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# Skeletal anchorage for intrusion of bimaxillary molars in a patient with skeletal open bite and temporomandibular disorders

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## Abstract:

The treatment of severe skeletal anterior open bite is extremely difficult in adults, and orthognathic surgery is generally selected for its treatment. We report the case of an 18-year-old adult patient with skeletal anterior open bite and temporomandibular disorders who was successfully treated using temporary anchorage devices. She had an open bite of  $-2.0$  mm and an increased facial height. Miniplates were implanted in both the maxilla and mandible, and molar intrusion resulted in counterclockwise rotation of the mandible over a period of 12 months. After active treatment, her upper and lower first molars were intruded by approximately 2 mm and her overbite became  $+2.5$  mm. Her retrognathic profile improved with counterclockwise rotation of the mandible. Orthodontic treatment aided with skeletal anchorage is beneficial for intrusion of bimaxillary molars in patients with anterior open bite.

## Keywords:

Miniplate, skeletal open bite, temporary anchorage device, temporomandibular disorders

## Introduction

Skeletal anterior open bite is considered a complicated malocclusion, and its treatment planning depends on the severity of the skeletal discrepancies.<sup>[1]</sup> In adults, orthognathic surgery is generally selected for severe skeletal open bite.<sup>[2-4]</sup> Maxillomandibular advancement with counterclockwise rotation of the occlusal plane is a stable procedure for patients with healthy temporomandibular joints (TMJs). However, patients with active temporomandibular disorders (TMDs) and either concomitant or resultant maxillofacial skeletal discrepancies, who are treated with orthognathic surgery, often have poor outcomes and unexpected relapse.<sup>[5-10]</sup> For such patients, various

alternatives have been applied, including multibrackets in conjunction with high-pull headgear therapy,<sup>[11]</sup> multiloop edgewise archwire (MEAW) therapy,<sup>[1]</sup> and nickel-titanium wires with intermaxillary elastic.<sup>[12]</sup> These techniques can correct open bite in terms of making the posterior teeth upright, leading to correction of the occlusal cant and posterior discrepancies. However, with these techniques, open bite correction is achieved as much by dentoalveolar changes as by extrusion of the upper and lower incisors, and skeletal changes are not noted. This indicates that counterclockwise mandibular rotation leading to reduction of lower facial height and forward movement of the mandible is not produced by these techniques. Therefore, orthodontists do not generally propose these alternative treatment plans as a substitute for surgery in patients with TMDs.

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At present, titanium miniplates<sup>[13,14]</sup> and miniscrews<sup>[15-17]</sup> are often used as temporary anchorage devices (TADs) to obtain absolute anchorage. In the correction of skeletal open bite using TADs, significant intrusion of the molars is possible, resulting in counterclockwise rotation of the mandible without the patient's cooperation. There are many reports on the use of skeletal anchorage in various teeth procedures, such as intrusion or retraction of anterior teeth,<sup>[15-17]</sup> protraction of molars,<sup>[15]</sup> and making molars upright.<sup>[18]</sup> However, there have been few reports on the use of TADs for intrusion of bimaxillary molars in skeletal open bite cases affected with TMDs. Here, we present an adult case of skeletal anterior open bite with TMDs treated using titanium miniplates for absolute anchorage.

## Case Report

### Diagnosis and etiology

The patient was a woman aged 18 years and 2 months who had mandibular retrusion and circumoral musculature strain upon lip closure [Figure 1]. She complained of anterior open bite and severe maxillary protrusion. She had anterior open bite in childhood which worsened with age. She had experienced frequent TMJ pain at maximum mouth opening and trismus for at least 2 years when she was a junior-high-school student. There was no history of injury to the head, neck, and jaw. Maximum mouth opening without pain was 51 mm, and TMJ clicking was noted on the right side at the early period of mouth opening. No muscle tenderness was observed on palpation. Her facial profile was convex, with a retropositioned mandible, and no facial asymmetry was observed. She had vertical and horizontal open bite and

mild crowding of the lower anterior teeth. Overjet and overbite were +10.0 mm and -2.0 mm, respectively. At the maximum intercuspation, occlusal contacts were recognized only at the premolar and molar regions. The molar relationship was Angle Class II on both sides. Although the upper dental midline was nearly aligned with the facial midline, the lower dental midline was shifted 1.0 mm to the left.

From model analysis, we noted that the arch-length discrepancy was -0.5 mm in the upper arch and -3.5 mm in the lower arch. A panoramic radiograph showed the congenital presence of lower bilateral third molars. The condylar neck was bilaterally short, and condylar deformity was suspected. In addition, magnetic resonance imaging (MRI) showed anterior disc displacement without reduction in both the TMJs, although an osteophyte-like structure was detected only in the right TMJ [Figure 2].

Cephalometric analysis revealed a skeletal Class II malocclusion with a severely repositioned mandible [Figure 2]. The mandibular plane and ramus plane angles were large (Mp-FH, 39.3°; ramus plane to FH, 95.7°). The mandible exhibited backward and downward rotations with a short ramus, and consequently, the lower anterior facial height was large (Me/NF, 73.3 mm). Furthermore, the maxillary and mandibular incisors



Figure 1: Pretreatment facial and intraoral photographs (age, 18 years 2 months)

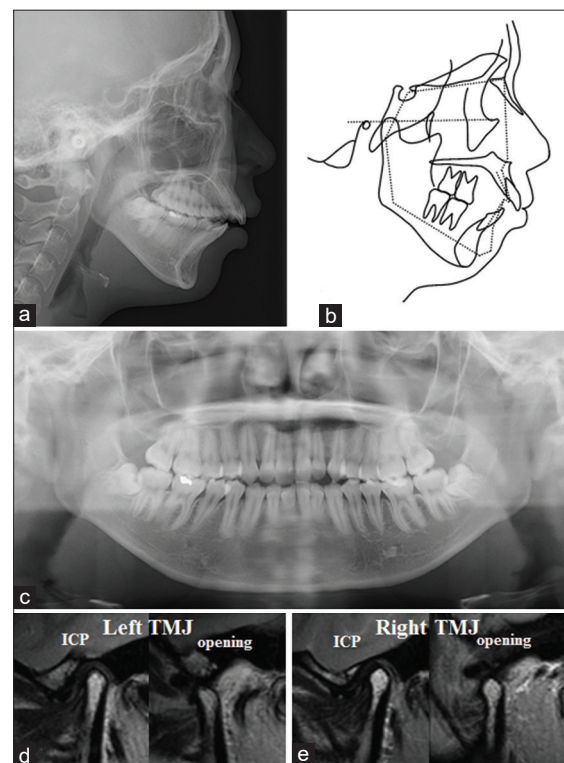


Figure 2: Pretreatment records. (a) Lateral cephalograph; (b) tracing (solid line) superimposed with mean profilogram (dotted line); (c) panoramic radiograph; (d,e) MRI of the temporomandibular joint. ICP, Intercuspal position

were labially inclined (U1 to FH, 111.0°; L1 to mandibular plane, 102.7°), and the lower molars were significantly extruded (U6 to palatal plane, 26.6 mm; L6 to mandibular plane, 36.7mm).

### Treatment objectives

She was diagnosed with Angle Class II malocclusion, with a skeletal Class II jaw-base relationship, skeletal open bite, and TMDs. The treatment objectives were correction of the anterior open bite, establishment of an ideal overjet and overbite, achievement of an acceptable occlusion, with a functional Class I occlusion, and correction of the retrognathic appearance of the facial profile.

### Treatment alternatives

Several procedures were explored to achieve ideal overjet and overbite. Although orthognathic surgery, including mandibular advancement, was considered the most effective treatment, she rejected surgery because it required prolonged hospitalization, involved high medical cost, and was the most invasive option. We did not want to correct her anterior open bite by extruding the anterior teeth because the vertical relationship between the incisors and jaws was acceptable. We considered that intrusion of the extruded molars and counterclockwise rotation of the mandible were appropriate to treat her anterior open bite.

### Treatment progress

Before the start of orthodontic treatment, the patient did not visit our clinic for 1 year owing to some personal reasons. At treatment 1 year after the initial visit, the lower third molars were extracted. Y-shaped anchor miniplates (Orthoanchor SMAP, Dentsply-Sankin, Tokyo, Japan) were then bilaterally implanted onto the zygomatic process of the maxilla through the buccal mucosa under local anesthesia. Additionally, L-shaped anchor miniplates were placed at the apical regions of the mandibular first and second molars.

A transpalatal arch and lower lingual arch were placed between the first molars to compensate for the crown buccal torque that would be produced by the intrusion force. Preadjusted edgewise appliances with 0.018 × 0.025-inch slots were then placed on the upper molars and lower dentitions, except for the lower incisors. Orthodontic force was applied using elastic chains (estimated at 150 g) from 4 weeks after placement of the miniplates. Twelve months after the start of loading, overbite had increased to +2.5 mm [Figure 3]. The upper first premolars were extracted, and leveling of the upper arch was initiated. After leveling and alignment with nickel-titanium archwires, 0.017 × 0.025-inch stainless steel archwires were placed and retraction of the anterior teeth was initiated. After removal of the edgewise



**Figure 3:** Intraoral photographs during treatment. (a) Starting of the intrusion; (b) 4 months after the start of the intrusion; (c) 8 months later; (d) finishing of the intrusion (12 months after the start of the intrusion)

appliances, a tooth positioner was placed to retain both arches and a lingual bonded retainer was placed on the lower arch between the bilateral canines. The total active treatment period was 44 months.

### Results

Facial photographs showed that the overall facial balance improved after the procedure [Figure 4]. Her convex profile caused by the retrognathic mandible improved considerably, and her lips exhibited less tension on closure. Her facial proportions improved because of a decrease in the lower anterior facial height. Acceptable occlusion was achieved, and overjet and overbite improved to +3.2 mm and +2.5 mm, respectively [Figure 4]. In addition, the canine anteroposterior relationship improved to Class I on both sides.

A panoramic radiograph showed little or no change in the condylar structure [Figure 5]. No root resorption or alveolar bone resorption was noted. Cephalometric analysis revealed counterclockwise rotation of the mandible [Figures 5, 6 and Table 1]. The maxillary first and second molars were intruded 7 mm and 3 mm, respectively, and the mandibular first and second molars were intruded 1 mm and 2 mm, respectively. The upper and lower dental midlines were coincident with the facial midline. Neither the upper nor the lower incisors were extruded. Throughout the treatment period, she did not experience recurrence of TMJ pain. Additionally, maximum mouth opening without pain was possible.



Figure 4: Posttreatment facial and intraoral photographs (age, 22 years 2 months).

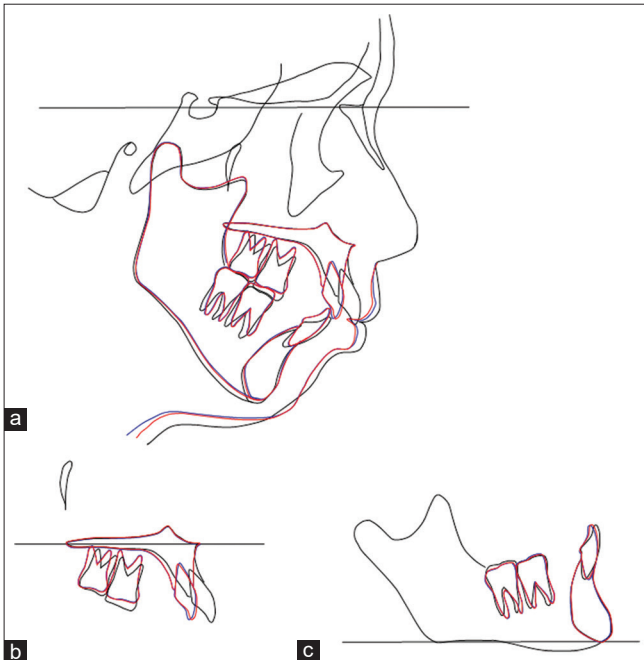


Figure 6: Superimposition of cephalometric tracings made before (black) and after (blue) treatment, and after 5-year retention (red) (a) Superimposition on the Sella-Nasion plane at Sella. (b) Superimposition on the palatal plane at ANS. (c) Superimposition on the mandibular plane at Menton

Five years after retention, the mandibular position was nearly stable and the circumoral musculature strain upon lip closure disappeared [Figure 7]. An acceptable occlusion was maintained without recurrence of TMJ symptoms [Figure 7]. Further, no relapse of the anterior open bite was noted. Her overjet and overbite were +3.5 mm and +2.5 mm, respectively. A panoramic radiograph showed little or no change in the condylar structure, with condylar resorption and deformity and no condylar movement restriction during mouth

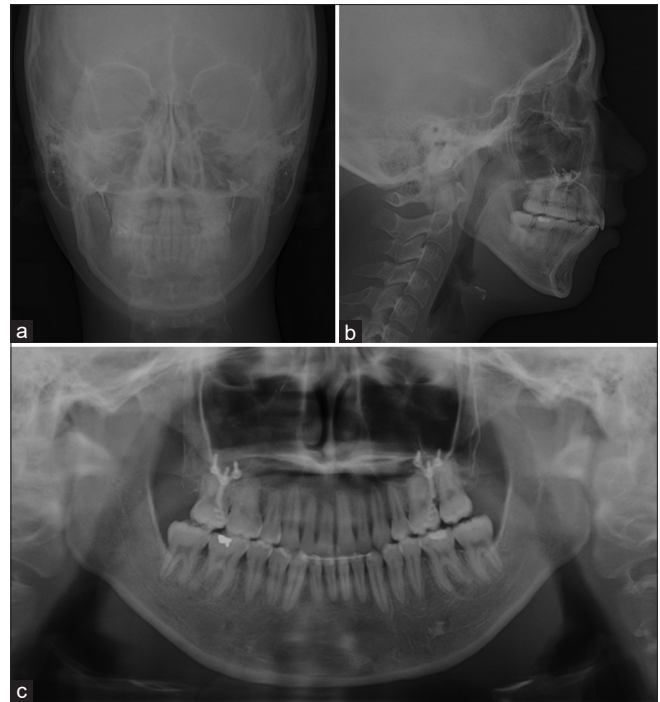


Figure 5: Posttreatment records. (a) Poster-anterior cephalograph; (b) lateral cephalograph; (c) panoramic radiograph (age, 22 years 2 months)



Figure 7: Five-year post retention facial and intraoral photographs (age, 27 years 4 months) opening [Figure 8]. Moreover, cephalometric analysis revealed little or no change in the mandibular position [Figure 6 and Table 1].

## Discussion

In the present case, the patient had skeletal anterior open bite, excessive lower anterior facial height, chin deficiency, and TMDs. In such cases, we have mainly selected orthognathic surgery of the maxilla and/or

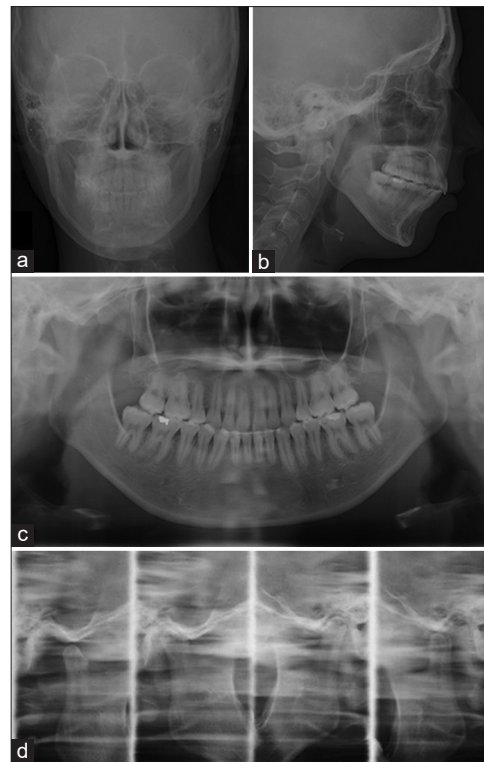
**Table 1: Cephalometric summary**

Variables	Mean	SD	Pretreatment	Postactive treatment	Postretention
<b>Angle (°)</b>					
ANB	2.8	2.4	12.6	9.4	9.3
SNA	80.8	3.6	82.9	80.8	80.8
SNB	77.9	4.5	70.3	71.3	71.5
Mp-FH	30.5	3.6	39.3	37.1	37.3
Go.A	122.1	5.3	123.6	124	123.3
U1-FH	112.3	8.3	111	100.6	102.1
L1-Mp	93.4	6.8	102.7	97.6	97.9
IIA	123.6	10.6	107	124.7	122.6
Occl.P	16.9	4.4	21.9	25.4	24.7
<b>Liner (mm)</b>					
S-N	67.9	3.7	69.4	69.4	69.7
N-Me	125.8	5	137.7	136	136.1
Me/NF	68.6	3.7	73.3	71.8	72.2
Go-Me	71.4	4.1	74.1	73.5	74.8
Ar-Me	106.6	5.7	103	103.1	103.8
Overjet	3.1	1.1	10	3.2	3.4
Overbite	3.3	1.9	-2	2.3	2.2
U1/NF	31	2.3	33	32	32
U6/NF	24.6	2	26.6	22.5	23
L1/Mp	44.2	2.7	50.9	50.3	50.5
L6/Mp	32.9	2.5	36.7	35.9	36.5

mandible until now.<sup>[2-4]</sup> Orthognathic surgery generally provides good facial esthetic and occlusion outcomes.

In previous studies, successful outcomes were reported with the use of orthognathic surgery to manage maxillofacial skeletal discrepancies with signs and symptoms of TMDs.<sup>[19,20]</sup> However, some studies have reported that orthognathic surgery may not successfully treat TMDs.<sup>[21,22]</sup> These reports demonstrated that the treatment outcomes after orthognathic surgery depend on the presurgical TMJ condition, implying that patients with presurgical TMJ symptoms requiring mandibular advancement might be at high risk for condylar resorption.<sup>[5-10]</sup> Furthermore, degenerative and osteolytic changes make the TMJ components highly susceptible to failure under new functional loading that results from orthognathic surgical repositioning of the maxillofacial skeleton. The most common TMJ pathology is anterior disc displacement, as in our case, and this displacement initiates a cascade of events leading to arthritis and other TMJ-related symptoms. Advancing the mandible in a patient with displaced discs will cause the discs to remain displaced, as the condyle will move in the superoposterior position in the fossa because of postsurgical soft tissue tension. This might initiate or worsen TMJ pain and dysfunction, headaches, condylar resorption, and other complications.

MEAW therapy has been widely used for the treatment of anterior open bite to avoid orthognathic surgery. Treatment with MEAW results in adequate overbite. However, cephalometric evaluation of patients treated



**Figure 8:** Five-year post retention records. Frontal (a) and lateral (b) cephalograms, panoramic radiograph (c) and panoramic TMJ projections (d) (age, 27 years 4 months)

with MEAW showed that there were few changes in the skeletal pattern and that notable changes depended on dentoalveolar changes.<sup>[1]</sup> The intrusion of molars is relative to the extrusion of incisors because the force system depends on intermaxillary elastics.<sup>[1,23]</sup> The use of elastics is necessary, and cooperation and perseverance of the patient are required. Anterior extrusion is untenable for the treatment of skeletal open bite cases with a long-face tendency and compensative eruption of the anterior teeth. In the present case, the patient had a long-face tendency and her mandible was rotated downward owing to extrusion of both upper and lower molars. Therefore, we decided to use absolute anchorage for intrusion of the upper and lower molars.

TADs have been used to provide anchorage for various types of tooth procedures, including retraction of the anterior teeth and whole dentition, protraction of the posterior teeth, intrusion of the anterior and posterior teeth, and making the molar upright.<sup>[24]</sup> Over the past few years, absolute anchorage has been established as a new treatment method. Absolute molar intrusion using TADs achieves counterclockwise rotation of the mandible, and overbite is increased without extrusion of the incisor. Kuroda *et al.*<sup>[25-27]</sup> found that, although the mandibular plane was rotated more than 5° by molar intrusion, patients had no functional problems after treatment. Furthermore, the placement of TADs is possible under only local anesthesia and is less invasive than LeFort I osteotomy for maxillary impaction

with mandibular repositioning osteotomy. In addition, it provides morphological improvement over orthognathic surgery. Therefore, absolute anchorage with TADs was used in the present case.

In the present case, intrusion of the upper and lower molars resulted in 4.2° of counterclockwise mandibular rotation and improvement of the anterior open bite. Rotation of the mandible resulted in a 4-mm advancement of the chin at the pogonion, considerably improved the retrognathic appearance of the facial profile, and significantly reduced the anterior facial height. Additionally, straining of the circumoral musculature during lip closure disappeared. Furthermore, by preventing anterior extrusion, an esthetic smile was achieved. Umemori *et al.*<sup>[10]</sup> and Sherwood *et al.*<sup>[14]</sup> reported that intrusion of the molars in a single jaw was quite effective for overbite correction; however, facial profile improvement was not significant because of extrusion of the molars in the opposite jaw. In our case, we implanted the miniplates onto the maxilla and mandible, and intruded both molars. As a result, the mandible was effectively rotated in the counterclockwise direction, and major skeletal changes were achieved. Therefore, we believe that intrusion of the molars in both jaws is desirable in patients with severe anterior open bite caused by extrusion of the upper and lower molars.

Studies have shown that long-term stability can be achieved with surgery in patients with anterior open bite.<sup>[3,4]</sup> A previous report on anterior open bite cases treated with miniplates demonstrated that one-third of the mandible molar intrusions showed relapse during a 1-year retention period.<sup>[24]</sup> However, our case showed limited relapse after a five-year retention period. We could easily achieve functional adaptation in the circumoral musculature because of counterclockwise rotation of the mandible, and this was one of the most important factors for retention of the anterior open bite. However, retention was assessed for only 5 years. No previous study has reported on the long-term stability of TADs for anterior open bite, and further studies will be needed to determine the stability.

The recent development of the miniscrew implant is important and being used in various methods. The use of a miniscrew implant may allow molar intrusion to be performed without surgical stress as the device is small and simple and has good success rates equal to or greater than miniplates.<sup>[28-30]</sup> Further studies will be needed to determine the long-term stability of the miniscrew implant.

## Conclusion

We presented an adult case of skeletal anterior open bite with TMDs treated using titanium miniplates for absolute anchorage. We believe that skeletal anchorage is

beneficial for intrusion of bimaxillary molars in patients with anterior open bite.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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