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STACKED IMPACTED MANDIBULAR MOLARS ASSOCIATED WITH PRIMARY FAILURE OF ERUPTION: A CBCT CASE REPORT

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ABSTRACT
Tooth eruption is a complex, biologically regulated process involving coordinated interactions among the dental follicle, gubernacular cord, and dental lamina remnants which is important in a process that is essential for establishing proper occlusion and masticatory efficiency.
OBJECTIVES: The present case report aims to describe the radiographic features of primary failure of eruption (PFE) in permanent mandibular molars using cone-beam computed tomography (CBCT). It seeks to evaluate the pattern and positioning of multiple impacted molars in the mandibular posterior region and to assess the role of retained deciduous teeth in disrupting the normal eruption pathway. It further emphasizes the importance of CBCT in accurate diagnosis and treatment planning, while highlighting the need for early detection and appropriate management to prevent complications affecting occlusion, jaw development, and overall oral function.
METHODS: This case report describes a 28-year-old female of East Indian descent who presented with a long-standing history of missing tooth in left mandibular region which was diagnosed after proper clinical examination then radiographical evaluation was done using CBCT.
RESULTS: The CBCT imaging revealed multiple impacted molars arranged in a stacked configuration over each other in the left mandibular region, providing comprehensive insight into their position, orientation, and relationship with adjacent anatomical structures. CONCLUSION: This highlights the importance of early diagnosis using 3D imaging modalities like CBCT and intervention to prevent complications affecting occlusion, jaw development, and overall oral function.

KEYWORDS: Tooth erupt ion; failure of eruption; radiographic evaluation

INTRODUCTION

The eruption of molars is influenced by multifactorial theories of tooth eruption, from gubernacular cord to tooth germs developing as an extension posterior to the dental lamina. The eruption is mainly attributed to the presence of a tooth germ not on a primary tooth position, as they do not replace the primary tooth. Disruption, persistence, or abnormal behaviour of dental lamina remnants may compromise this pathway, impair normal eruptive movement, and potentially contribute to delayed eruption or failure of eruption of permanent molars in the absence of obvious mechanical obstruction(1,2).Simultaneously, the position of molars is not only dependent on their eruption, but their position in the arch is also determined by postnatal growth of the mandible, as it undergoes remodelling during early and mixed dentition stages. Thus, in vertical growers, the posterior rotation of the mandible is noted, which progressively reduces growth in the retromolar region, causing distal movement of the molars in the ascending ramus where the second and third molars erupt. Consequently, any change in this retromolar space or narrowing of the gap can lead to horizontal impaction, tipping of the tooth, or in severe cases, a stacked vertical arrangement of teeth. Additionally, heredity has been proposed as a contributing factor in molar impaction, indicating a possible genetic basis for this anomaly (3)
Radiographically, primary failure of eruption may manifest as multiple permanent molars exhibiting abnormal positioning along with a reduced vertical height of the alveolar bone in the affected region. This case report

presents an unusual occurrence of multiple impacted permanent mandibular molars, emphasizing the characteristic radiographic findings consistent with primary failure of eruption. Furthermore, distalization of teeth causing them to stack on the retromolar region secondary to postnatal mandibular growth is also highlighted.

CLINICAL MANIFESTATIONS AND EPIDEMIOLOGY:

The occurrence of primary failure of eruption is relatively low, with a prevalence of approximately 0.06% in the population and a gender predilection with a male to female ratio of 1:2.25. Posterior teeth are most commonly involved, with the first molar being the most frequent, accounting for more than 90% of affected individuals, followed by second molars. Permanent teeth are most often affected, though primary teeth may also be involved, with an approximate permanent to primary tooth ratio of 3:1.5 The condition tends to affect the distal and middle neighbouring teeth, often leading to an open bite in the posterior region — notably, teeth located distally to the unerupted tooth are also affected; for instance, if the second premolar is the first unerupted tooth, both the first and second molars will remain impacted as well(4,5). The affected tooth may be either partially erupted or wholly buried within the alveolar bone; however, imaging reveals no obstruction along the eruption path, and the vertical height of the alveolar bone in the affected area is significantly reduced compared to neighbouring teeth (4). The condition is more commonly observed bilaterally than unilaterally, with a bilateral to unilateral ratio of approximately 2:1, and in approximately 25% of affected individuals, eruption is limited to one quadrant, while in others, two or more quadrants may be involved. Orthodontic traction is generally ineffective and often leads to root cementum resorption (4,5)

CASE REPORT:

A 28-year-old female of east Indian descendent was referred to the Department of Oral and Maxillofacial Radiology for radiographic evaluation of missing posterior teeth in the left mandibular region. She reported a long-standing absence of erupted teeth in the lower left posterior area since early adulthood, accompanied by intermittent discomfort during mastication. There was no history of trauma, prior orthodontic intervention, or systemic disease. No such condition was noted in the family and siblings.

After obtaining informed consent, radiographic evaluation was carried out using a cone-beam computed tomography (CBCT) for comprehensive assessment. CBCT of mandible revealed retained deciduous left mandibular second molar tooth (75), with the occlusal level present at the cemento-enamel junction of left mandibular first premolar. Evidence of an ill-defined radiolucency involving the enamel and dentin noted in disto-proximal aspect of the crown of 75. The left mandibular first, second and third molar were impacted and stacked one over the other with the first molar being placed inferiorly and third molar in superior most location (Figure 1). No significant radicular morphology could be appreciated in the scan and was associated with sclerotic changes in surrounding trabecular pattern (Figure 2; Slice number 1-6).

The cropped panoramic section of 1 mm slice thickness and sequences of cross-sectional images of 150 microns slice thickness and 1.5mm slice spacing revealed the long axis of left mandibular first molar (36) was perpendicular to long axis of 75, the occlusal surface of 36 was abutting the disto-proximal aspect of 75. An ill-defined radiolucency involving enamel dentin was noted in coronal aspect of 36 (Figure 1A-1H). Two separate mesial and distal root noted in relation to 36. The mesial root of 36 was at the level of inferior alveolar nerve canal and was abutting the cortical margins of inferior alveolar nerve canal (Figure 2; Slice number 13-20).

The long axis of the left mandibular second molar (37) was parallel to left mandibular first molar. the tooth 37was placed superior to 36 with the mesial surface of 37 abutting the distal aspect of 36 (Figure 1A-1H). In the radicular portion of 37 no significant inter-radicular bone was appreciated in between 36 and 37(Figure 2; Slice number 15-20).

The left mandibular third molar (38) was placed higher in the ascending ramus region with long axis parallel to 37. The relative size of 38 was comparable smaller than 36, 37. The location of 38 is superior to 37 with long axis parallel to 37 (Figure 1A-1H). The radicular morphology of 38 is altered when compared to 36, 37. The apex of 37 and 38 were terminating 1 mm lingual to inferior alveolar nerve canal (Figure 2; Slice number 19-25). Complete root formation of all the three molars are formed. No evidence of any bone covering noted over coronal aspect of left mandibular molars however soft tissue coverage over the coronal aspect was evident.

Notably, the contra-lateral mandibular quadrant demonstrated horizontally impacted 48 having a gross carious lesion. The right mandibular first and second molar exhibited normal eruption pattern. No evidence of any retained deciduous teeth in the right mandibular quadrant (Figure 3).

In view of the clinical and radiographic findings, the features are suggestive of Primary Eruption Failure (PEF) involving 36 and 37, with developing 38, secondary to persistence of retained deciduous 75, leading to disturbance in normal eruptive mechanism rather than a purely mechanical obstruction.

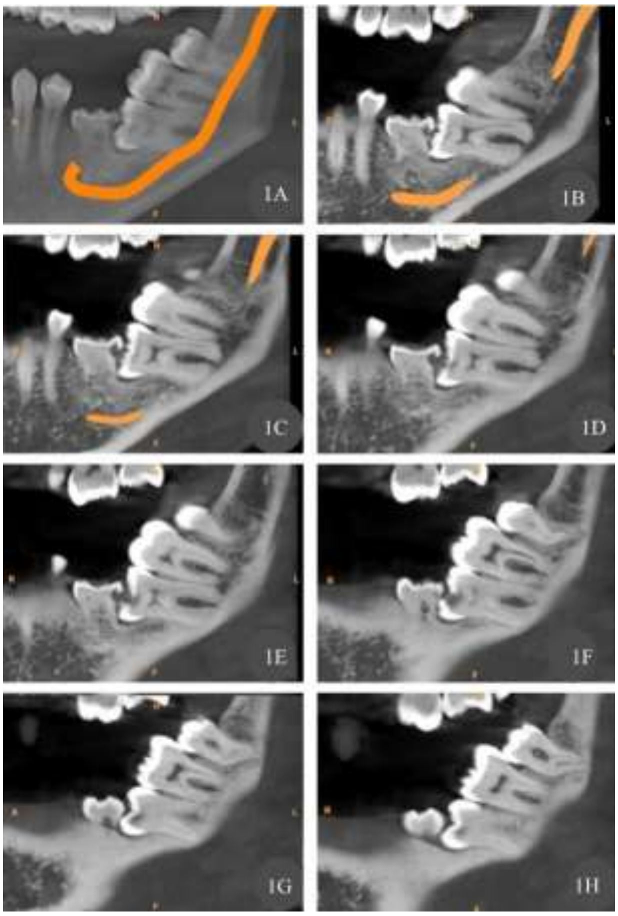

Figure 1. Cropped panoramic sections of the mandibular arch of the patient. A) Panoramic section of 40 mm thickness. B-H) Panoramic section of 1mm thickness and 1 mm slice spacing from lingual to buccal direction.

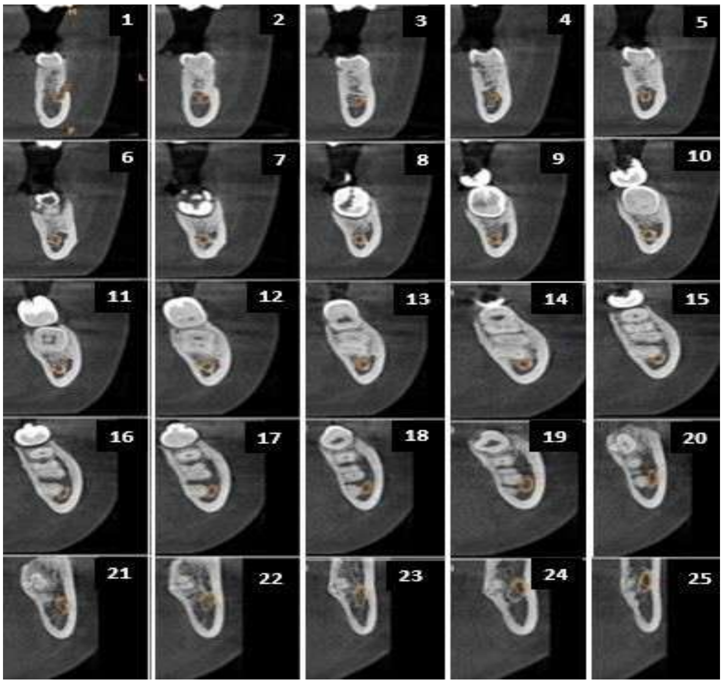

Figure 2. Series of cross-sectional images from slice number 1 to 25 with slice thickness 150 microns slice thickness with 1.5 mm slice spacing.

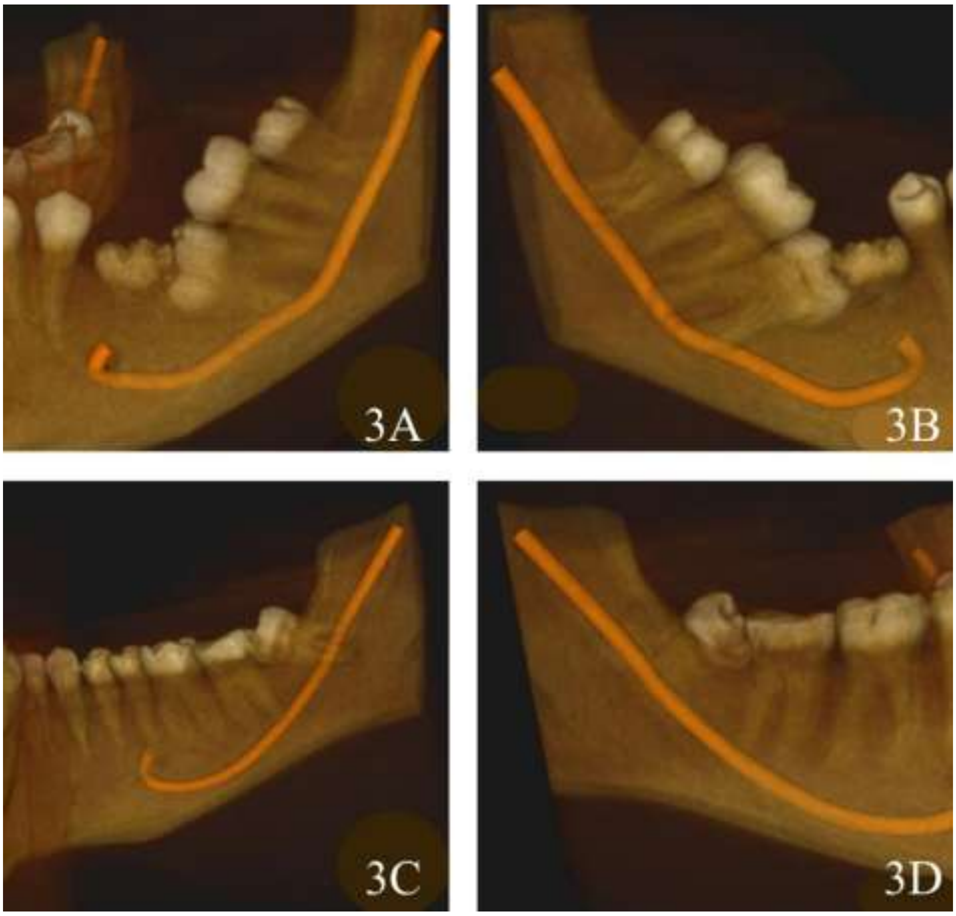

Figure 3. Three- Dimensional reconstructed images. A) Three- Dimensional reconstructed image of buccal view of right mandible; B) Three- Dimensional reconstructed image of lingual view of right mandible; C) Three- Dimensional reconstructed image of lingual view of left mandible; and D) Three-Dimensional reconstructed image of buccal view of left mandible

Figure 4. Schematic representation showing how retained deciduous teeth can lead to primary failure of eruption by interfering with normal root resorption, altering the eruption pathway, and impairing bone remodelling.

DISCUSSION

Failure of eruption of permanent teeth may occur due to mechanical obstruction either idiopathic or pathological in origin or as a result of impairment of the eruptive mechanism itself. Such eruption disturbances may involve a single tooth or multiple teeth, affect either the primary or permanent dentition, and present as partial or complete failure depending on the underlying etiology (7). Several genes have been implicated in the regulation of tooth eruption, including PTH1R, TMEM119, and WDR72, with PTH1R recognized as the principal regulatory gene. Mutations in these and other related genes may directly impair osteoblast function or disrupt bone matrix mineralization, ultimately leading to inadequate eruptive force and failure of tooth eruption.[4] Primary retention of both primary and permanent teeth may result from defects in the dental follicle, leading to altered local metabolic activity and disruption of the biological interactions essential for normal tooth eruption (8).

Primary eruption failure may result from a variety of local and systemic factors. Local causes include ankylosis or prolonged retention of deciduous teeth, lack of physiologic root resorption, ectopic or impacted teeth, arch-length deficiency, skeletal discrepancies, supernumerary teeth, odontogenic or non-odontogenic tumors, cysts, gingival hyperplasia, mucosal scarring, trauma to primary teeth, regional developmental anomalies, and idiopathic factors. Systemic associations include endocrine and metabolic disorders, genetic conditions, nutritional deficiencies, prematurity or low birth weight, neurological disorders, chronic systemic diseases, and environmental or iatrogenic influences such as drugs, radiation, chemotherapy, and toxic exposures (8).

Mutations in the PTH1R gene are a major cause of autosomal dominant primary failure of eruption (PFE), with over 50 variants identified to date. PTH-related signaling remains the only confirmed molecular pathway implicated in PFE. Experimental PTH1R ablation studies demonstrate initial formation of an intra-osseous eruption pathway followed by arrest of eruption, indicating that loss of receptor function in the dental follicle disrupts further eruptive movement. Clinically, PFE is challenging to manage, as affected teeth often become ankylosed in response to orthodontic traction, highlighting the potential role of targeted restoration of PTHrP–PTH1R signaling as a future therapeutic approach (9).

First permanent molars are most commonly affected, being involved in more than 90% of individuals with primary failure of eruption, followed by the second molars. Eruption disturbances may occur in the maxilla, mandible, or both, with a notable tendency for unilateral presentation. Approximately 25% of affected individuals exhibit involvement limited to a single quadrant, whereas others may show involvement of two or more quadrants. A characteristic feature of this condition is that teeth distal to the initially affected tooth are also involved. The eruption process of molars is primarily depended on the position and eruption process of premolar adjacent to it (4)

Physiological resorption of deciduous tooth roots is a prerequisite for normal eruption of permanent successors. Failure or delay in this resorptive process can result in prolonged retention of the deciduous tooth, which may compromise the eruptive potential of the permanent tooth. In such situations, the dental follicle–bone interaction required for eruption may be disturbed, leading to inadequate bone remodeling and reduced eruptive force. This mechanism may contribute to eruption failure even in the absence of a clear mechanical obstruction (Figure 4).

An important yet frequently overlooked factor contributing to abnormal molar positioning is the distalization of mandibular molars secondary to the mandibular growth pattern. In individuals exhibiting a predominantly vertical or hyperdivergent mandibular growth pattern, the mandibular ramus undergoes posterior rotation, which alters the spatial trajectory available for erupting molars. As the mandible grows in a downward and backward direction, the retromolar space may be progressively reduced, effectively compressing the posterior dental arch. This biomechanical constraint can redirect the eruptive pathway of developing molars in a distal direction, increasing the likelihood of impaction, ectopic positioning, or stacking as observed in the present case. The relationship between mandibular growth rotation and molar eruption disturbance was described by Björk and Skieller, who demonstrated that posterior growth rotation of the mandible is associated with a reduction in retromolar space and is a significant determinant of third molar impaction. However, this principle extends to second and first molars in cases where primary failure of eruption coexists with an adverse skeletal growth pattern (10). In the present case, the vertical stacking of all three permanent mandibular molars in the left posterior region may be partly attributed to such a growth-related distalization effect, superimposed upon the inherent eruption failure mechanism. The downward and backward mandibular growth trajectory effectively displaced the eruption pathway posteriorly, while the compromised eruptive force due to PFE prevented compensatory mesial drift. This combination resulted in a characteristic “bullet molar” configuration, in which successively erupting molars are forced to stack vertically rather than assume their normal occlusal position. Recognition of the mandibular growth pattern as a contributing etiological factor is therefore clinically significant, as it has direct implications for treatment planning. Patients with vertical growth patterns may require growth modification therapy or orthognathic surgical correction in conjunction with management of the impacted molars, rather than orthodontic traction alone.

PROGNOSIS:

The prognosis in cases of multiple molar impaction secondary to PFE is primarily governed by four factors: (1) the position and inclination of each impacted molar relative to the alveolar crest and adjacent anatomical structures; (2) the degree of root formation at the time of diagnosis; (3) the degree and direction of impaction of each tooth; and (4) the availability of space within the dental arch for alignment following surgical intervention. In this case, all three molars demonstrated complete root formation at the time of presentation, which constitutes a prognostically unfavorable feature, as fully formed roots are less amenable to guided eruption and are more prone to ankylosis during orthodontic traction (9). The intimate proximity of the mesial root of 36 to the cortical margins of the inferior alveolar canal significantly elevates the risk of inferior alveolar nerve injury during surgical exposure, further complicating the prognosis for functional restoration of this tooth. The absence of inter-radicular bone between 36 and 37, as identified on CBCT cross-sectional images, suggests a degree of osseous fusion or advanced ankylosis, which would render orthodontic traction of either tooth mechanically impractical without prior surgical separation. The reduced vertical alveolar bone height in the affected quadrant, a hallmark of PFE, also limits the available bone support for any prosthetic or implant-based rehabilitation that may ultimately be required (5). An adverse mandibular growth pattern, as discussed, further compounds the prognosis by limiting the retromolar space available for tooth movement (10). The contralateral impacted 48 with gross carious involvement does not directly affect the prognosis of the left quadrant but underscores the systemic or genetic predisposition of this patient to eruption failure, which should be factored into the overall treatment plan.

TREATMENT CONSIDERATIONS:

Management of multiple impacted molars in the context of PFE demands early intervention and a well-structured, hierarchical treatment approach guided by a multidisciplinary team comprising a pedodontist, orthodontist, oral and maxillofacial surgeon, endodontist, periodontist, and prosthodontist. Given the proximity of the impacted roots to the inferior alveolar nerve canal in this case, the oral and maxillofacial surgeon's role is particularly critical, and pre-surgical neurovascular risk assessment using CBCT is mandatory. The following treatment hierarchy is proposed, in order of preference. The first and most desirable option is surgical exposure combined with orthodontic traction, which represents the gold standard where biologically feasible. This approach aims to preserve natural tooth structure, stimulate alveolar bone development, and maintain the integrity of the periodontal apparatus. However, in PFE, orthodontic traction carries a significant risk of inducing ankylosis, and clinicians must be vigilant for early signs of treatment failure.

CONCLUSION:

Early recognition of such atypical eruption patterns and careful radiographic evaluation are essential to avoid inappropriate orthodontic intervention, which may predispose affected teeth to ankylosis. This case underscores the importance of considering primary failure of eruption in the differential diagnosis of unilateral posterior eruption failure and highlights the value of CBCT in diagnosis, treatment planning, and prevention of potential neurovascular complications.

Conflict of interests: The authors have no competing interests.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Kalinga Institute of Dental Sciences (KIDS/RES/242/2026, 13 February 2026).

Patient consent: Written patient consent was obtained from all patients.

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