Severe Anterior Open-Bite Case Treated Using Miniscrew Anchorage: A Case Report

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Abstract: Downward and backward rotation of the mandible and/or excessive eruption of posterior teeth often cause anterior open bite. Depending on the severity of the case, orthognathic surgery is often the treatment of choice due to the difficulty of establishing absolute anchorage of molars by using a traditional orthodontic mechanics. This article reports the successful treatment of a severe skeletal anterior open-bite case using titanium screw anchorage in a 44 years 4 months female patient with 7.0 mm anterior open bite and increased facial height. The titanium screws were implanted in both the buccal and palatal area of the maxilla, and an intrusion force was provided via elastic chains for 13 months. After active treatment of 19 months, her upper first molars were intruded 3.0 mm on each side and good occlusion was achieved. Her retrognathic chin and convex profiles were improved by an upward rotation of the mandible. The results suggest that titanium screws can be considered useful for intrusion of molars in selected anterior open-bite cases.
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1. Introduction

Skeletal Anterior open bite is one of the most difficult malocclusions the clinician has to deal with. In adult patients, the best management of skeletal anterior open bite is via surgical repositioning of the maxilla or the mandible or a combination of both. **(1)** However, a number of patients do not wish to perform orthogenetic surgery because of the involved risk. For such patients, various alternatives can be used, including multibrackets in conjunction with high-pull headgear therapy **(2)**, multiple-loop edgewise arch wire (MEAW) therapy**(3),** reversed curve nickel-titanium wire with intermaxillary elastics**(4)** and extraction therapy. **(5)** These treatment modalities can achieve acceptable overbite and interincisal relationship. On the other hand, the skeletal improvement is poor due to failure to establish absolute anchorage during molar intrusion.

To obtain absolute anchorage several devises have been used such as dental implant [6-9], screw [10, 11] and miniplates [12-14]. The advantages of these devices are by providing absolute anchorage different teeth movement without the need for patient's cooperation. Several reports have been reported on the use of screw for anchorage in teeth movement, intrusion or retraction of anterior teeth [10, 11], and protraction of posterior teeth in the mandible [15]. In addition, few papers have reported the use of titanium screws for orthodontic anchorage to intrude upper and /or lower molars of an adult patient with sever skeletal anterior open bite. The present case report demonstrates the usefulness of titanium screws for orthodontic anchorage to intrude the upper molars of an adult patient with severe skeletal anterior open bite.

Case summary:

A 44 years and 4 months female patient complaining "I had my braces for 2 years and 6 months and I don't want to do orthognathic surgery is there any way to correct my anterior open bite without surgery". Figure 1 shows a composite of extra and intra oral views. The patient had convex profile due to a retrognathic mandible; acute nasolabial angle, increased lower facial height, and circumoral musculature strain on lip closure were observed. An increase overjet of 4 mm and an increase in open bite of 7.0 mm was observed. In addition, two distinct occlusal planes were present in the upper arch 3 mm of Spacing in the lower arch was noted with no crowding nor spacing in the upper arch. The upper and lower midlines were coincident to one another and to the facial midline. No radiographical abnormalities were seen in the orthopantogram. Cephalometric analysis (Table 1) showed a skeletal Class II relationship (ANB 6^{o}) with mandibular retrusion (SNB 72^{o}) (Figure 2). The mandibular plane angle was hyperdivergent (50^{o}) and the Gonial angle was large (MP/FH 40 ^{o}), but the mandibular body length and ramus height were within the normal range. The lower incisors were labially inclined (U1/ FH 113, L1-MP 98). Both upper and lower molars were significantly extruded (U6/NF 26, L6/MP 35.5), and the molar relationship was Angle Class I on both sides. Although there were flattening of the condylar head on both joints, no symptom of temporomandibular disorder (TMD) was noticed.

Diagnosis and treatment objectives

The patient was diagnosed as having an Angle Class I malocclusion with a skeletal Class II jaw base relationship and skeletal anterior open bite. The treatment objectives were (1) correct the anterior open bite and establish ideal overjet and overbite, (2) achieve an acceptable occlusion with a good functional Class I occlusion, and (3) correct the retrognathic appearance of the facial profile. The cause of the anterior open bite in this case was suggested to have been extrusion of both upper molars, base on her cephalometric readings, therefore, the plan was to intrude both upper molars using implanted titanium screws to deliver the force.

Treatment progress

Rebonding and rebanding all teeth, using 0.022-inch slot, preadjusted edgewise appliances were placed in both arches and leveling and aligning phase using progressive arch wires (Victory Series ™ , Roth Rx,3M Unitek, Monrovia, CA, USA) was performed. Correction of the two-step occlusal plane was done during the leveling and aligning phase by extrusion of anterior teeth. Once a heavy stainless steel arch wire (0.019"x0.025") was reached, Titanium screws (1.6-mm diameter, 8 -mm length; RMO Co Ltd, Denver, Colorado, USA) were inserted bilaterally in the alveolar bone of the maxilla through the buccal mucosa between the second bicuspid and the first molar from both the labial and palatal area (Figure 2). All the screws were implanted at the same visit after local anesthesia was administered. Analgesics were prescribed to the patients for 3 days after the implantation. One week after implantation of the titanium screws, intrusion of posterior teeth began using elastic chains. The total active treatment period was 19 months. The implant screw anchorage was stable for the entire duration of the treatment, and the screws were removed during the retention phase.

3. Results

The posttreatment smiling facial photograph showed a significant change in the smile when compared with the pretreatment photograph (Figure 3). The retrognathic chin and convex profiles were corrected, resulting in a straight profile. The facial proportions were also improved due to of the decrease in the lower facial height. The strain in the circumoral musculature during lip closure was improved. Posttreatment cephalometric evaluation showed a skeletal Class I jaw base relationship (ANB 2). Clockwise rotation of the mandible was observed (Figures 7 and 8; Table 1), and an Angle Class I molar and canine relationship was maintained bilaterally. An acceptable overjet and overbite of 2.0 mm was achieved and the anterior open bite was corrected. Maxillary first and second molars were intruded 3.0 mm. The upper incisors were minimally extruded, but the lower incisors were intruded. The occlusion was more stable, and acceptable intercuspation of the teeth was achieved.

Table 1 Cephalometric measurements of the patient described in this case

Measurement	Normal	Before intrusion	After Intrusion
SNA (°)	82	78	76
SNB (°)	80	72	74
Facial angle SN- Pog	80	72	75
Facial angle FH-N Pog	87	93	85
ANB (°)	2	6	4
Mandibular plane to SN (°)	32	50	47
Mandibular plane to FH (°)	25	40	38
U1 to NA			
Angle (°)	22	23	24
Distance (mm)	4	8	6
L1 to NB			
Angle (°)	25	28	28
Distance (mm)	4	5	5
L1 to mandibular plane (°)	90	98	92
ANS–PNS perpendicular to U6 tip (mm)	23	26	23
Lower face/total face (%)	57	61	58

aS = sella, N = nasion, A = point A, B = point B, U1 = upper incisor, L1 = lower incisor, U6 = upper first molar, ANS = anterior
nasal spine, PNS = posterior nasal spine.
bCalculated as (ANS – Gn)/(N – Gn) × 100, where Gn = Gnathion.

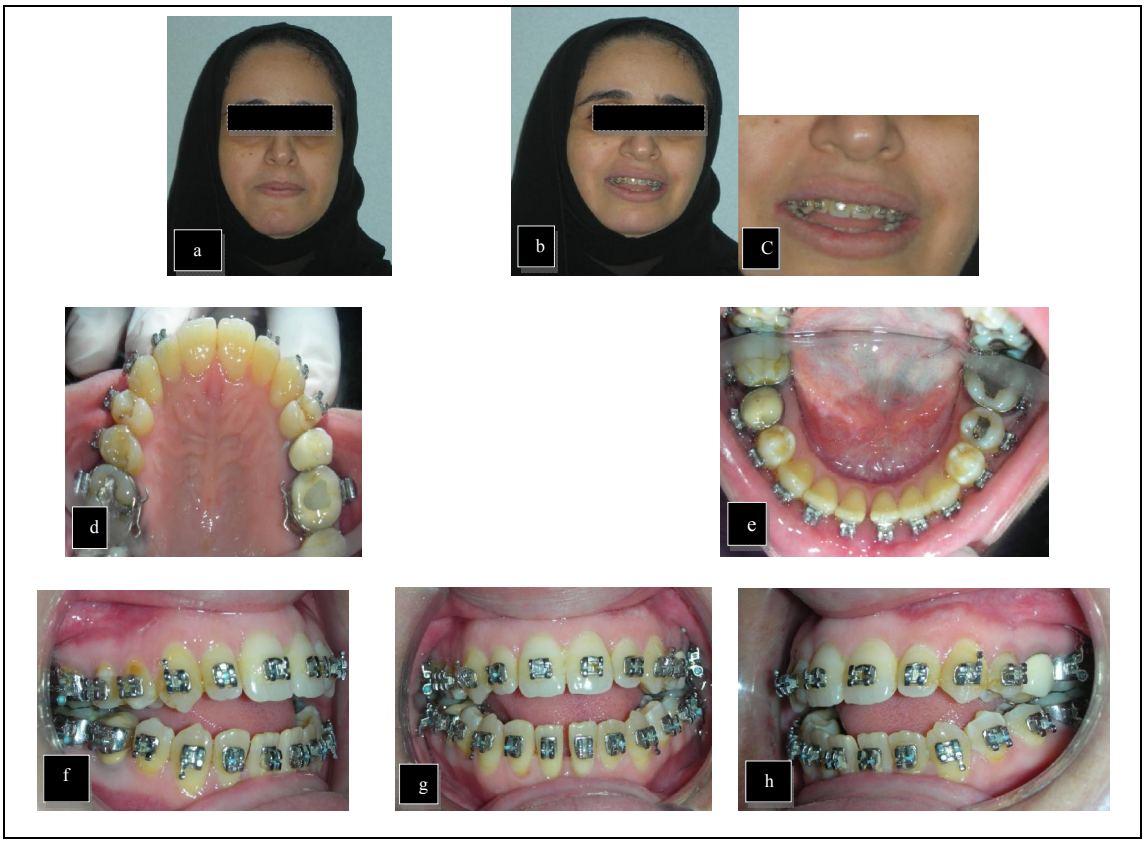


Figure 1: Initial extra oral and intraoral photographs: a) view of the frontal facial profile b) view of the frontal smiling profile c) close frontal smile d) occlusal view of the upper arch; e) occlusal view of the lower arch: f) view of the right side, showing the lateral and anterior open bite; g) frontal view, showing the 7mm anterior open bite; h) view of the left side, showing the lateral and anterior open bite.

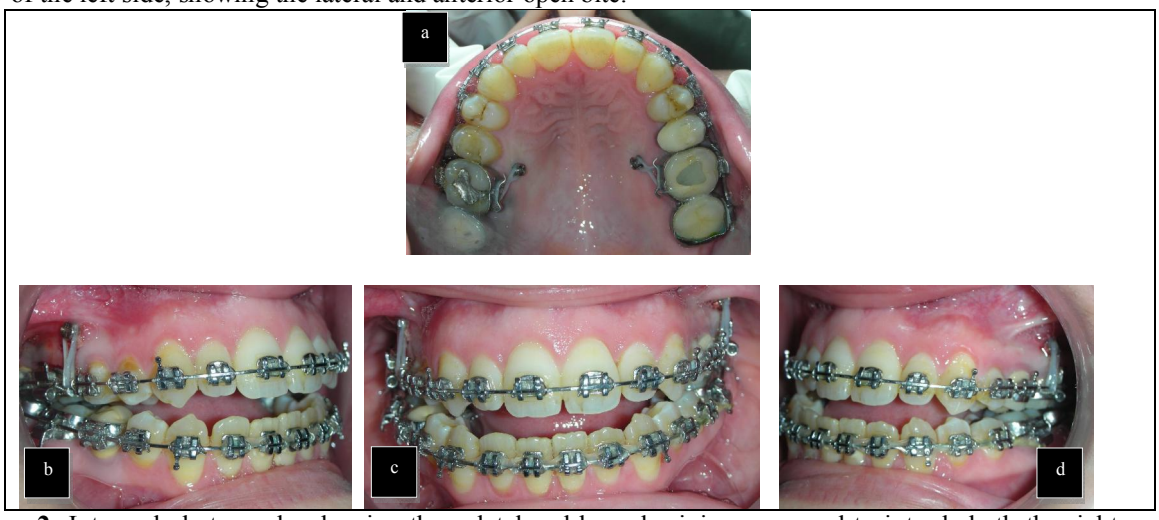


Figure 2: Intraoral photographs showing the palatal and buccal mini-screws used to intrude both the right and the left first molars: a) maxillary occlusal view showing palatal temporary anchorage device and force delivered with a power chain attached to the cleat on the palatal surface of the tooth maxillary first molars b) right first molar intrusion using a temporary anchorage device and force delivered with a power chain attached to molar buccal tube buccal surface of the tooth; c) left temporary anchorage device with power chain attached to a button bonded to the buccal surface of the molar; 0.012-in ligature wires were engaged to the device and bent to make a hook over which the power chain could be attached; c) view of the right and left temporary anchorage devices with power chains attached to buttons bonded to the palatal surfaces of both molars.

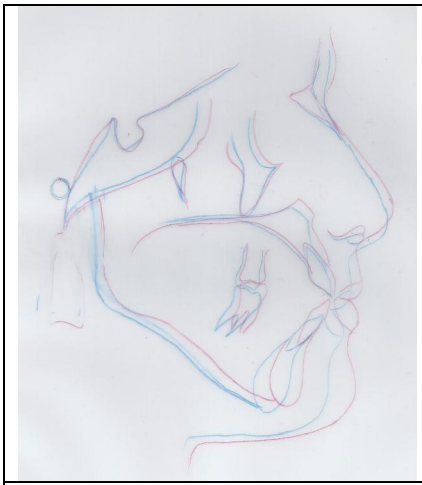
Figure3 : Final smiling and intraoral photographs: a) frontal smiling photograph, showing bite closure ; a) view of the right side, showing the fixed retention wire between the first and second molars; b) occlusal view of the upper arch c) occlusal view of the lower arch; d) frontal view with provisional temporary crowns in place; c) view of the left side, showing the fixed retention wire between the first and second molars;

Figure 4: Pre-treatment panoramic radiograph.

Figure 5: Post-treatment panoramic radiograph

Figure 6: Pre-treatment lateral cephalograph

Figure 7: Post-treatment lateral cephalograph.



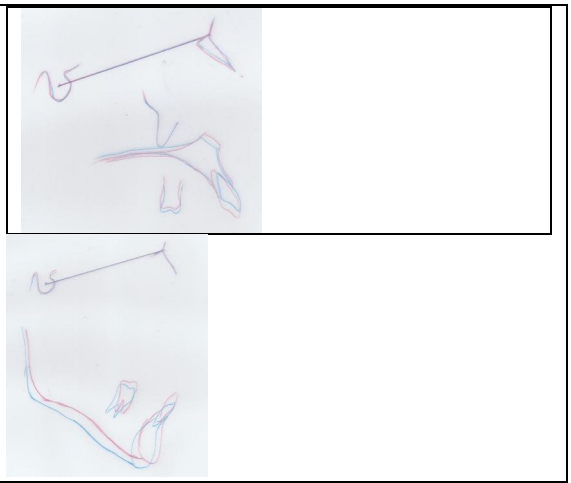


Figure 8 Over all superimposition showes outororation of the mandible and 3 mm of molar introusion

Regonal superimostion showes 4 mm om molar intrusion

4. Discussion

Excessive eruption of posterior teeth often cause downward rotation of the jaws which might result in an anterior open bite.[16] MEAW technique sometime used in these cases for a nonsurgical treatment, which will result in adequate overbite.[3] However the cephalometric evaluation of patients treated with MEAW technique shows only significant changes in the dentition with very minimal or no skeletal changes, [3] since molar intrusion is relative to incisors extrusion due to on the intermaxillary elastics. In long- face tendency patients with anterior open bite and maxillary vertical excess, anterior teeth extrusion is often undesirable. In the present case, the mandible was rotated downward, and the patient had a long-face tendency due to extrusion of maxillary molars. Therefore, absolute anchorage was required for intrusion of the maxillary molars since the patient refused to undergo orthognathic surgery to correct her condition.

Several methods to acquire bone anchorage have been reported. Dental implants are strong enough to resist the counteraction of orthodontic tooth movement, but they require complicated surgery for both placement and replacement and also involve higher cost [6-9]. In addition, miniplates have also been used for orthodontic anchorage. [12-14] In anterior open-bite cases, two reports showed the value of the use of the miniplates as a skeletal anchorage for bite closure without extrusion of the anterior teeth.[12, 14] However, surgical damage during insertion and removal of the miniplates together with the need for a mucoperiosteal flab are considered to be a major disadvantage of miniplates.[17]

When compared with dental implants for abutments, titanium screws, which were originally used for intermaxillary fixation and bone fixation, have the advantages of functioning as rigid anchorage against orthodontic loads, minimal anatomic limitation for placement, lower costs, simpler placement surgery, and less discomfort after implantation.[10, 11, 15, 17, 18] Therefore, titanium screws have gradually gained popularity for absolute anchorage for various tooth movements, including but not limited to intrusion or retraction of the anterior tooth,[10, 11, 15] and protraction of the lower molars.(15) In the present case, maxillary molars were extruded, and titanium screws were placed in the posterior region in the maxilla. However, the posterior part of the maxilla tends to have a thinner, more porous cortex and finer trabeculae [19] Consequently, the screws were placed in more anterior between the second premolar and the first molar to overcome this problem. After the intrusion, the screws were retained until completion of active treatment to prevent possible relapse. In the retention phase, the screws were easily removed with a screwdriver. As a result of intrusion of the upper molars, the mandible rotated counterclockwise, and the severe anterior open bite was improved. Rotation of the mandible caused a favorable advancement of the chin (3mm) at pogonion and improved the retrognathic appearance of the facial profile as demonstrated by the change in facial angel N Pog - FH by 8 ^{o} as shown in table 1. The anterior facial height was considerably reduced, and the lip incompetence improved. By preventing the anterior extrusion, an esthetic smile was achieved. In previous reports, the intrusion of molars in one jaw was quite effective for overbite correction, but the facial profile improvement was poor because unwanted extrusion of molars occurred in the opposite jaw [12, 14] In the present case, intrusion of

both upper molars was performed while preventing the extrusion of the lower molars by using a heavy stainless steel arch wire 0.019"X0.025", and as a result of this treatment, the mandible was significantly rotated in a counterclockwise direction, and major skeletal changes were achieved. The autorotation of the mandible caused the reduction in the lower facial height by 3%. Therefore, it is suggested that the intrusion of maxillary molars is desirable in cases of severe anterior open bite caused by extrusion of the upper molars. In addition, the lower molars have to be prevented from erupting using heavy arch wires. The treatment result was acceptable and comparable to those obtained by two-jaw surgeries. [20] Moreover; treatment using implant anchorage is considered minimally invasive and requires a shorter treatment period compared to orthognathic surgery. Therefore, there is a possibility that this technique could become an alternative to orthognathic surgery in selected cases. It is well known that long-term stability can be achieved after surgical treatment for anterior open bite.[20, 21] In a recent report of one year of retention for anterior open-bite cases treated with miniplates skeletal anchorage, 30% of the lower molar intrusion showed relapse.[22] In the present case, little relapse was observed after a 6 months period, although maxillary molars had been intruded approximately 3 mm. As a result of a significant counterclockwise rotation of the mandible caused by the intrusion of maxillary molars, the functional adaptation in circumoral musculature may be easily achieved. Therefore, functional adaptation in musculature should be an important factor in the retention of the correction of anterior open bites. Long-term stability after the treatment for anterior open bite using implant anchorage remains unknown, and this remains a topic for future study in implant orthodontics.

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