



RESEARCH ARTICLE

ORTHODONTIC SPACE CLOSURE IN A PATIENT WITH CONGENITALLY MISSING MANDIBULAR SECOND PREMOLARS AND COMPROMISED FIRST MOLARS: A CASE REPORT AND FOCUSED LITERATURE REVIEW

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ABSTRACT

An 18-year-old female with skeletal Class I malocclusion, hyperdivergent growth pattern, bimaxillary crowding, compromised permanent first molars, and bilateral congenital absence of mandibular second premolars was treated with fixed mechanotherapy following strategic extraction of the compromised first molars. Maxillary molar mesialization was performed using NiTi closed-coil springs, while mandibular mesialization employed reverse helical loops with tip-back bends. Complete extraction space closure and sequential posterior tooth substitution were achieved without skeletal anchorage, resulting in a functional therapeutic Class III molar and Class I canine relationship, improved alignment, dental midlines, incisor inclination, and soft tissue profile. No significant root resorption or periodontal compromise was observed. The case demonstrates that controlled molar mesialization and sequential posterior substitution can provide a conservative alternative to prosthetic rehabilitation in selected patients with congenitally missing mandibular second premolars and compromised first molars.

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INTRODUCTION

Management of compromised permanent first molars in orthodontic patients presents a clinical challenge. First molars are frequently affected by extensive caries, failed endodontic treatment, hypomineralization, or periodontal compromise, often requiring extraction.¹ Conventionally, premolar extractions have been preferred during orthodontic treatment to relieve crowding and facilitate space management. However, strategic extraction of compromised first molars may provide a biologically favorable treatment alternative in selected patients.² Orthodontic space closure following first molar extraction offers advantages including preservation of healthy premolars, elimination of future prosthetic rehabilitation, and utilization of existing posterior dentition for functional occlusal rehabilitation.³ Nevertheless, molar mesialization remains biomechanically challenging because of the large root surface area of molars, anchorage demands, prolonged

treatment duration, and tendency for mesial tipping and bite opening during protraction.⁴ Congenital absence of mandibular second premolars is among the most frequently encountered forms of tooth agenesis after third molars, with a reported prevalence ranging from 2% to 5%. Their absence presents a significant orthodontic challenge due to altered posterior occlusal relationships, reduced mesiodistal space availability, and residual alveolar ridge deficiency. These factors complicate space management, biomechanical control, and long-term stability.⁵ Various treatment approaches have been proposed for the management of congenitally missing mandibular second premolars, including retention of primary molars, orthodontic space closure, prosthetic replacement, and autotransplantation. Treatment choice depends on the patient's age, occlusal relationships, periodontal condition, and associated dental anomalies. Among these, orthodontic space closure is considered a biologically conservative option because it preserves natural dentition and avoids long-term

prosthetic rehabilitation, although it presents biomechanical challenges.^{6,7} In the present case, bilateral congenital absence of mandibular second premolars coexisted with multiple compromised permanent first molars, creating a posterior space management dilemma. Unlike conventional agenesis cases where retained primary molars may offer temporary space maintenance, the absence of such an option combined with poor prognosis of adjacent first molars necessitated a comprehensive space closure approach. This required sequential mesialization of second and third molars to establish a functional therapeutic occlusion while avoiding future prosthetic replacement. Reports describing strategic extraction of multiple compromised permanent first molars in conjunction with bilateral congenital absence of mandibular second premolars managed by sequential posterior tooth substitution without skeletal anchorage remain limited in literature. The present case highlights the biomechanical and occlusal considerations of managing this posterior space discrepancy through a conservative orthodontic approach, along with a focused review of relevant literature. A focused literature review identified studies on congenitally missing mandibular second premolars and posterior space closure. Electronic searches were performed in PubMed, Google Scholar, and Scopus using combinations of the following keywords: “mandibular second premolar agenesis,” “congenitally missing mandibular second premolars,” “orthodontic space closure,” “molar mesialization,” “strategic first molar extraction,” and “third molar substitution.” Articles published in English describing treatment approaches, biomechanics, and long-term outcomes relevant to posterior space management were included. Priority was given to clinical studies, reviews, and case reports with direct applicability to the present case.

Diagnosis and Etiology: An 18-year-old female patient reported to the Department of Orthodontics with the chief complaint of irregularly placed upper front teeth. Extraoral examination revealed a mesoprosopic facial form with a straight profile, competent lips, and a non-consonant smile arc. The patient exhibited a hyperdivergent growth pattern with increased lower anterior facial height. Intraoral examination showed Class I canine and premolar relationship on the right side and end-on canine and premolar relationship on the left side. Crowding was present in both maxillary and mandibular anterior segments.

The maxillary arch demonstrated mesiolabial rotation of 21 and mesiopalatal rotation of 15 and 25. Root stumps were present with respect to 16 and 26. In the mandibular arch, 36 was grossly decayed and 46 was distopalatally rotated. Congenitally missing mandibular second premolars (35 and 45) were also noted. Radiographic evaluation confirmed bilateral agenesis, and the edentulous regions demonstrated reduced mesiodistal space and residual alveolar ridge deficiency, indicating long-standing absence of the teeth. The patient had an overjet of 2 mm and an overbite of 4 mm (55%). Maxillary dental midline was shifted 2 mm to the right, while the mandibular midline was shifted 1 mm to the left (fig 1). Cephalometric analysis revealed a skeletal Class I relationship (ANB = 1°) with a hyperdivergent growth pattern (Y-axis = 67°, Bjork's sum = 395°). The maxillary incisors were proclined (U1-SN = 112°), while the mandibular incisors were relatively upright (IMPA = 85°). Soft tissue analysis demonstrated protrusive upper and lower lips with increased lip strain (fig 2).

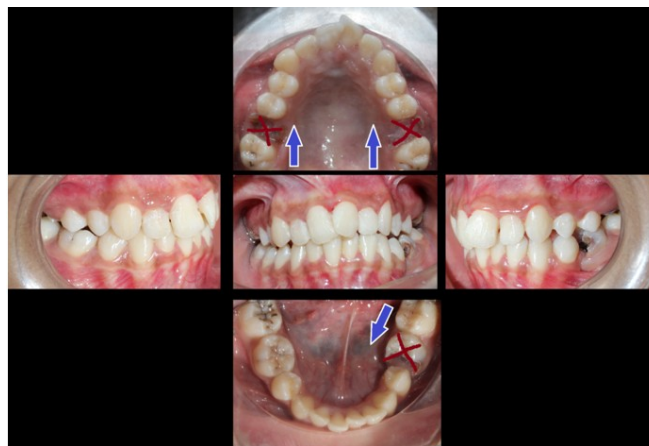


Figure 1. Pretreatment intraoral photographs showing the initial malocclusion and posterior dental condition



Figure 2. Pretreatment radiographic evaluation showing lateral cephalogram and panoramic radiograph

Based on the clinical and cephalometric findings, the patient was diagnosed with Angle's Class I malocclusion on a skeletal Class I base with hyperdivergent growth pattern, bimaxillary crowding, compromised maxillary first molars, grossly decayed mandibular first molar, and congenitally missing mandibular second premolars.

Treatment Objectives: The objectives of treatment were to relieve crowding in the maxillary and mandibular arches, achieve proper leveling and alignment, correct dental rotations and axial inclinations, establish ideal overjet and overbite, improve soft tissue balance and reduce lip strain, extract the compromised first molars with poor long-term prognosis, and achieve complete orthodontic space closure through molar mesialization. The treatment also aimed to establish a functional and stable therapeutic Class III molar relationship that would maintain posterior occlusal support following sequential mesialization and third molar substitution, avoid future prosthetic rehabilitation and reduce the long-term restorative burden, and achieve these outcomes using cost-effective biomechanics without temporary anchorage devices.

Treatment Alternatives: The first treatment alternative considered was extraction of compromised maxillary first molars (16 and 26) and grossly decayed mandibular first molar (36), followed by orthodontic mesialization of posterior teeth using skeletal anchorage. However, considering the young age of the patient, complete orthodontic space closure was preferred to eliminate future prosthetic requirements and preserve the remaining healthy dentition. Since the mandibular second premolars were congenitally missing, the mandibular posterior segment already exhibited altered dental anatomy and occlusal relationships.

Therefore, the treatment was planned to achieve a stable therapeutic occlusion rather than a conventional molar relationship. Treatment planning also anticipated a therapeutic Class III molar relationship after complete space closure. This planned occlusal setup would ensure functional intercuspation of the mesialized mandibular third molars with the maxillary posterior dentition, thereby maintaining posterior occlusal support and avoiding concerns related to shortening of the occlusal table that may otherwise arise following extensive posterior tooth substitution. Alternative management options included prosthetic replacement, space maintenance, or retention of deciduous molars where present. However, in the present case, absence of retained deciduous molars and the poor restorative prognosis of multiple first molars shifted the treatment objective toward complete orthodontic space closure. This approach allowed preservation of natural dentition and avoided future restorative dependency.^{6,7} Although temporary anchorage devices could have been used for anchorage reinforcement during molar mesialization, non-skeletal anchorage mechanics were selected considering the government institutional setting and the need for a cost-effective treatment approach. Loop mechanics with differential moments and tip-back bends were considered favorable for controlled molar protraction and uprighting. Hence, strategic extraction of 16, 26, and 36 followed by orthodontic mesialization of 17, 27, and 38 using fixed mechanotherapy without skeletal anchorage was planned.

Clinical Technique: After extraction of 16, 26, and 36, preadjusted edgewise appliances with MBT prescription and 0.018-inch slot brackets were bonded in both arches. Leveling and alignment used a sequential archwire progression of 0.014-inch NiTi, followed by 0.016-inch NiTi and 0.016 × 0.022-inch NiTi archwires. After satisfactory alignment and leveling, working archwires of 0.016 × 0.022-inch stainless steel were placed. Maxillary molar mesialization was initiated using 0.9 mm × 12 mm NiTi closed coil springs (Koden, Kozhikode, Kerala, India). The coil springs were extended from the maxillary molars to the canine hooks bilaterally for controlled posterior space closure.

Mandibular molar mesialization was performed using reverse helical loop mechanics with tip-back bends incorporated in 0.017 × 0.025-inch TMA archwires to control molar protraction, root uprighting, and mesial tipping (fig 3).

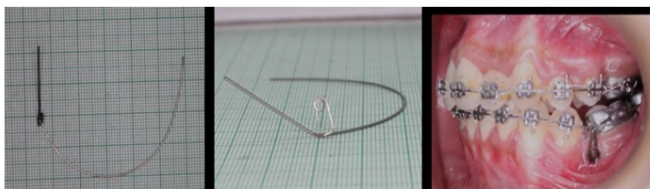


Figure 3: Fabrication and clinical application of the reverse helical loop mechanics used for mandibular molar mesialization

Skeletal anchorage was not used during treatment. Conventional biomechanics involving differential moments, loop activation, and tip-back control were used to achieve molar mesialization while minimizing unwanted reciprocal effects. Mesialization was initiated after completion of leveling and alignment and continued during the working wire stage. The total duration of molar mesialization was approximately 12 months.

The mandibular posterior segments were challenging because bilateral congenital absence of the mandibular second premolars had resulted in reduced mesiodistal space and residual alveolar ridge deficiency. This altered posterior anatomy complicated molar mesialization by limiting the available space envelope and increasing the tendency for mesial tipping, anchorage loss, and bite opening. These effects were controlled through progressive loop activation and additional tip-back bends. Third molar eruption occurred during active treatment and facilitated sequential posterior tooth substitution in the mandibular arch. Finishing and detailing procedures are currently ongoing using 0.017 × 0.025-inch stainless steel archwires.

Treatment Results

After 24 months of active treatment, complete closure of extraction spaces was achieved through successful molar mesialization in both arches. A functional therapeutic Class III molar relationship with Class I canine relationship was established (fig 4).



Figure 4. Intraoral photographs following orthodontic space closure and posterior tooth substitution

Alignment and leveling of both arches were achieved with improved rotations and axial inclinations. Maxillary and mandibular dental midlines were corrected and coordinated satisfactorily. Improvement in incisor inclination and soft tissue profile with reduction in lip strain was also observed. Successful posterior tooth substitution was achieved in the mandibular arch despite bilateral congenital absence of mandibular second premolars, reduced mesiodistal space, and residual ridge deficiency. Progressive eruption and mesial migration of the mandibular third molars contributed to establishment of posterior occlusal support and functional intercuspation (fig 5).



Figure 5: Post-treatment radiographic evaluation showing lateral cephalogram and panoramic radiograph

Side effects including mesial tipping, anchorage loss, and bite opening were controlled through loop mechanics and tip-back activation. Radiographs showed no significant root resorption. Periodontal health remained satisfactory. Finishing and detailing procedures were completed, and satisfactory occlusal settling was achieved with establishment of a stable therapeutic Class III molar relationship and functional posterior intercuspation. Appropriate informed consent was obtained from the patient for publication of clinical records and images. The authors declare no conflict of interest. No external funding was received for this study.

DISCUSSION

Extraction of compromised first permanent molars during orthodontic treatment planning remains a valuable alternative to conventional premolar extraction protocols in selected patients. Preservation of healthy premolars while simultaneously eliminating teeth with poor restorative prognosis may improve long-term dental health and reduce future prosthetic burden.⁹In the present case, strategic extraction of 16, 26, and 36 allowed utilization of existing posterior dentition for orthodontic space closure and functional rehabilitation. Management of congenitally missing mandibular second premolars remains debated. Reported treatment options include retention of primary molars, orthodontic space closure, prosthetic replacement, and autotransplantation, with distinct advantages and limitations. Recent literature suggests that treatment planning should be individualized based on patient age, occlusal requirements, periodontal status, and long-term restorative considerations. Relevant management strategies are summarized in Table 1. Management strategies for mandibular second premolar agenesis and posterior substitution are summarized in Table 1. Table 1. Summary of literature on management of congenitally missing mandibular second premolars and posterior space closure anchorage requirements. Common adverse effects during molar protraction include mesial tipping, anchorage loss, extrusion, and bite opening.¹³ These effects were also observed initially. However, incorporation of reverse helical loops and tip-back bends facilitated gradual root uprighting and improved control during mandibular molar mesialization. An important treatment planning consideration in the present case was the anticipated establishment of a therapeutic Class III molar relationship after complete space closure. This occlusal design permitted functional intercuspation of the mesialized mandibular third molars with the maxillary posterior dentition, thereby preserving posterior occlusal support despite sequential posterior tooth substitution. This eliminated concerns related to shortening of the occlusal table, which may otherwise arise in extensive posterior space closure cases.

Following extraction of 36, the mandibular second molar was mesialized into the first molar extraction space, while the erupting third molar progressively occupied the position of the second molar. Congenital absence of 35 had resulted in reduced mesiodistal space and residual ridge deficiency, thereby complicating posterior tooth movement and biomechanical control. Despite these limitations, controlled orthodontic mechanics enabled sequential posterior tooth substitution with successful space closure and establishment of a functional therapeutic occlusion. Temporary anchorage devices are increasingly advocated for molar mesialization

because they provide absolute anchorage and reduce unwanted reciprocal tooth movement. However, space closure was achieved without skeletal anchorage using conventional biomechanical principles. Reverse helical loop mechanics combined with tip-back bends allowed controlled molar protraction, root uprighting, and management of vertical side effects. This highlights the continued relevance of non-skeletal anchorage mechanics, particularly in cost-sensitive settings where lower complexity and cost may improve accessibility.¹² The patient's hyperdivergent growth pattern was another clinical consideration. Hyperdivergent patients are susceptible to bite opening during posterior mesialization because of molar extrusion. This increased treatment complexity, particularly with posterior tooth agenesis and extensive molar substitution. Careful biomechanical control through progressive loop activation and tip-back mechanics was therefore essential to minimize vertical discrepancies and maintain occlusal stability throughout treatment.¹³ This case demonstrates that strategic extraction of compromised first molars combined with controlled orthodontic molar mesialization can provide a functional and conservative treatment alternative in patients with compromised posterior dentition and congenitally missing premolars. Successful outcomes may be achieved without skeletal anchorage when sound biomechanics are applied. This case highlights an important principle: strategic extraction of compromised molars in the presence of posterior tooth agenesis can convert a potentially prosthetic problem into a biologically conservative orthodontic solution. With careful occlusal planning and sequential substitution, this approach may preserve natural dentition, maintain posterior occlusal support, and reduce long-term restorative burden. Satisfactory occlusal settling and stable posterior intercuspation support the feasibility of strategic posterior space closure as a definitive option in selected cases.

CONCLUSION

Strategic extraction of compromised permanent first molars can be an effective conservative orthodontic alternative in selected patients with concomitant posterior tooth agenesis. This case demonstrates that bilateral congenital absence of mandibular second premolars increases posterior space management complexity by reducing available space, altering occlusal relationships, and increasing biomechanical demands during molar mesialization. Sequential posterior tooth substitution through controlled protraction of second and third molars achieved complete space closure and a stable therapeutic Class III molar relationship without skeletal anchorage. This approach preserved posterior occlusal support, eliminated the need for future prosthetic rehabilitation, and maintained functional occlusal integrity without shortening of the occlusal table. The focused review supports individualized treatment planning, with strategic space closure representing a biologically favorable and functionally stable option when guided by sound biomechanical principles and careful occlusal planning.

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