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Diagnostic Dilemmas and Management Strategies in Conjoined Primary Teeth: A Case Series on Fusion and Gemination

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Abstract

Introduction: Conjoined primary teeth (fusion and gemination) are developmental anomalies that pose diagnostic ambiguity with direct implications for treatment planning. Their co-occurrence in the same primary dentition and the limitations of any single diagnostic modality have rarely been described in a single case series.

Case Presentations: Three paediatric patients (aged 5 to 8 years) with conjoined primary anterior teeth were evaluated. A three-step diagnostic approach was applied including Intraoral periapical radiography, Mader's two-tooth rule, and developmental groove analysis. Case 1 (teeth 51, 52): non-vital fused teeth, treated with pulpectomy. Case 2 (teeth 72, 73): asymptomatic fusion with delayed exfoliation causing eruption obstruction, managed by extraction. Case 3 (teeth 71, 72): diagnostic dilemma between fusion and gemination with intact pulp, treated with glass ionomer cement restoration and scheduled for follow-up.

Conclusion: No single diagnostic modality reliably differentiates fusion from gemination in all cases. A three-step validation protocol enhances diagnostic accuracy. Treatment should be guided by pulpal status and eruption dynamics rather than anomaly classification alone. Paediatric dentists must maintain clinical vigilance for conjoined teeth across all primary dentition presentations.

Keywords: Fusion; Gemination; Conjoined teeth; Primary dentition; Mader's rule; Diode laser; Pediatric dentistry

Introduction

Developmental anomalies of the primary dentition encompass a spectrum of morphological variations affecting tooth number, size, shape, and structure. Among these, conjoined teeth, comprising fusion and gemination, present a distinctive diagnostic and management challenge in paediatric dentistry [1]. The term "conjoined teeth" serves as an appropriate provisional designation until radiographic and clinical diagnostic criteria confirm the specific anomaly [2].

Gemination arises from the attempted division of a single tooth germ, typically producing a bifid crown with a single root and pulp canal. Fusion, in contrast, results from the union of two distinct tooth germs at the dentin level, producing an enlarged tooth that may exhibit partial or complete merging of pulp chambers depending on the developmental stage at which union occurred [3,4]. While both conditions share overlapping clinical morphology,

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their implications for arch integrity, space maintenance, and the eruption sequence of permanent successors differ considerably.

The prevalence of conjoined teeth in primary dentition ranges from 0.1% to 0.9% in Caucasian populations and 1.55% to 3.0% in Asian populations [5]. A 2021 systematic review confirmed that fused teeth are more common in primary than permanent dentition, with a predilection for the mandibular anterior region [6]. In the Indian population, fusion is reported more frequently than gemination, with a combined prevalence of 57.43% in males and 42.57% in females among screened subjects [7]. This case series presents three cases of conjoined primary teeth evaluated through a structured three-step diagnostic protocol and managed according to pulpal and eruptional status, aiming to address the persistent diagnostic ambiguity that characterises this anomaly group.

Methods

Study Design and Setting

This retrospective case series was conducted in the Department of Paediatric and Preventive Dentistry, ITS Dental College, Hospital and Research Centre, Greater Noida, India. Cases were identified from routine clinical attendance. Eligibility criteria included patients presenting with clinically visible conjoined primary anterior teeth confirmed radiographically, with no syndromic diagnosis or systemic illness. All cases were evaluated using a standardised three-step diagnostic protocol comprising: (i) intraoral periapical (IOPA) radiography for pulp chamber and root canal morphology, (ii) Mader's two-tooth rule to assess arch tooth count, and (iii) clinical analysis of the developmental groove's depth and position. Written informed consent was obtained from the legal guardians of all patients prior to clinical examination, investigation, and treatment. All patient identifiers have been removed from this report.

Case presentations

Case 1: Fusion with Non-Vital Pulp (Teeth 51 and 52)

A 5-year-old male presented with a chief complaint of decayed maxillary anterior teeth and a 6-month history of spontaneous nocturnal pain that had resolved with medication 20 days prior. Clinical examination revealed a single enlarged crown in the region of the maxillary right central and lateral primary incisors (51, 52) with a deep developmental groove on the labial surface. IOPA radiography demonstrated two distinct pulp chambers and separate root canals, with no evidence of internal or external root resorption. Applying Mader's two-tooth rule, the conjoined unit was counted as two teeth, yielding a normal total arch count; this, combined with two distinct pulp spaces, confirmed a diagnosis of fusion.

Access opening confirmed loss of vitality, evidenced by absent haemorrhage. Pulpectomy was performed with working length establishment, canal preparation, and zinc oxide eugenol obturation, followed by stainless steel crown placement. The patient was recalled at 1 week, 1 month, and 3 months, with no adverse events or signs of recurrence.

Figure 1: Obturation IOPA wrt 51 and 52.

Figure 2: Post Operative Clinical Photograph wrt 51 and 52.

Figure 3: Pre-operative wrt 71 and 72.

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Case 2: Fusion with Eruption Obstruction (Teeth 72 and 73)

An 8-year-old male presented with concern regarding erupting permanent mandibular anterior teeth and persistent retention of the primary predecessors (teeth 72 and 73) over a 2-month period. The patient was asymptomatic. Clinical examination revealed a single enlarged crown in the mandibular left incisor and canine region with a deep developmental groove. IOPA radiography showed advanced root resorption obscuring pulp chamber anatomy, precluding radiographic classification. Absence of contralateral primary teeth rendered Mader's two-tooth rule inapplicable. The diagnosis of fusion was therefore supported provisionally on the basis of the deep developmental groove morphology and clinical presentation consistent with union of two distinct tooth germs.

Given that the retained primary unit was mechanically obstructing the eruption of the permanent mandibular left central incisor, extraction was performed under local anaesthesia. The eruption path normalised at the 1-week follow-up. No postoperative complications were reported.

Figure 4: Post-operative clinical photograph of wrt 71 and 72.

Case 3: Gemination with Diagnostic Dilemma (Teeth 71 and 72)

A 5-year-old patient was brought by parents with a chief complaint of carious involvement of the mandibular anterior teeth and extrinsic staining of the maxillary anterior teeth. Parental history disclosed inconsistent oral hygiene practices. Clinical examination identified a shallow pit carious lesion on the gingival third of the labial surface of a single enlarged crown in the region of teeth 71 and 72. IOPA radiography revealed a bifid pulp chamber with a single wide root canal, more consistent with gemination. However, the developmental groove was shallow and centrally positioned, and Mader's two-tooth rule produced a normal tooth count in one arch when the unit was counted as two, which is more consistent with fusion.

The case thus presented a genuine diagnostic dilemma: radiographic and groove findings supported gemination, while the arch count supported fusion. Pulpal status was intact with no periapical pathology and no disturbance to permanent tooth eruption. Following pulpal assessment, a glass ionomer cement restoration was placed over the carious pit, and the patient was enrolled in a 3-monthly monitoring schedule. No adverse events were reported at the 1week review.

Figure 5: IOPA wrt 71 and 72.

Figure 6: GIC Restoration was done wrt 71 and 72.

Table 1: Case series summary and timeline.

Feature	Case 1	Case 2	Case 3
Teeth involved	51, 52	72, 73	71, 72
Pulp chambers	Two separate	Not assessable (resorption)	Bifid, single canal
Mader's rule	Normal count	Not applicable (absent contralateral teeth)	Normal count
Developmental groove	Deep	Deep	Shallow, central
Final diagnosis	Fusion	Fusion (provisional)	Gemination (diagnostic dilemma)
Management	Pulpectomy	Extraction	GIC restoration

Discussion

This case series illustrates three distinct clinical scenarios in which conjoined primary teeth required differential diagnostic reasoning before management could be planned. As summarised in table 2, fusion and gemination share overlapping morphological features that make single-modality diagnosis unreliable.

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Table 2: Differential diagnostic features of fusion and gemination.

Feature	Fusion	Gemination
Pulp chambers	Two separate or partially merged	Single, common
Root canals	Two distinct canals	Usually one (occasionally two)
Mader's rule count	Normal	Exceeds normal
Developmental groove	Present; often deep	Present centrally; shallow
Supernumerary association	Possible	Absent

A consistent finding across all three cases was the inadequacy of any single diagnostic criterion. In case 1, two separate pulp spaces and a normal arch count converged on a diagnosis of fusion with confidence. However, in case 2, progressive root resorption had eliminated the radiographic utility of canal morphology assessment, and the absence of contralateral teeth invalidated Mader's rule, leaving groove analysis as the sole functional diagnostic tool. This mirrors the findings of Bernardi et al. (2020), who noted that mandibular fused primary teeth frequently exhibit aberrant root resorption patterns that impair radiographic diagnosis and predispose to delayed exfoliation and eruption disturbance of permanent successors [6]. The management decision in case 2 was, therefore, appropriately guided by eruptional status rather than diagnostic certainty.

Case 3 is the most instructive of the three. Radiographic findings (bifid pulp chamber, single canal) and groove morphology (shallow, central) both pointed to gemination, yet Mader's rule produced a normal arch count, which is characteristic of fusion. This morphological overlap is well-documented and underpins the common recommendation to use the provisional term "conjoined teeth" until all three criteria have been evaluated [2]. The therapeutic implication was, in this instance, academic: the carious lesion was confined to enamel, the pulp was vital, and permanent tooth eruption was undisturbed, making conservative restoration appropriate regardless of the final diagnostic label.

From a management standpoint, this series supports a pulpal and eruptional status-guided algorithm rather than an anomaly-type-driven one. When the pulp is non-vital, pulpectomy is indicated (Case 1); when retained primary teeth mechanically obstruct permanent successors, extraction is preferred (Case 2); when the tooth is asymptomatic with no eruption concerns, conservative restoration and surveillance are appropriate (Case 3). This pragmatic approach aligns with the framework proposed by Goswami and Lohia [9].

The primary strength of this series is the simultaneous reporting of all three possible diagnostic outcomes within a single series, providing a practical reference for the three-step protocol in a real clinical setting. Key limitations include the small sample size inherent to a case series design, the absence of long-term follow-up data beyond the immediate postoperative period for cases 2 and 3, and the inability to confirm the diagnosis in case 2 by conventional means. Additionally, reporting bias cannot be excluded, as only cases presenting to a single tertiary paediatric dental centre were included, and the series may not represent the full spectrum of conjoined primary tooth presentations seen in community-based practice.

The present report adopts the CARE guidelines for case series reporting. While STROBE criteria are primarily designed for case-control study designs, relevant elements, including clear setting description, defined eligibility criteria, explicit diagnostic criteria, and transparent discussion of bias and limitations, have been incorporated to strengthen the methodological transparency of this report.

Conclusion

Fusion and gemination in primary dentition share clinical morphology that renders single-modality diagnosis unreliable. A three-step protocol integrating radiographic pulp canal evaluation, Mader's two-tooth rule, and developmental groove analysis offers the most reproducible path to diagnostic accuracy. Where diagnostic certainty cannot be achieved, the provisional designation of conjoined teeth is justified and clinically defensible. Management should be driven by pulpal and eruptional status rather than anomaly classification. Paediatric dentists, particularly in populations with elevated prevalence of conjoined teeth, should maintain a high index of clinical suspicion and adopt a case-specific, minimally invasive treatment philosophy.

Patient perspective

In all three cases, guardians reported satisfaction with the clinical care and management approach. The parents of case 1 noted relief following resolution of the child's nocturnal pain after pulpectomy. The guardians of case 2 expressed satisfaction with the improvement in the permanent tooth eruption pattern at follow-up. The parents of case 3 reported no postoperative concerns and compliance with the planned recall schedule. No guardian raised objections to the documentation or publication of their child's anonymised clinical information.

Informed consent

Written informed consent was obtained from the legal guardians of all three patients for clinical examination, radiographic investigation, treatment, and anonymised publication of case findings. All patient identifiers have been removed.

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Conflict of interest

The authors declare no conflict of interest.

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