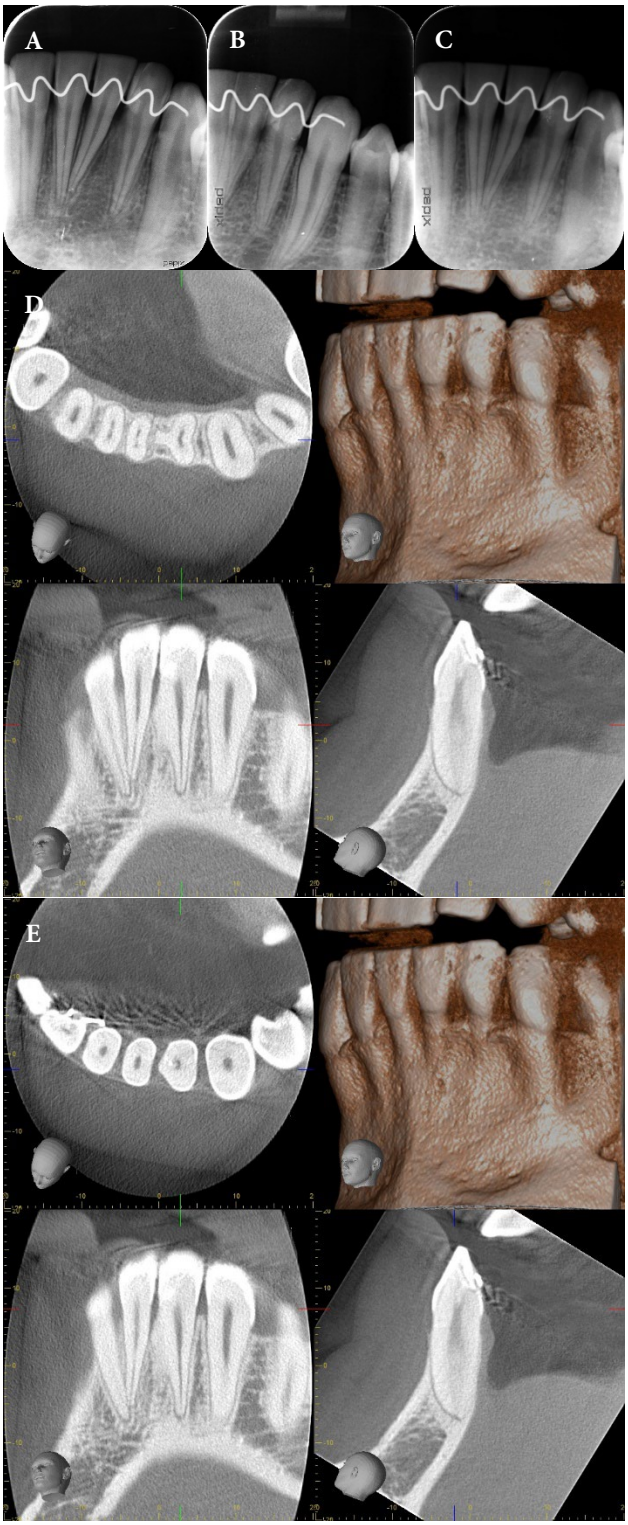

Figure 3. *A*) Intra-oral review radiographs at 2.5 years; *B*) Intra-oral review radiographs at 3.5 years; *C*) Intra-oral review radiographs at 9.5 years; *D*) CBCT assessment at 9.5 years review confirmed normal apical tissues. Note the atypical mesial root anatomy of the 32D following hemi-section; *E*) CBCT assessment at 9.5 years review confirmed normal apical tissues. Note the atypical mesial root anatomy of the 32D following hemi-section

trauma to the pulps and pre-plan any possible complications. CBCT can be used to plan the plane of sectioning to ensure no pulpal exposure occurs [25]. One report outlined the need to perform access and extirpation of one unit in a fused tooth to determine if there was pulpal communication prior to hemi-section, with pulp vitality being maintained in the retained tooth [26]. Kim & Jou [27] reported a case of fusion of a supernumerary to a maxillary right central incisor (tooth #11). The tooth was endodontically treated prior to removal of the supernumerary, and MTA was used to seal the pulpal communication between the supernumerary and the main tooth. As the authors noted, it was unknown whether the pulps of these fused teeth were communicating before treatment.

Fusion can lead to complications including periodontal disease, dental caries, abnormal eruption, malocclusion and ectopic eruption of adjacent teeth [2]. Fused teeth are an aesthetic challenge as they are typically malformed and affect dental symmetry and spacing [26, 28]. Composite resin can be used to aesthetically modify teeth and close spaces in minor cases [29], as was completed in this case. Malocclusions can be further exacerbated by the presence of supernumerary teeth.

From an orthodontic perspective, a decision was made to retain a segment of the fused tooth rather than extracting it entirely. The primary benefit of this approach was to maintain the proper space for the tooth to match the contralateral lateral incisor, maintaining symmetry between tooth #32 and tooth #42. Extraction of the entire fused tooth would have led to a compromised aesthetic outcome, as the canines would not achieve a Class I occlusion, potentially leading to a midline shift and further malocclusion concerns [30]. Preserving the lateral incisor would aid in the future development of the dental arch and maintain arch integrity [31].

Similar reports have presented cases of hemi-section of fused teeth. Cetinbas *et al.* [3] reported a case of hemi-section of fused teeth, however no pulp exposure occurred, and the responsiveness of the remaining tooth was maintained at two-years follow up. Zheng *et al.* [28] reported a maxillary central incisor was fused with a supernumerary tooth. The pulp was exposed after removing the majority of the supernumerary, and the hemi-section was undertaken, and the pulp capping with calcium hydroxide was performed. The authors reported the tooth to be disease free and functional at 10-year follow-up. Pulp capping with MTA was reported by Hong *et al.* [29], where a geminated tooth #22 was successfully treated with hemi-section. In this presented case, pulp exposure was inevitable as a consequence of the hemi-section of the conjoined anatomy of the root canal systems of the fused teeth. A similar clinical

scenario to this case would be that of managing a talon cusp, whereby the anomalous cusp is removed and the pulp electively exposed, followed by VPT [32, 33]. VPT with MTA is a highly successful treatment option in mature teeth following dental trauma and carious pulp exposure, with one systematic review reporting a pooled success rate of 93.2% [34].

Given the expected size of the pulpal exposure and ease of restoration, MTA was chosen as the restorative material over calcium hydroxide. MTA upregulates osteogenic and osteoclastic pathways in dental pulp stem cells and promotes differentiation into odontoblast-like cells [35, 36]. MTA has been found to stimulate formation of thicker, less porous, and more predictable dentine bridges than calcium hydroxide [37-39]. Less inflammation is found at the pulp-restoration interface when MTA is used compared with calcium hydroxide [39]. There is also some evidence to suggest that MTA use can result in regeneration of periodontal ligament and cementum-like tissue [40].

Whilst MTA is dimensionally stable and fluid-resistant once set [41], wash-out is a recognized risk intra-operatively and post-operatively in the short term [26, 29]. One report used decalcified freeze-dried bone allograft as a grafting material following hemi-section and extraction to assist with protecting MTA from the oral environment following VPT. Placement of a glass-ionomer cement can protect partially set MTA [42]. This was completed in the presented case, and a satisfactory seal was achieved to allow the MTA to fully set.

One possible complication following the use of MTA is discoloration of tooth structure [43], which occurred in this presented case. Internal bleaching is an option should discoloration occur [44]; however, this can only be completed if a calcific bridge has formed beneath the MTA layer. In this presented case, there was no calcific barrier observed at follow-up, and the interproximal nature of the pulp exposure and restoration would pose a technical difficulty for re-entry and bleaching. For these reasons, and as the tooth had continued responsiveness to pulp testing and there were no signs of infection, a direct composite veneer was preferred to conservatively manage the discoloration.

It would have been preferable to have known in advance which tooth unit, 32D or 32M, was to be retained prior to performing the hemi-section, to allow for minimal damage to the unit that was retained. There was some question in the initial treatment planning however, as to which tooth unit should be retained. A decision was made to wait for the clinical response of both tooth units to the hemi-section procedure before making a final decision, especially given the atypical nature of the fused tooth.

Conclusion

This report outlines the successful management of a fused mandibular supernumerary and highlights the importance of a multi-disciplinary approach with multiple specialists at an opportune time in the patient's development. Appropriate treatment required comprehensive planning, relying on detailed clinical assessment using intra-oral radiography X-ray and cone-beam CT, alongside multi-disciplinary communication are necessary to achieve an ideal outcome for the patient. Such planning allowed the patient to have the fused tooth hemi-sectioned and treated with vital pulp therapy. The final outcome was that the tooth maintained its pulp sensibility and was able to obtain ideal alignment and occlusion, with optimum aesthetics obtained by the operation of restorative dentist.

Acknowledgment
None.

Conflict of interest
None.

Funding support
None.

Authors' contributions
Conceptualization: MR/MJ; Methodology: AL/MJ; Formal Analysis and Investigation: MR/DM; Writing-Original Draft Preparation: MR/AL/MJ DM; Writing-Review and Editing: MR/AL/MJ DM; Supervision: MR. All authors read and approved the final manuscript.

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Please cite this paper as: Rahimi M, Lalousis A, Johnstone M, Mahony D. Endodontic and Orthodontic Management of a Fused Mandibular Incisor and Supernumerary: A Case Report. Iran Endod J. 2026;21(1): e30. Doi: 10.22037/iej.v21i1.49822.