Uprighting of Impacted Mandibular Molar Using Intra-Ramal Bone Screw- A Case Report

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ABSTRACT

Impaction of second molar is a complex problem in orthodontics and its management can be very challenging. Intra-ramal bone screws provide traction forces in a superior and posterior direction, simplifying the mechanics and making uprighting of the mandibular molars highly efficient. This case report describes a 15-year-old male patient with impaction of second and third molars on lower left side of mandible. The second molar was trapped between the first and third molars and was overridden by the third molar. The impacted left mandibular third molar was extracted. At the same time, the crown of the second molar was surgically exposed and an attachment was bonded. The orthodontic traction was used to move and upright the second molar into its proper position by using intra-ramal bone miniscrew. At the end of treatment, the patient achieved an optimal occlusion and improved facial esthetics.

Keywords: Intra-ramal bone miniscrews, Orthodontic management, Tooth impaction, Tooth uprighting

INTRODUCTION

Management of mandibular second molar impaction is challenging for orthodontists because of its location and biomechanical limitations. When a tooth fails to erupt into its functional position beyond its eruption time, it is considered to be impacted. Tooth impaction affects patients' esthetics, speech, and masticatory efficiency.

The incidence of impaction is highest for third molars, followed by maxillary canines and mandibular second molars.[1] The prevalence of impacted second molars is ≤ 2.3%.[2] Second mandibular molar (MM2) impaction provides an autosomal trait without prevailing sex or side preference.[3] The etiology may be due to ectopic position, obstacles in the path of eruption, and/or failure of the tooth eruption mechanism.[4]

Shapira et al.[3] classified second molar impaction based on these criteria: (1) full eruption of the MM2 was observed on one side, but the contralateral MM2 had not emerged even despite more than three-fourths root formation; and (2) the mesial cusps of the impacted MM2 were angulated and locked in tight contact with the distal wall undercut of the mandibular first molar (MM1).

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Treatment decision-making for its management is guided by several factors like patient's age, tooth inclination, root formation stage, caries/periodontal problems/root resorption/retention of adjacent teeth, intra-oral visibility, bone tissue around the tooth etc.[5-7]

Adolescents show better treatment outcomes compared with adults, with an optimal age of 14 years.[8] The intervention before the completion of root formation increases the likelihood of success.[7] When an impacted MM2 is locked under the distal height of contour of the MM1, then it is essential to release its mesial cusp by removing the obstacle in the uprighting pathway, either by distalizing MM2 or mesializing MM1.[9]

To upright mesial inclined or impacted MM2, the key biomechanics is to provide the distalizing and uprighting force to rotate the MM2 around the center of resistance, which lies in the bifurcation of the roots, giving a favorable tipback moment.[9] The force can be executed either by wire bending or pushing/pulling force from the anchorage units of the teeth, anchorage devices or any appliances.

In this case report, a 15-year-old male having impacted mandibular left second and third molars was managed successfully. The impacted mandibular third molar was extracted followed by bonding an attachment on impacted second molar. Later, the second molar was moved orthodontically and uprighted in its place by using intra-ramal bone miniscrew.

CASE REPORT

Diagnosis and etiology:

A 15-year-old male patient presented for an orthodontic consultation with the chief complaint of a missing tooth in the left lower back region of the jaw. The patient had no relevant family, prenatal and medical history and no history of parafunctional habits.

On clinical examination, the patient had a convex profile with apparently symmetric face along with competent lips. Intraoral examination revealed a Class II molar relationship (end-on by 4.5 mm) on the right side and a Class I molar on left side, with a Class I canine relationship on both sides. The upper right second premolar was palatally positioned, and the lower left second molar was clinically absent (Fig. 1). His upper midline was shifted towards right side by 1.5 mm from the facial midline.

Fig. 1 Pretreatment intraoral and extraoral photographs

The cephalometric analysis showed a skeletal Class I relation with an ANB angle of 3° and horizontal growth pattern (FMA: 18°; SN-GoGn: 25°), nearly normally inclined and normally placed maxillary and mandibular incisors along with obtuse nasolabial angle (98°) and mild protrusive lips (Fig. 2).

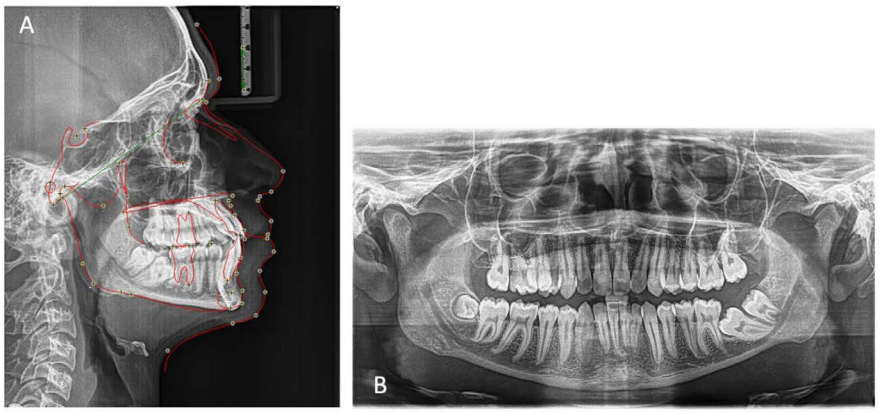

Fig. 2 Pre-treatment radiographs: A. Lateral Cephalogram with tracing; B. Orthopantomogram

The panoramic radiographs confirmed the impaction of the lower left second and third molars and lower right third molar. Third molars were absent in the upper quadrants and the overall alveolar bone level was within normal limits (Fig. 3).

Treatment objectives and alternatives:
These four treatment options were offered to the patient and his parents.

1. Option 1: Extraction of lower left third molar and surgically upright the second molar. There might be risk of pulp necrosis, external root resorption, root fracture, ankylosis, questionable post-surgical tooth stability and buccal crossbite.

2. Option 2: Extraction of lower left third molar and upright the second molar orthodontically. In this approach, surgical exposure of impacted mandibular second molar for bonding an attachment and third molar extraction is advocated at the same time. This would preserve the patient's natural teeth and result in better occlusion, although it requires little more treatment time.

3. Option 3: Extraction of impacted lower left second and third molars followed by implant prosthesis in the place of missing lower left second molar. In this option, the patient should wait for at least 2-3 years before implant placement and there was a great risk of alveolar bone loss. Bone graft and holding of opposing teeth might be needed to prevent extrusion till the implant placement.

4. Option 4: Extraction of lower left second molar and allowing mesial drift of third molar. This option is indicated in severe horizontally impacted second molar having severe ankylosis or progressive caries.

After discussion in the different treatment options, patient and his parents opted for the second treatment option that is surgical exposure followed by traction of second molar orthodontically.

The patient had a skeletal Class I relation but horizontal growth pattern and he already crossed the active growth phase so growth modulation is not feasible. His facial profile was not bad enough to undergo for orthognathic surgery, so orthodontic camouflage was planned. Only extraction of palatally placed upper right second premolar was planned in this case by considering acceptable facial profile.

The treatment objectives were:
1. Creation of space for lower left second molar by extraction of impacted third molar.
2. Surgical exposure, orthodontic traction and uprighting of impacted tooth to their desired positions.
3. Achievement of functional occlusion and facial aesthetics

At the end, treatment aimed at Class II molar on the right side, Class I molar on the left side, Class I canine of both sides, normal overjet and overbite, coincided midlines along with good interdigitation.

Treatment progress:
Both maxillary and mandibular teeth were banded and bonded with fully programmed preadjusted 0.022 slot MBT prescription ceramic brackets (Fig. 3). The arches were aligned using the following sequence of archwires; 0.014" NiTi and 0.016" NiTi. The palatally placed upper right second premolar was extracted. After alignment and levelling, 0.018" SS wires were placed in the both arches.

Fig. 3 Bonding of brackets

During surgical exposure, a full thickness mucoperiosteal flap was reflected to expose the impacted 37 & 38. Tooth 38 was extracted and the bone superior to the crown of 37 was removed up to the level of cementoenamel junction with a high-speed handpiece. Tooth 37 was surgically luxated to rule out ankylosis.10 Lingual button was bonded on the distal surface of the 37 using the new method of bonding an attachment to an impacted tooth by following a strict isolation protocol.11 In this method, after conventional bonding of lingual button, a flowable composite was poured over the bonded lingual button by covering partly the existing composite and base of the lingual button to make it a single unit to increase the surface area and hence the bond strength. Ligature wires along with multiple eyelets were tied to the bonded lingual buttons at one end and the other end was exposed in the mouth and placed in desired position for orthodontic traction before flap closure. A closed eruption technique was used in this case (Fig. 4).

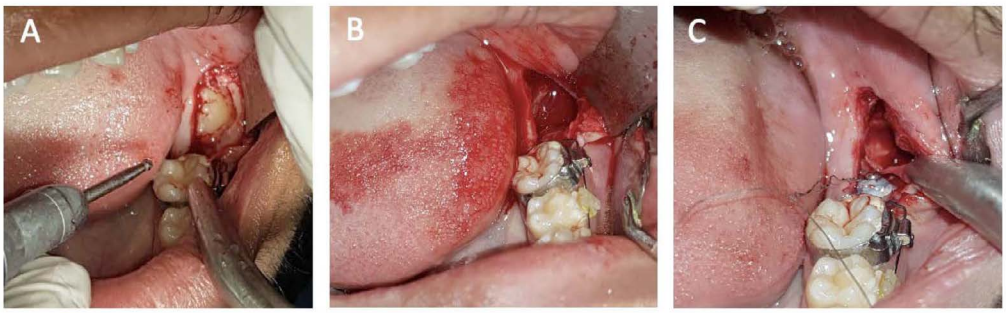

Fig. 4 A. Surgical exposure; B. Extraction of lower left third molar; C. Bonding an attachment on the distal aspect of lower left second molar.

Under local anesthesia, intra-ramal SS bone screw of 2x14 mm (S. K. Surgicals, India) was placed in midway between the external and internal oblique ridges of the ascending ramus, approximately 5-8 mm above the mandibular occlusal plane to avoid the occlusal interference. It was placed in such a way that it must penetrate the much thicker soft tissue before engaging the dense cortical bone of the mandible. The screw head was at least 5 mm of soft tissue clearance after penetrating a minimum of 3 mm into the bone. The position of this screw allowed to provide the traction force in superior and posterior direction (Fig. 5).

Traction was done initially using elastic thread followed by use of E-chain. After initial traction, the bondable buccal tube was placed on the exposed tooth and the force was placed through it. Later, the arch wire was inserted in to the attached buccal tube (Fig. 6).

Fig. 5 Mid treatment photos showing the traction of impacted lower left second molar using E-chain from the intra-ramal bone screw.

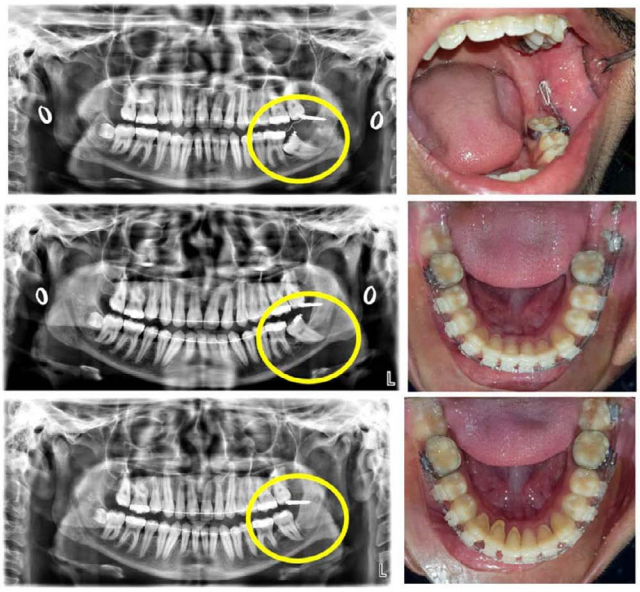

Fig. 6 Mid treatment photographs and orthopantamograms showing traction of lower left impacted second molar from the intra-ramal bone screw.

Archwires were changed to a rigid 0.019 x 0.025" SS wire in both arches and spaces were closed using E-chain. Class III elastics (1/4";3.5 Oz) was placed on the right side to correct the molar relation, midline correction and achieve the proper interdigitation. This unilateral elastic was placed along with the rigid wires for a short duration to avoid occlusal canting (Fig. 7).

Fig. 7 Mid- treatment photographs

Treatment results:

A remarkable improvement in the facial and smile esthetics of the patient was achieved at the end of the treatment (Fig. 8). The total treatment duration was approximately 20 months.

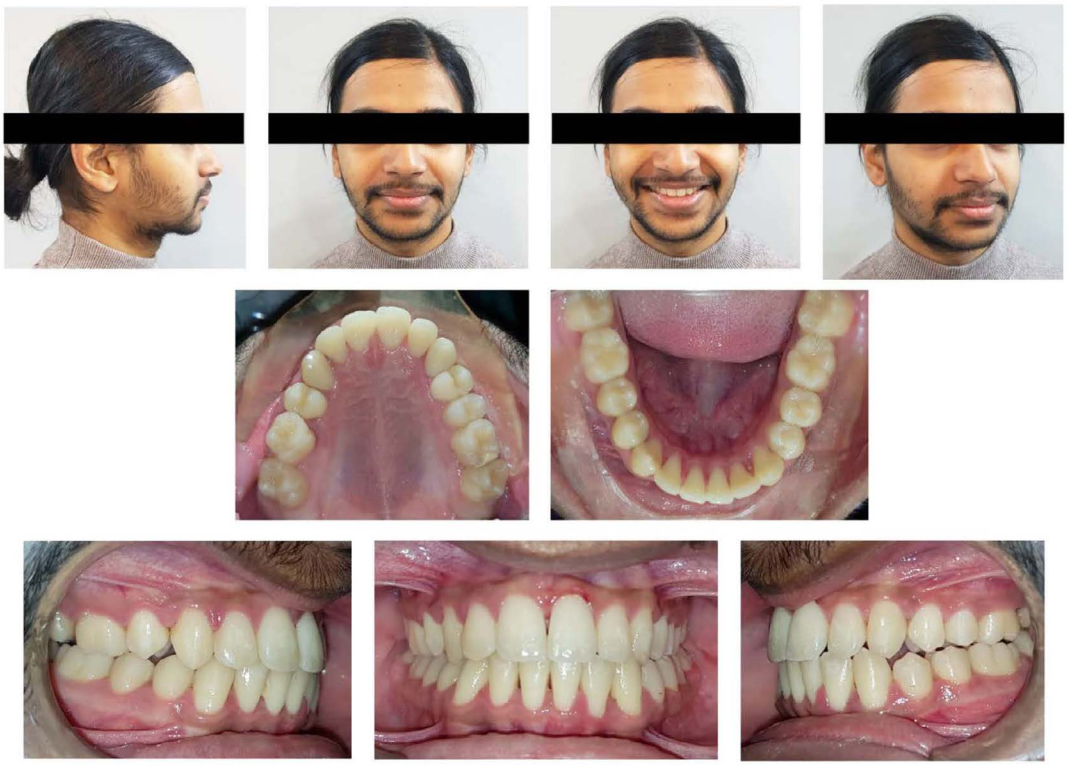

Fig. 8 Post-treatment extraoral and intraoral Photographs

Intraorally, there was Angle's class I molar relationship on the left side and a Class II molar relationship on the right side, with a Class I canine relationships bilaterally, along with normal overjet and overbite. There was achievement of canine guidance during lateral excursions and proper anterior guidance without balancing side interferences. The maxillary dental midline coincides with the facial midline, while the lower midline is shifted towards the left side by 0.5 mm, but it is considered clinically acceptable.

The posttreatment radiographs (Fig. 9) revealed remarkable changes in the dental and skeletal parameters. An orthopantomogram which was taken just before the debonding showed good root parallelism.

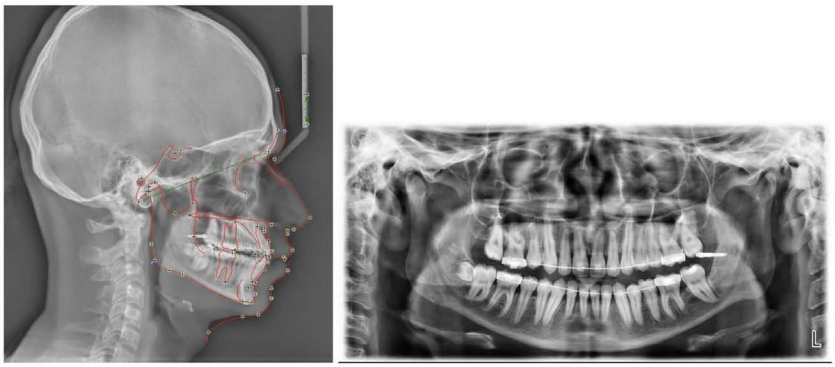

Fig. 9 Post-treatment lateral cephalogram with tracing and orthopantomogram

The pre- and post-treatment cephalometric values are compared in Table 1 and it is well demonstrated in superimposition (Fig. 10).

Table 1: Comparative cephalometric parameters

Cephalometric parameters	Clinical norms	Pre-treatment values	Post-treatment values
Skeletal parameters			
SNA	82±2°	87°	86°
SNB	80±2°	84°	84°
ANB	2±2°	3°	2°
Wits	0-(-)1 mm	0 mm	1 mm
FMA	25±2°	18°	20°
SN-GoGn	32±2°	25°	28°
Dental parameters			
Max.I-NA (Angular)	22±2°	23°	24°
Max.I-NA (Linear)	4 mm	3 mm	4 mm
Max.I-SN	102±2°	110°	111°
Man.I-NB (Angular)	25±2°	26°	24°
Man.I-NB (Linear)	4 mm	5 mm	4 mm
LI-A-Pog	2.7±1.7 mm	3 mm	2.5 mm
IMPA	90±2°	94°	92°
Interincisal angle	134°	129°	132°
Soft tissue parameters			
Nasolabial angle	102±8°	98°	100°
S line-Upper lip	0 mm	1.5 mm	1 mm
S line-Lower lip	0 mm	2.5 mm	2 mm
E line to lower lip	-2 mm	1 mm	0.5 mm

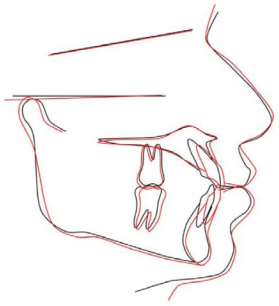

Fig. 10 Superimposed cephalometric tracing of pre-treatment (black line) and post-treatment (red line)

DISCUSSION

In this case report, impacted mandibular left second and third molars were managed using proper biomechanics. The impacted mandibular third molar was extracted followed by bonding an attachment on impacted second molar. Later, the second molar was moved orthodontically and uprighted in its place by using intra-ramal bone miniscrew.

Obstacles during teeth eruption may result in mandibular second molar (MM2) impaction such as a supernumerary tooth, odontoma, odontogenic tumor, alveolar bone, or non-resorbing deciduous tooth roots.[4,12] Pressures from soft tissues such as the tongue, cheek, and finger can also act as an obstacle to eruption. The deficiency of eruption space for the MM2 that is the decreased horizontal distance between fist molar and anteroposterior rim of the ramus can be a factor for its failed eruption.[3,13] The excess space between MM1 and MM2 may also cause MM2 impaction, as the MM2 erupts against the MM1 roots.[14]

Primary failure of eruption is a rare condition defined as incomplete tooth eruption despite the clearance of the eruption pathway which may be the factor of MM2 impaction.[5,15] In some rare cases, molar impaction is a symptom of a general disease such as cleidocranial dysplasia, GorlineGoltz syndrome, and GAPO syndrome.[16]

In this case, the suspected etiology of MM2 impaction was a mesial orientation of the tooth buds and/or superior position of the MM3 tooth buds that blocked the normal path of eruption. The anomalous path of eruption resulted in the occlusal surfaces of the MM2 infringing on the roots of the adjacent MM1. When a MM2 is mesially impacted against the MM1 root, the distal curvature of the MM1 crown may prevent uprighting of the MM2. Subsequently, dense cortical bone occlusal to the MM2 crown and the overlying MM3 impaction become physical barriers to MM2 uprighting.

In general, there are four treatment options available for the treatment of impacted MM2:17 a. Surgically expose the MM2 and upright orthodontically; b. Surgically upright the impacted MM2 c. Extract the MM2 and allow mesial drift of MM3 d. Extract the MM2 and autotransplant the maxillary/mandibular third molar If no adjacent third molar is available.

Various orthodontic appliances are used for mandibular molar uprighting in the past, such as cantilever spring, NiTi coil spring, push spring appliance, helical uprighting

spring, Australian uprighting spring, prefabricated Sander spring, and traction from the removable appliances.

Unwanted reciprocal movement of the anchorage units, extrusion of the target molar, longer treatment time, and possible need for bulky appliances are the disadvantages of conventional treatment methods for molar uprighting. Nowadays, with the introduction of skeletal anchorage devices, including miniscrews and mini-plates, the MM2 impaction can be possibly solved in shorter treatment time, reducing the biomechanical side effects and increasing the effectiveness of the treatment.[18] Advantages of temporary anchorage devices (TADs) are easy placement and removal, and predictability for routine dental practice.[19]

Conventional temporary anchorage device in retromolar and inter-radicular (I-R) areas lacked the versatility to manage horizontal impactions. Chang et al. expanded the skeletal anchorage concept by developing a 2mm diameter stainless steel (SS) bone screw that is suitable for extra-alveolar sites, such as the mandibular buccal shelf (MBS), zygomatic process and mandibular ramus.[20] However, the mechanics to recover horizontal impactions with MBS bone screws were complex and difficult to control. To better address the mechanical problems, bone screws were needed in the anterior ramus of the mandible to provide a more superior and posterior direction of traction, along the plane of the impaction. Simple and efficient mechanics are designed to upright the impacted lower molars with ramus screw anchorage.

Uprighting a horizontally/mesioangular impacted molar requires both occlusal and distal components of force to unlock and upright the impacted lower molars. It becomes easy and efficient with the ramal bone screw. The presence of thick soft tissue, twisted anatomy of the ramus and the presence of neurovascular structures in and around the site of insertion, hence a proper guideline should be followed during the intra-ramal screw placement to avoid the risk of damaging the neurovascular bundle, except for the anatomical variations.[21-23]

A ramus screw should penetrate a thick mucosa, as well as the inferior fibers of the temporalis muscle, and it also has to have an average of at least 3 mm of bone engagement for the stability. To facilitate the oral hygiene, the screw head should be about 5 mm above the soft tissue.[23]

Lin reviewed six different methods of molar uprighting, and concluded that surgical exposure of the deeply impacted molars, followed by traction with elastic chains anchored by ramus screws, was the most efficient.[24]

In this case, we have used 2x14 mm of stainless-steel self-drilling screw as the study concluded that implants of smaller diameter (<2 mm), made of softer materials like titanium/titanium alloy, impose a substantial risk of fracture through a self-drilling technique used in their insertion.[25] Increasing the length of the screw should be avoided, as this would make it more susceptible to flexural stress.

A preliminary study found a failure rate of only 5% for ramus screws, which is lower than for mandibular buccal shelf screws (7.2%).[26,27] The "success" of ramus screws mainly depends on appropriate hygiene measures. So, it is very important to provide hygiene instructions and monitor soft tissue inflammation at each appointment.[28]

Intra-ramal screw allows simple and efficient uprighting of impacted lower molar and address the mechanics in a better way, as they aid a more posterosuperior direction of traction. The patient had an optimum occlusion and improved facial esthetics at the end of the treatment after the active treatment of about 20 months.

CONCLUSIONS

Mandibular second molar impaction is a challenging condition that requires thorough clinical, radiological, and biomechanical evaluation, along with selection of an appropriate treatment approach to achieve a successful outcome.

Intra-ramal bone screw delivers a traction force in a superior and posterior direction, that makes the mechanics simple and efficient for the uprighting of the deeply impacted mandibular molars.

Conflicts of Interest

The authors declare that they have no conflicts of Interest regarding the publication of this paper.

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