Case Report

Orthodontic Management of Vertically Impacted Mandibular Permanent Second Molar in Adults: Case Report

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Abstract

Impacted mandibular permanent second molars (MM2) are uncommon, with a reported prevalence of 1.8% to 3% among orthodontic populations, and vertically impacted MM2 are particularly infrequently reported. This case describes the orthodontic preservation of a vertically impacted tooth 47 in a 20-year-old Chinese male who presented with recurrent right-sided mandibular pain, gingival swelling, and bleeding associated with pericoronitis around tooth 48. Clinical examination revealed an Angle Class I molar relationship on the left and a Class II relationship on the right, a rightward mandibular midline deviation, 3 mm of anterior mandibular crowding, overeruption of teeth 17 and 27, and an unerupted tooth 47. Panoramic imaging showed vertically impacted teeth 18, 28, and 47, a horizontally impacted tooth 48, and mesioangular impaction of tooth 38. Cone beam computed tomography demonstrated the relationship between tooth 47 and adjacent structures and minimal resorption of the distal root of tooth 46, without obvious root dilaceration or clear ankylosis-related changes. Cephalometric findings included a skeletal Class I relationship, bimaxillary protrusion, proclined incisors, and a hypodivergent facial pattern. Following a discussion of extraction and implant replacement versus orthodontic retrieval, the patient selected preservation for psychosocial and economic reasons, with extraction planned if no movement occurred within 2 to 3 months. Treatment included fixed appliances, extraction of tooth 48, and surgical exposure of tooth 47. At month 6, with 0.017×0.025-inch stainless steel archwires in place, a customized 0.7-mm stainless steel loop with an approximately 10-mm distal extension was bonded to tooth 46. Elastic traction between this loop and the attachment on tooth 47 applied approximately 50 to 60 gf of extrusive force. Tooth 47 became visible at month 8, approximately half its crown was visible at month 11, and a buccal tube was then bonded for continued alignment. The tooth reached the occlusal level at month 13, and treatment was completed at month 14. Teeth 46 and 47 retained vital pulp responses, and no symptoms or apical pathologies were reported. Immediately after treatment, external root resorption of approximately 1 mm was observed on tooth 46; at 10 months, the corresponding radiolucent area was approximately 0.5 mm, with stable clinical findings and good oral hygiene. The outcome suggests that surgical exposure combined with tooth-borne orthodontic extrusion may be a feasible tooth-preserving option for carefully selected adults with vertically impacted mandibular second molars. Longer-term reports with standardized clinical and radiographic assessments are needed to define prognosis and broader applicability.

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KEYWORDS

mandible; tooth; impacted molar; orthodontic extrusion; case report

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Introduction

Impacted mandibular second molars (MM2s) are an uncommon clinical finding, with reported global incidence rates ranging from 0.03% to 1.7% [1-3] and slightly higher prevalence (1.8%-3%) among orthodontic populations [4]. These impactions frequently present diagnostic challenges as they are often asymptomatic and incidentally detected during routine radiographic examination. The primary etiological factors include insufficient retromolar space and local obstructive anomalies, specifically posterior crowding, reduced mandibular arch length, premature loss of the adjacent first molar, early eruption of the third molar, abnormal inclination of the second molar bud, and ankylosis [4-7]. Additionally, class II skeletal relationships associated with micrognathia and a reduced gonial angle have been implicated in MM2 impaction development [6]. Epidemiological studies indicate a male predilection, a peak detection age between 11 and 14 years, and a higher prevalence among individuals of Chinese ethnicity (2- to 3-fold greater than in other racial groups), with unilateral involvement more common than bilateral presentation [1,4].

MM2 impactions are classified into 3 distinct angulation patterns. Shpack et al [8], in their analysis of 165 impacted MM2s, reported that the majority (88%) were mesially angulated, with 8% being vertical and 4% distally angulated. This distribution underscores the relative rarity of vertically impacted MM2s, which have received limited attention in the existing literature.

Multiple treatment strategies have been described for managing impacted MM2s, including surgical exposure combined with orthodontic uprighting, surgical uprighting alone, extraction with subsequent mesial drift of the third molar, and extraction with autotransplantation of the maxillary or mandibular third molar (MM3) [9,10]. Treatment success depends upon several prognostic factors, including patient age, tooth inclination, root development stage, caries status, periodontal condition, root resorption of adjacent teeth, intraoral visibility, and surrounding bone support. Patients around 14 years of age demonstrate significantly more favorable outcomes, and mesially angulated impactions generally respond better to treatment than other types [2,9,11].

However, vertically impacted MM2s represent a distinct clinical entity that challenges conventional understanding of impaction etiology and management. Unlike mesially or distally angulated impactions, vertical impactions cannot be attributed solely to differential root growth patterns or space deficiency. Furthermore, existing treatment protocols and mechanical designs are predominantly oriented toward uprighting angulated impactions, leaving a notable gap in evidence-based guidance for vertical presentations.

This case report describes the successful orthodontic management of a vertically impacted MM2 in a 20-year-old Chinese male patient with a simple tooth-borne orthodontic appliance. The purpose of this case report is to provide a possible mechanical approach that can be used in the management of vertically impacted permanent MM2s in adults.

Ethical Considerations

This case report was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from the patient before treatment. The patient was provided with signed consent for publication.

Patient Information

A 20-year-old Chinese male patient presented to the Orthodontic Department of the First Affiliated Hospital of Jinzhou Medical University with a chief concern of intermittent mild pain on the right side of the lower jaw for about a week, associated with swollen gum around the last tooth on the same side and occasional bleeding during toothbrushing. No medication was taken for pain management. He reported that he had been experiencing intermittent swelling and pain on that side for nearly 6 months. The pain sometimes made chewing uncomfortable on the affected side. He denied a history of orofacial injury or previous orthodontic treatment. There was no history of chronic illnesses or a similar dental anomaly in the family. He was the only child in his family and was a high school student.

The patient was generally healthy with a normal gait and posture. Extraoral examination revealed a symmetrical straight facial profile with competent lips. The temporomandibular joint was normal, with no pain or clicking sound on palpation and no jaw deviation on opening or closing the mouth. No palpable swelling was detected on the affected side. Intraoral examination showed permanent dentition, an Angle class I molar relationship on the left and a class II relationship on the right side, a mandibular midline shift to the right, overeruption of teeth 17 and 27, an unerupted tooth 47 with no bulginess of the overlying mucosa, and pericoronitis on tooth 48 (Figure 1).

Model analysis showed an Angle class II molar relationship on the right side with a class I relationship on the left, 3 mm of crowding of the anterior mandibular teeth, lingually inclined teeth 37 and 42, and normal overjet and overbite (Figure 2).

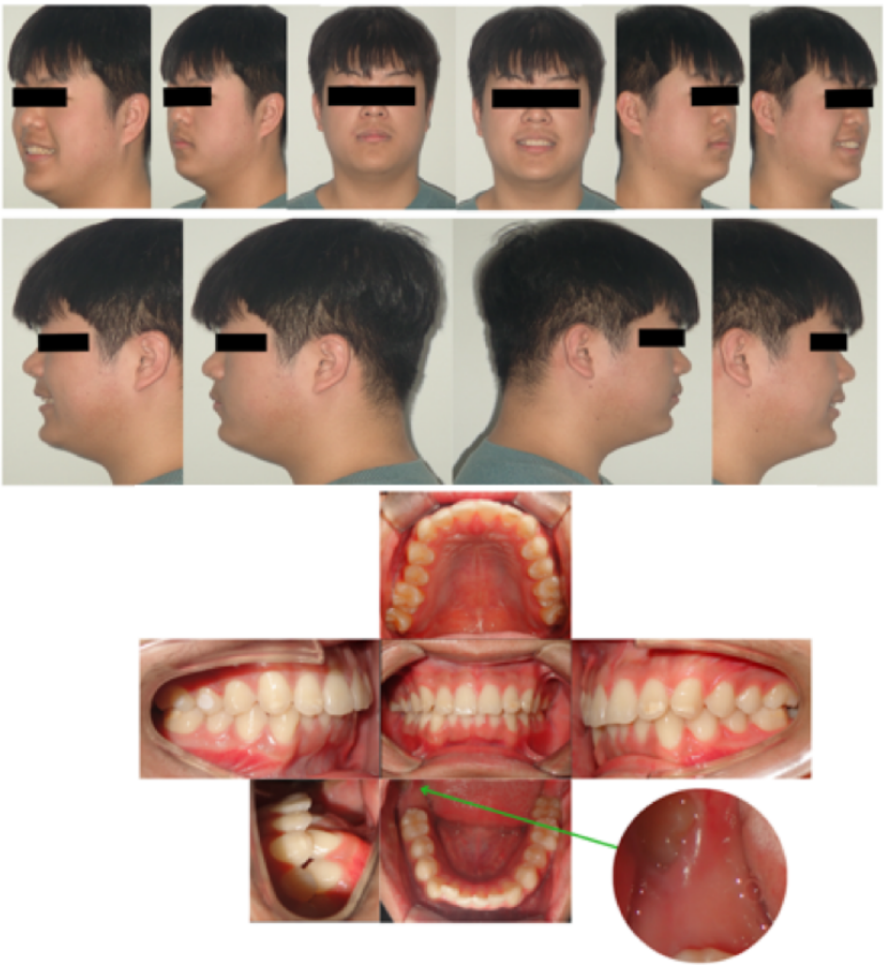
Panoramic radiography showed vertical impaction in teeth 18, 28, and 47, a horizontally impacted tooth 48, mesial angulated impaction of tooth 38 and overeruption of teeth 17 and 27. The distal aspect of the MM2 crown was blocked by one third of MM3 mesial occlusal surface and its mesial aspect was in contact with the distal surface of the mandibular first molar (MM1) distal root with signs of minimal external root resorption at the contact point (Figure 3A and 3B) and no contact further down the root (Figure 3C). No signs of ankylosis areas were evident, and no root dilaceration were detected.

Cephalometric analysis according to Chinese norms showed increased sella turcica-nasion-point A (SNA) and sella turcica-nasion-point B (SNB) angles, normal point A-nasion-point B (ANB) angle, a decreased upper incisor–lower incisor (Ui-Li) angle, increased lower incisor–mandibular plane (Li-MP) angle, increased upper incisor-sella turcica-nasion (Ui-SN) angle, and a decreased mandibular plane-sella turcica-nasion (MP-SN) angle (Figure 4).

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A diagnosis of Angle class II subdivision malocclusion with skeletal class I; vertically impacted teeth 18, 28, and 47; resorption of tooth 46 distal root surface; pericoronitis on a horizontally impacted tooth 48; mild crowding; overeruption of teeth 17 and 27; lingually inclined teeth 37 and 42; bimaxillary protrusion; proclination of both upper and lower incisors; and a hypodivergent face was made.

Figure 1. Extraoral photos (top) showing a symmetric face with a straight facial profile and competent lips. Intraoral photos (bottom) showing an unerupted tooth 47, overeruption of teeth 17 and 27, with mild crowding of the mandibular anterior teeth, and pericoronitis on tooth 48.



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Figure 2. Study model showing an Angle class II molar relationship on the right side (red line), lingually inclined tooth 37, and crowding on the mandibular anterior teeth (measured 3 mm) with subsequent lingual inclination of tooth 42.

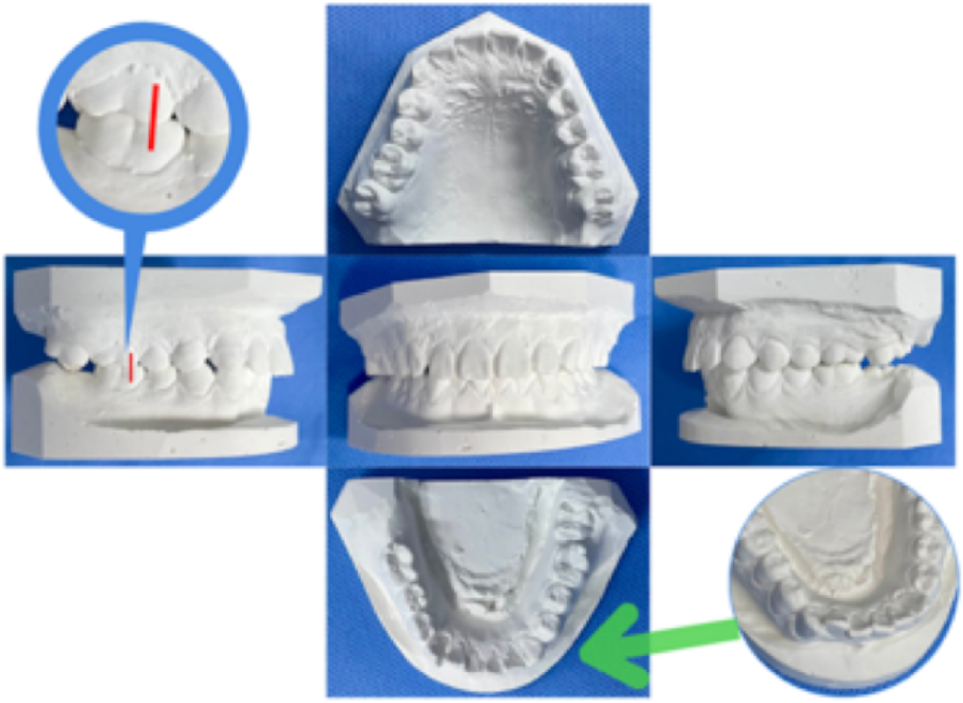
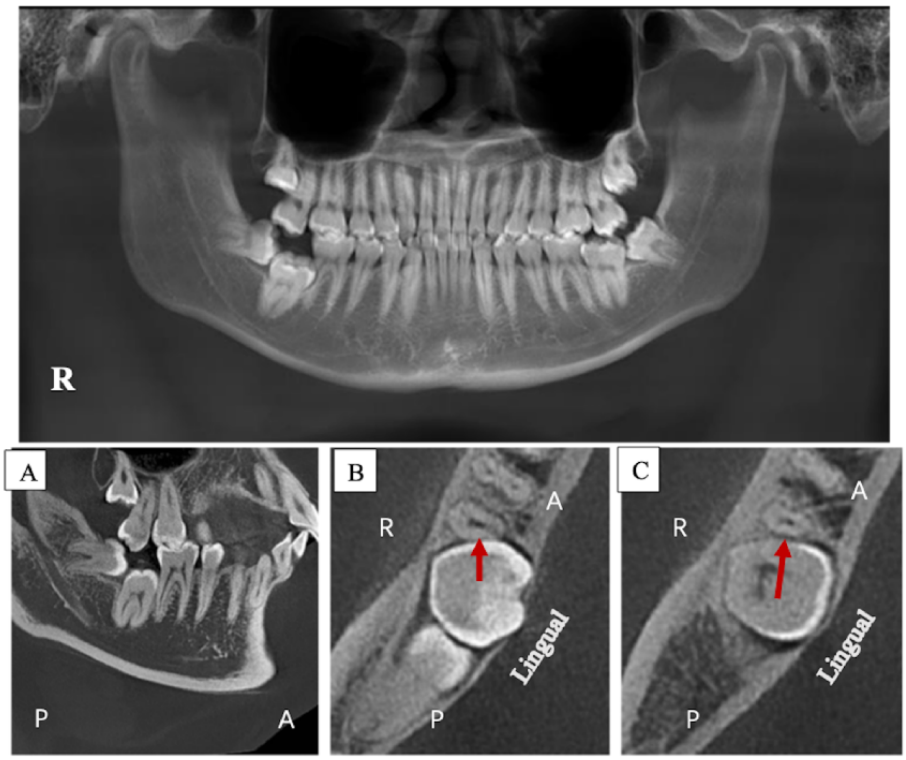
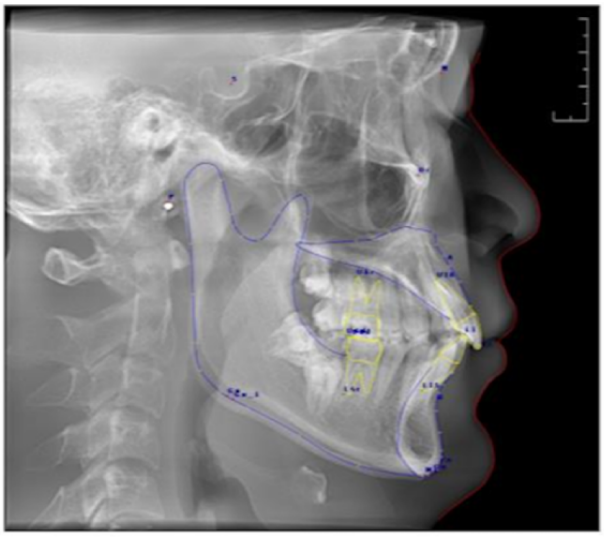


Figure 3. Panoramic image (top) showing vertically impacted teeth 18, 28, and 47; a horizontally impacted tooth 48; mesial angulated impaction of tooth 38; and overeruption of teeth 17 and 27 and infraocclusion of tooth 37. Cone beam computed tomography images (bottom) illustrating the spatial relationship of the impacted mandibular second molar (MM2) with respect to the adjacent dentition. (A) Sagittal view (P, posterior; A, anterior) showing an intact mandibular first molar (MM1) distal root surface at the contact point with the MM2 crown; (B) axial view (R, right; lingual, lingual side) showing minimal external resorption of the MM1 distal root at the contact point with the MM2 crown (red arrow); (C) axial view showing no contact and resorption further down the MM1 distal root (red arrow).

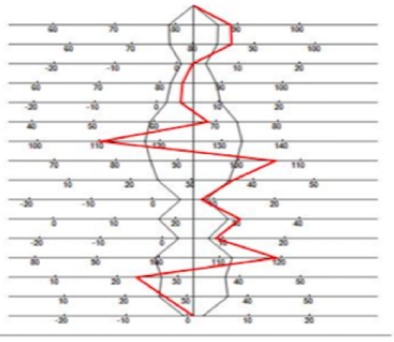


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Figure 4. Cephalometric analysis according to Chinese norms showing bimaxillary protrusion (increased sella turcica-nasion-point A and sella turcica-nasion-point B), a class I skeletal relationship (point A-nasion-point B), proclined incisors (decreased upper incisor–lower incisor), proclined lower incisors (increased lower incisor–mandibular plane), proclined upper incisors (increased upper incisor-sella turcica-nasion), and a hypodivergent face (decreased mandibular plane–sella turcica-nasion angle).



项目名	均值	标准差	测量值
SNA(dg)	82.8	4	88.85
SNB(dg)	80.1	3.9	86.31
ANB(dg)	2.7	2	2.55
NP-FH(dg)	85.4	3.7	83.60
NA-PoA(dg)	6	4.4	3.93
Y轴角	66.3	7.1	68.68
U1-L1(dg)	125.4	7.9	110.30
L1-MP(dg)	92.6	7	105.97
L1-NB(dg)	30.3	5.8	36.74
L1-NB(mm)	6.7	2.1	8.01
U1-NA(dg)	22.8	5.7	30.41
U1-NA(mm)	5.1	2.4	8.74
U1-SN(dg)	105.7	6.3	119.26
MP-SN(dg)	32.5	5.2	23.20
FH-MP(dg)	31.1	5.6	26.42
Po-NB(mm)	1	1.5	1.04



Treatment Options

Considering the age of the patient, the developmental stage of the impacted MM2 roots and its position relative to the surrounding structures, the type of malocclusion, and the functional importance of the MM2, two following treatment options were suggested: extraction of teeth 38, 48, and the MM2; orthodontic treatment with fixed appliances; and implant replacement of the MM2; or extraction of teeth 38 and 48; attempted extrusion of the MM2 by surgical exposure and orthodontic mechanics, with extraction planned if no movement of the MM2 occurred in 2 to 3 months.

Treatment Progress

The treatment options were explained to the patient highlighting their pros and cons. For psychosocial and economic reasons, the patient consented to the second treatment option.

Fixed orthodontic appliances were bonded to both jaws to begin tooth alignment and leveling with a 0.014-inch nickel-titanium (NiTi) archwire.

Under local anesthesia, tooth 48 was extracted, and tooth 47 was exposed during the same sitting. A passive lingual button with a traction chain was bonded to its occlusal surface and sutured.

The patient was studying in a distant city, so monthly visits were not feasible for him. Therefore, he was seen again after 5 months. At that visit the archwires were changed in both jaws to 0.016-inch NiTi archwires to finalize the tooth alignment and leveling.

At month 6, the archwires were changed to 0.017×0.025-inch stainless steel archwires on both jaws. A ligature wire in a figure-of-8 configuration was placed in the maxilla. A round loop was then customized using a stainless-steel wire of 0.7 mm and bonded to the occlusal surface of tooth 46 with a distal overhang of about 10 mm. To avoid occlusion imbalance and damage to the temporomandibular joint, a special light-cured resin was bonded to the contralateral maxillary first molar. A vertical force of about 50 to 60 gf was applied by tying an elastic between the round loop and the traction chain bonded to the MM2 occlusal surface. At month 8, the impacted MM2 was visible in the oral cavity (Figure 5), and the same mechanics were maintained until the next follow-up visit.

At month 11, nearly half of the MM2 crown was visible in the mouth. The occlusal traction chain, the loop, and the resin on tooth 26 were removed. A buccal molar tube was bonded to the MM2, and the archwire was changed to a 0.016-inch NiTi on the mandible.

At month 13, the MM2 reached the occlusal level. The archwire was changed to a 0.017×0.025-inch stainless steel on the

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mandible for finishing. One month later treatment was completed.

Treatment was successfully completed in 14 months by bringing the tooth into occlusion. Radiographic investigation immediately after treatment revealed sufficient repositioning of the MM2 into the occlusal plane. Axial views showed external root resorption (about 1 mm) on the distolingual surface of the MM1 distal root (Figure 6). Pulp vitality tests of the MM1 and MM2 revealed vital pulp responses and no symptoms were reported by the patient during the course of treatment. The patient was provided with an Essix retainer to be worn for 1.5 years.

Figure 5. Photos at month 8. The impacted mandibular second molar was visible in the oral cavity.

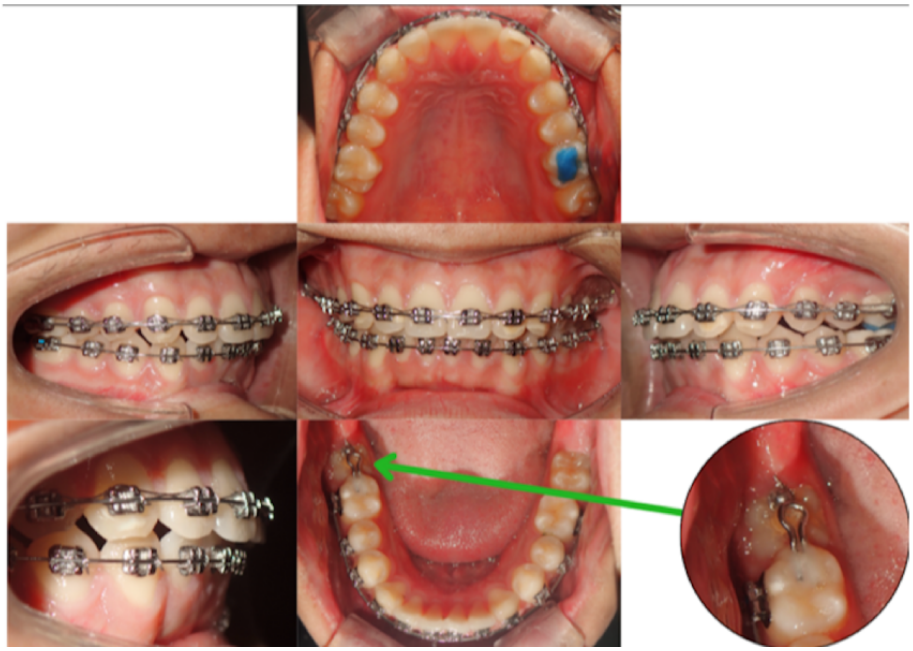
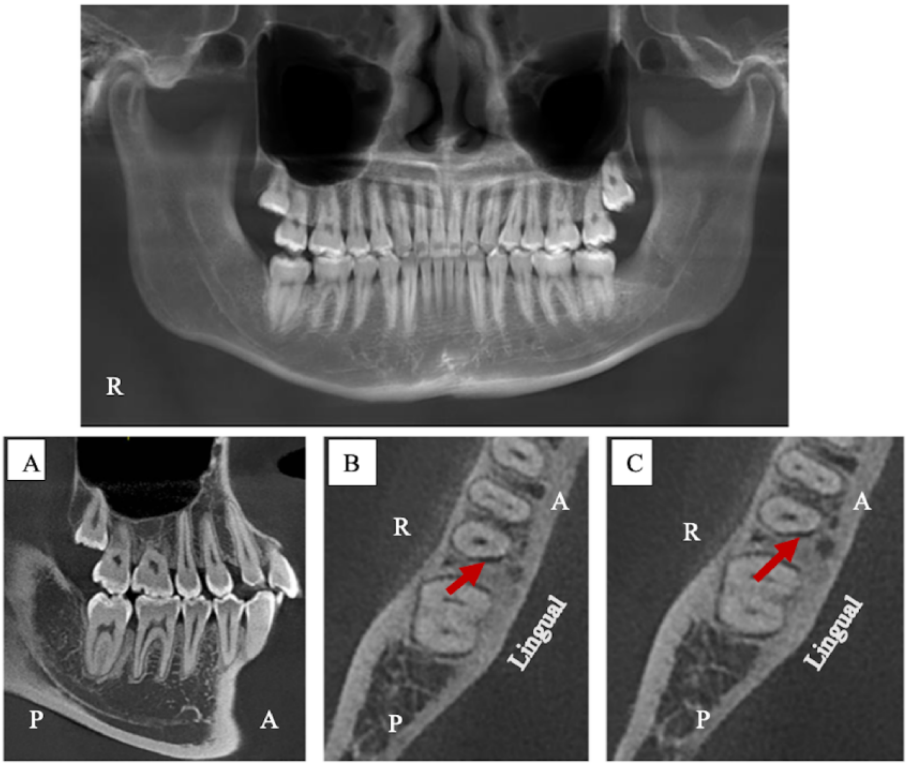


Figure 6. Panoramic radiography (top) immediately after treatment showing sufficient repositioning of the mandibular second molar (MM2) into the occlusal plane with intact apical area. Cone beam computed tomography imaging (bottom) immediately after treatment. (A) Sagittal view (P, posterior; A, anterior) showing successful alignment of the MM2 into occlusion; (B and C) axial views (R, right; lingual, lingual side) demonstrating root resorption on the distal root surface of the mandibular firts molar (red arrows).



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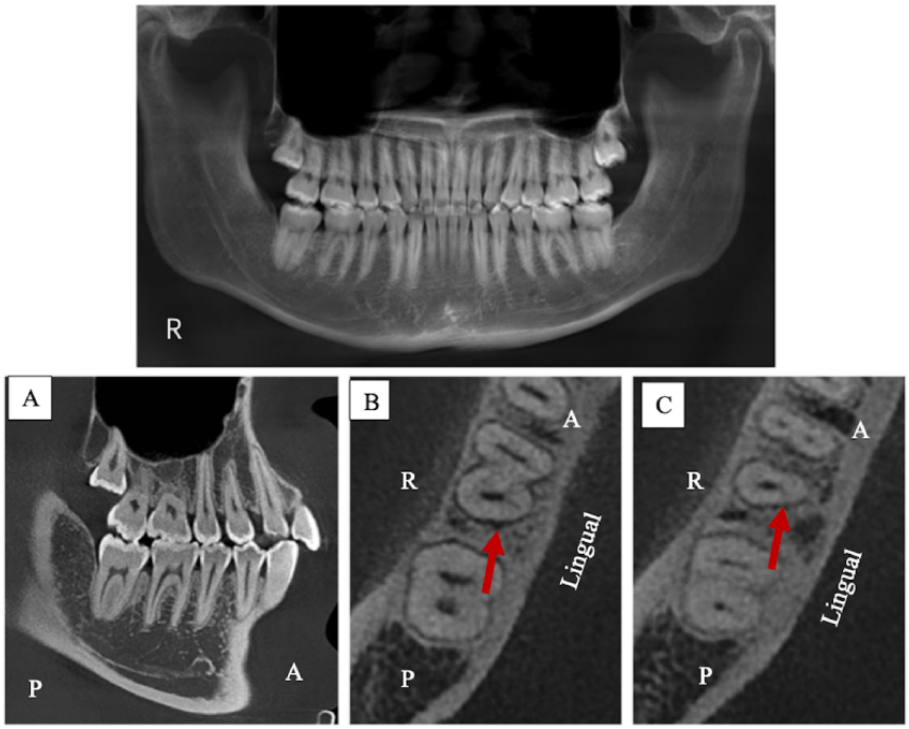
Follow-Up at 10 Months After Treatment

The patient was recalled for follow-up at 10 months after treatment. No new concerns were reported by the patient. No significant findings were observed upon intraoral examination. Percussion tests in the vertical and horizontal directions were both negative. Pulp vitality tests performed on the MM1 and MM2 indicated vital pulp status. Intraoral photographs (Figure 7) and cone beam computed tomography (CBCT) imaging were carried out. Radiographs showed that the MM1 and MM2 were healthy and free from apical pathologies, and they revealed a reduction in the radiolucent area around the resorption spot to about 0.5 mm (Figure 8).

Figure 7. Intraoral photos 10 months after treatment showing good oral hygiene with stable orthodontic treatment results and healthy mandibular first and second molars.



Figure 8. Panoramic view (top) at a follow-up visit 10 months after treatment showing healthy mandibular first and second molars (MM1 and MM2) with no signs of periapical pathology. Cone beam computed tomography imaging (bottom) 10 months after treatment. (A) Sagittal view (P, posterior; A, anterior) showing a healthy MM2 free from apical pathology, and an intact distal surface of the MM1 distal root; (B and C) axial views (R, right; lingual, lingual side) demonstrating progressive narrowing of the radiolucent area of root resorption on the distal root surface of the MM1 (red arrows).



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Discussion

This report describes a possible tooth-borne extrusion technique for a vertically impacted MM2 in a 20-year-old adult. Treatment included fixed appliances, extraction of the horizontally impacted tooth 48, and surgical exposure of tooth 47. Tooth 47 became visible at month 8, two months after traction began, reached the occlusal level at month 13, and treatment was completed at month 14. Teeth 46 and 47 retained vital pulp responses, with no reported symptoms or apical pathologies at the 10-month follow-up. The radiolucent area associated with external root resorption of tooth 46 also decreased. These findings demonstrate feasibility in this patient, not comparative effectiveness or wider predictability.

Most published reports concern mesially angulated MM2s; only 8% were vertically oriented in the series by Shpack et al [8]. This explains why existing biomechanical guidance emphasizes uprighting. In our patient, the position of tooth 47 between the distal root of tooth 46 and tooth 48 made local mechanical obstruction a plausible contributor. However, the Angle class II subdivision, 3 mm of anterior crowding, and lingual inclination of teeth 37 and 42 do not prove posterior arch length deficiency or distal drift of tooth 46. Theories linking differential root growth to mesially angulated impaction [9,12] also cannot be directly applied to this vertical case. The etiology therefore remains uncertain rather than attributable to a single demonstrated cause.

CBCT demonstrated the position of tooth 47, its relationship with adjacent structures, and the preexisting resorption on tooth 46. No obvious dilaceration or clear ankylosis-related change was identified, supporting an attempt at orthodontic retrieval. Nevertheless, CBCT cannot definitively exclude ankylosis, and its interpretation is affected by image quality and equipment parameters [1,13]. The planned extraction of tooth 47 if no movement occurred within 2 to 3 months was therefore an important contingency. Subsequent movement and crown emergence argued against ankylosis. Conversely, failure to move would not alone have confirmed it because inadequate force delivery, an unsuitable vector, or appliance problems can also prevent movement [14-16].

Treatment selection considered age, impaction morphology, adjacent root resorption, third molar condition, and patient priorities. Although approximately 14 years has been reported as an optimal treatment age [2,9,17], successful management in adults has been described [18-20]. The alternatives here were extraction of tooth 47 with implant replacement or preservation through exposure and extrusion, with extraction retained as an option if movement failed [21]. Tooth 48 was horizontally impacted and associated with recurrent pericoronitis, whereas tooth 47 was considered functionally worth preserving. The patient's psychosocial and economic preference for avoiding implant treatment informed the shared decision. This justifies the approach in this case but does not establish clinical or economic superiority.

The mechanical requirement was predominantly vertical extrusion rather than correction of severe mesial angulation. Reported superelastic wires, springs, loops, tubes, and miniscrew-supported systems principally address uprighting [6,18-20,22,23]. At month 6, with 0.017×0.025-inch stainless steel archwires in place, a 0.7-mm stainless steel loop with an approximately 10-mm distal extension was bonded to tooth 46. Elastic traction to tooth 47 applied approximately 50 to 60 gf. At month 11, after adequate crown exposure, the traction appliance was replaced by a buccal tube for conventional alignment and finishing. This staged method used routine materials, provided a direct extrusive vector, and avoided a temporary anchorage device (TAD).

The method also had disadvantages. Tooth-borne anchorage created reciprocal forces on tooth 46 and the supporting arch, requiring particular caution because tooth 46 already had root resorption. Although the stainless steel archwires were intended to provide stability, anchorage loss was not measured. Elastic force can decay between visits, and no serial measurements verified the force maintained over time; the reported 50 to 60 gf therefore represents applied rather than proven continuous force. The resin buildup on tooth 26 helped manage occlusion during traction, but its specific temporomandibular joint effect cannot be evaluated from this report. Thus, simplicity and avoidance of a miniscrew must be balanced against anchorage and force-control limitations.

Attendance was another challenge. Because the patient studied in a distant city, a 5-month interval followed appliance placement and exposure, and active traction began at month 6. This limited early review may have extended alignment; it should not be considered a recommended schedule. Moreover, the 14-month total included alignment, extrusion, and finishing, so it cannot support claims that vertical impactions are faster to treat. Immediately after treatment, tooth 46 showed approximately 1 mm of distal root resorption; at 10 months, the corresponding radiolucency was approximately 0.5 mm. Together with vital pulp responses and negative percussion, this suggests a favorable short-term course. However, radiographic narrowing is not histological proof of complete repair, and the respective contributions of impaction, surgery, and traction cannot be separated.

This report is limited by its single-case design, absence of a comparison group, irregular attendance, and short 10-month follow-up. The etiological interpretation is retrospective. Serial force measurements, quantitative anchorage and periodontal assessments, and patient-reported outcomes were not available. CBCT and the response to traction also leave some diagnostic uncertainty. Consequently, long-term stability, complete repair of the adjacent root defect, and durable pulpal and periodontal health remain unconfirmed. Additional reports with standardized measurements and longer follow-up are needed before conclusions about prognosis, treatment duration, or comparative effectiveness can be drawn.

Clinical Significance

Successful uprighting of a vertically impacted MM2 can be achieved in adults. Vertically impacted MM2s necessitate distinct biomechanical approaches compared with conventional uprighting techniques. Tooth preservation strategies remain viable even when implant alternatives exist.

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Clinical Practice Recommendations

Clinical practice recommendations based on this case are summarized in Table 1.

Table 1. Clinical practice recommendations.

Aspect	Recommendation
Diagnosis	3D imaging should be considered when it is expected to improve assessment of tooth position, root morphology, or adjacent structures.
Etiology	A thorough assessment of arch relationships and first molar position, as well as adjacent structures should be carried out in such cases.
Ankylosis	Radiological findings should be interpreted together with the clinical response to traction; neither alone resolves every diagnostic uncertainty.
Treatment	Orthodontic extrusion may be considered in selected adults; extraction and implant replacement remain alternatives when extrusion is unsuitable or unsuccessful.
Mechanics	Vertical extrusion mechanics should be individualized to the tooth position and available anchorage.
Follow-up	Posttreatment follow-up should monitor pulp vitality, root resorption, periodontal health, and stability.

Conclusions

This case demonstrates that surgical exposure combined with tooth-borne orthodontic extrusion can be a feasible method for preserving a vertically impacted MM2 in a carefully selected adult patient. The main clinical lesson is the importance of matching the mechanics to the impaction pattern. In this patient, treatment required removal of a local obstruction, application of a predominantly vertical extrusive force, and subsequent conventional alignment rather than reliance on uprighting mechanics alone. A customized loop and elastic traction offered a simple option without TADs, but this convenience must be balanced against elastic force decay, reciprocal loading of the anchor teeth, and the need for regular review. Preservation of the natural tooth was consistent with the patient's preferences and avoided implant replacement in this case; it does not establish that this approach is superior, faster, or cost-effective generally. Clinicians considering similar treatment should assess the tooth and adjacent structures carefully, discuss extraction and prosthetic alternatives, retain a contingency for unsuccessful movement, and monitor both the retrieved molar and the adjacent first molar over time. Longer-term reports and comparative case series are required to define prognosis and the circumstances in which this technique is most appropriate.

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Data Availability

Data used in this report can be obtained from the corresponding author upon reasonable request.

Generative AI Use

The authors declare that generative AI was used in the preparation of this manuscript. Kimi (Kimi K3.1) was used for proofreading, editing, and language polishing. The authors verified all outputs of the tool and take full responsibility for the final content of the manuscript.

Authors' Contributions

MHM designed the work and contributed to writing the manuscript. MPP and DDG were responsible for photograph preparation for the manuscript. XG, SLX, and JL were responsible for cone beam computed tomography image acquisition and interpretation. Yue Zhang and Yan Zhang were responsible for study model preparation. CL was responsible for providing guidance, reviewing, and proofreading the manuscript. All authors read and approved the final manuscript.

Conflicts of Interest

None declared.

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Abbreviations

CBCT: cone beam computed tomography

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MM1: mandibular first molar
MM2: mandibular second molar
MM3: mandibular third molar
NiTi: nickel-titanium
TAD: temporary anchorage device

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