Case Report

Skeletal Class III and open bite treated with bilateral sagittal split osteotomy and molar intrusion using titanium screws

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ABSTRACT

Two-jaw surgery has been performed for the treatment of severe skeletal open bite cases to obtain stability of occlusion after treatment. If molar intrusion with titanium screws could be performed instead of surgical superior repositioning of the maxilla, the incidence of surgical invasion would be reduced. However, there have been few reports of such a therapy. This case report describes treatment for skeletal Class III and open bite with bilateral sagittal split osteotomy and intrusion of the molars using titanium screws. The patient had a concave profile, a long lower facial height, Class III malocclusion, and excessive anterior open bite following mandibular protrusion and a high mandibular plane angle. The mandible autorotated closed 3.5° following intrusion of the upper and lower molars using titanium screws during the presurgical orthodontic treatment phase. After the autorotation of the mandible, a mandibular setback with a bilateral sagittal split osteotomy was performed. The posttreatment records showed a good facial profile and occlusion. The mandible was stable 1 year after surgery. These results demonstrate that surgical orthodontic treatment combined with bilateral sagittal split osteotomy and intrusion of the molars using titanium screws can reduce the need for surgical invasion by avoidance of maxillary surgery and was effective for correcting the facial profile and occlusion in a skeletal Class III and open bite patient. (*Angle Orthod.* 2010;80:1176–1184.)

KEY WORDS: Open bite; Intrusion; Titanium screw; Mandibular setback; Autorotation

INTRODUCTION

Skeletal open bite is one of the most difficult malocclusions to treat orthodontically.[1,2] The most effective treatment option in adult patients with skeletal open bite is surgical repositioning of the maxilla or both jaws.[1,3] The results of surgery to reduce the mandibular plane angle and to close the open bite by closing rotation of the mandible with only mandibular surgery have been shown to be highly unstable because this rotation lengthens the ramus and stretches the muscles of the pterygomandibular sling.[4] Therefore, a surgical procedure involving superior repositioning of the maxilla with a Le Fort I osteotomy is recommended to obtain more stable and predictable results for the surgical correction of skeletal open bite.[5–12] However, surgical invasiveness of two-jaw surgery is greater than that of mandibular surgery alone. Furthermore, in some patients, secondary morphological changes in the nose, such as alar flaring, have occurred after superior repositioning of the maxilla with Le Fort I osteotomy,[13–18] and soft tissue procedures such as rhinoplasty are therefore needed subsequently.[19]

Recently, a new treatment method for anterior open bite with skeletal Class I and II that employs molar intrusion via anchorage with an implant such as a titanium screw has been reported.[3,20–24] Intrusion of the molars enables autorotation of the mandible in a closing direction, thus closing the anterior open bite and reducing anterior facial height.[25] If intrusion of the molars with titanium screws and bilateral sagittal split osteotomy (BSSO) are performed instead of two-jaw

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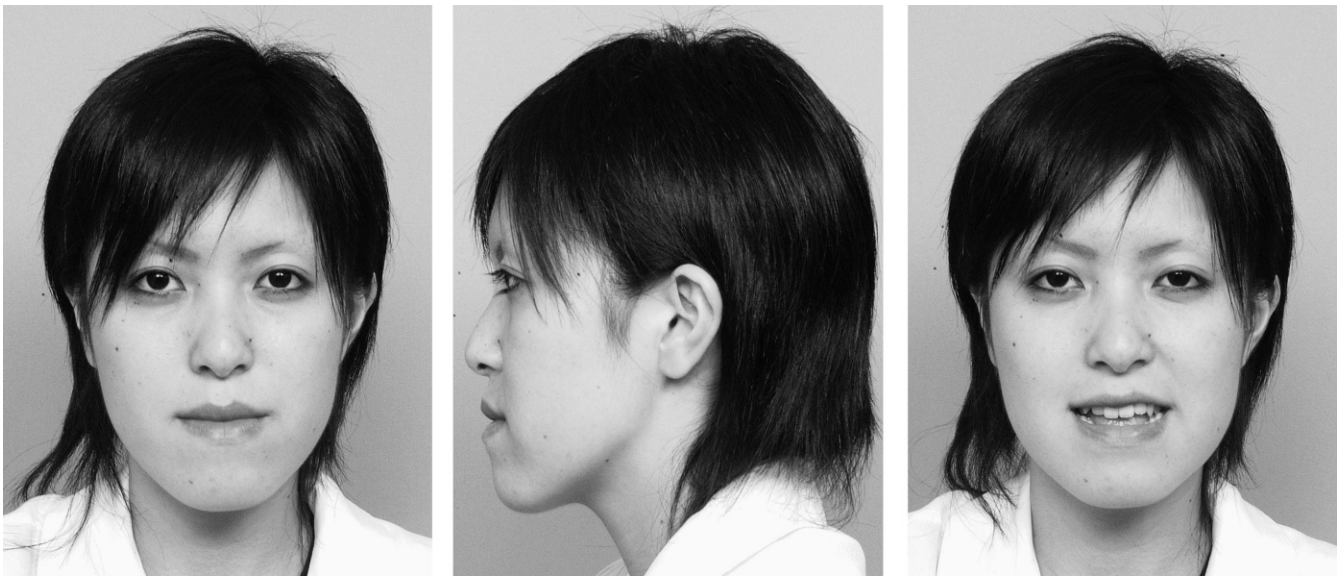

Figure 1. Pretreatment facial photographs.

surgery in patients with skeletal Class III and open bite, the surgical invasion is reduced and changes in the nasal profile can be avoided. However, there have been few reports of such a therapy.

This article reports on a patient with severe skeletal Class III and open bite treated by BSSO combined with intrusion of the molars using titanium screws.

CASE REPORT

Case Summary

The patient was a 17-year-old woman with a chief complaint of lack of incisal contact, total crossbite, and mandibular protrusion. The patient did have a history of dislocation of her right temporomandibular joint on one occasion approximately 3 years before the initial examination. However, no clicking, joint pain, or limitation of opening was found at the initial examination.

Her facial profile was concave, with chin protrusion and a long lower facial height (Figure 1). The patient had an Angle Class III malocclusion with total crossbite (−3.1 mm of overjet), excessive open bite (−5.3 mm of overbite), and a constricted maxillary dental arch (Figures 2, 3 and 4A).

The lateral cephalometric analysis indicated a skeletal Class III jaw relationship with mandibular protrusion and an ANB angle of 0°, an SNB angle of 82.0°, a severe high mandibular plane angle of 37.5°, a large gonial angle of 140.0°, and an upright mandibular central incisor–mandibular plane angle (IMPA) of 76.5°.

According to the soft tissue analysis, the lower facial height was slightly long, with a middle third height/lower third height (G-Sn/Sn–soft tissue menton [MeS]) ratio of 0.9 (Table 1). The mandibular growth spurt had already taken place according to a hand-wrist radiograph. Furthermore, the patient had a wide, broad, and flat tongue; an open bite; mandibular prognathism; Class III malocclusion; chronic posturing of the tongue between the teeth at rest; an accentuated curve of Spee in both arches; disproportionately excessive mandibular growth; an increased gonial angle; and an increased mandibular plane angle. We therefore diagnosed the patient with macroglossia.[26,27]

Diagnosis

This patient was diagnosed as an Angle Class III malocclusion with skeletal Class III, high mandibular plane angle, anterior open bite, and macroglossia.

Treatment Plan

Treatment was planned as follows:

- Extraction of the upper and lower third molars;
- Expansion of the maxillary dental arch with a quadhelix appliance, intrusion of the upper and lower molars with preadjusted edgewise appliances and titanium screws for mandibular closing rotation, and leveling and alignment of the upper and lower arches in presurgical orthodontic treatment;
- BSSO, genioplasty, and tongue reduction to correct the sagittal skeletal discrepancy between the maxilla and mandible and to reduce the vertical dimension of the lower facial height;
- Establishment of an ideal occlusal relationship through postsurgical orthodontic treatment.

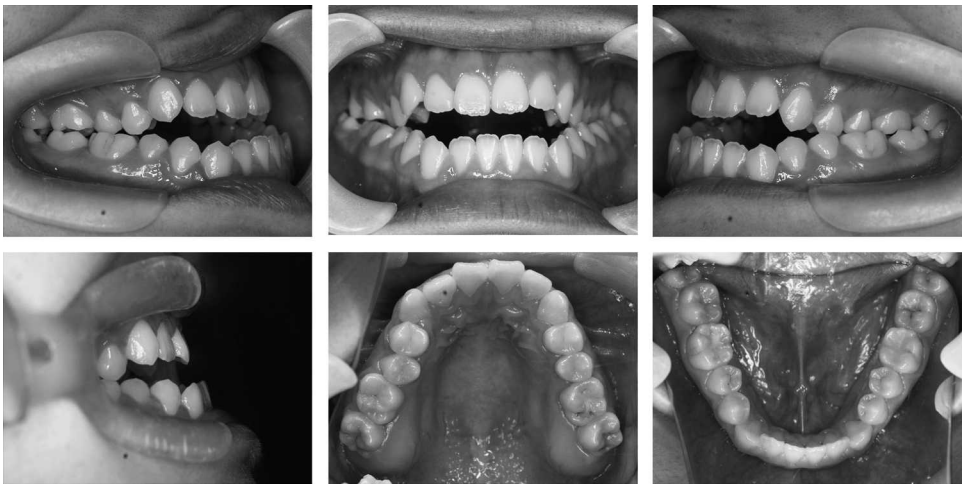

Figure 2. Pretreatment intraoral photographs.

Treatment Alternatives

The second option was two-jaw surgery: Le Fort I osteotomy and BSSO. This option was rejected because of the high level of surgical invasion and the possibility of alar flaring. The third option was multiloop edgewise archwire therapy. This option was also rejected because of the extrusion of the anterior teeth.

This patient had two different occlusal planes, long lower facial height, and large U6/NF and L6/MP before treatment (Table 1). Furthermore, no abnormality of incisor exposure at smiling and periodontal status was observed before treatment.[25] Therefore, molar intrusion was considered to be the best treatment choice to correct the open bite of this patient.

Treatment Progress

The patient gave written informed consent after receiving an explanation of the orthodontic treatment with titanium screws and surgical procedures, which was approved by the Ethics Committee of Kagoshima University Hospital. Under local anesthesia, all third molars were extracted and four titanium screws (1.6 mm in diameter, 10 mm long, Dual-Top; Jeil Medical Corporation, Seoul, Korea) were placed into the maxillary and mandibular alveolar bone between the first and second molars on both sides (Figure 4B), as described in previous reports.[28–32]

Initially, the upper dental arch was expanded with a quad-helix appliance. A preadjusted edgewise appliance

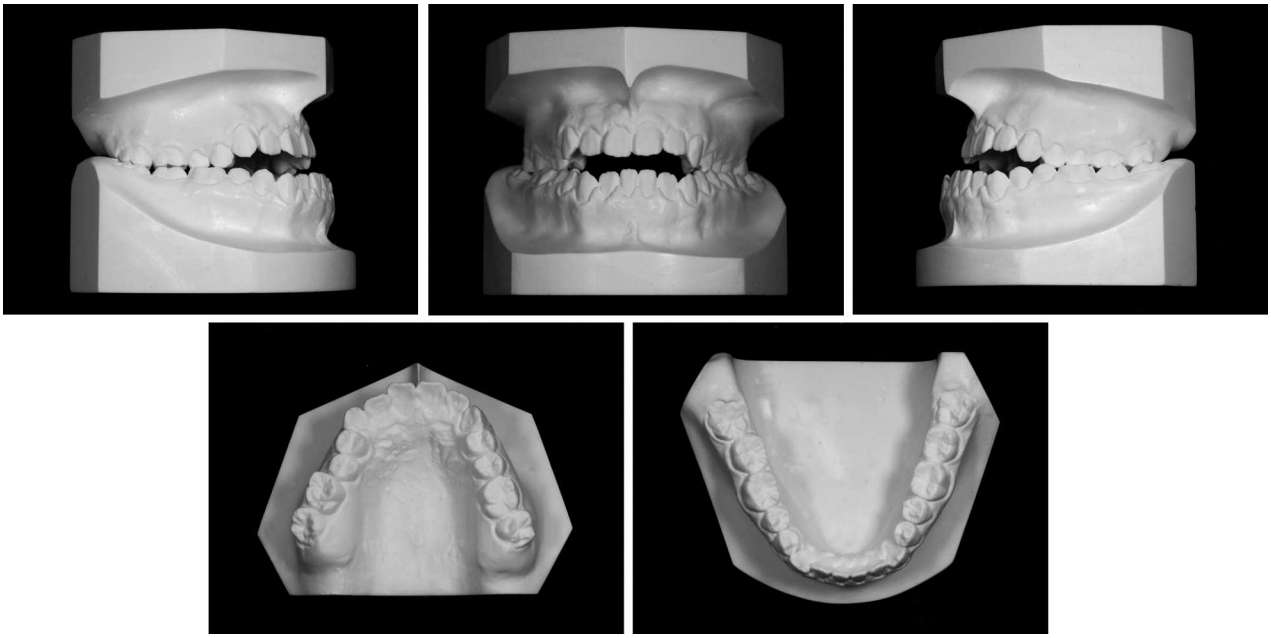

Figure 3. Pretreatment cast photographs.

Table 1. Cephalometric Measurements

Measurements	Norm[a] Mean	Norm[a] SD	Pretreatment (17 y 11 mo)	Immediately Before Surgery (19 y 11 mo)	Immediately After Surgery (20 y 1 mo)	Posttreatment (21 y 0 mo)
Angular (°)						
ANB	2.8	2.44	0	−1.0	2.0	2.0
SNA	80.8	3.61	82	82	82	82
SNB	77.9	4.54	82	83	80	80
MP-FH	30.5	3.60	37.5	34.0	31.0	31.0
Gonial angle	122.1	5.29	140.0	140.0	133.5	133.5
U1 to FH	112.3	8.26	112.5	112.5	112.5	112.5
IMPA	93.4	6.77	76.5	86.5	86.5	86.5
Linear (mm)						
S-N	67.9	3.65	70.0	70.0	70.0	70.0
N-Me	125.8	5.04	143.4	139.6	133.0	133.0
Go-Me	71.4	4.14	76.0	76.0	71.0	71.0
Ar-Me	106.6	5.74	124.7	124.7	115.5	115.5
Ar-Go	47.3	3.33	54.0	54.0	54.0	54.0
OJ	3.1	1.07	−3.1	−5.5	2.5	2.5
OB	3.3	1.89	−5.3	−1.0	2.5	2.5
U1/NF	31.0	2.34	32.0	32.5	32.5	32.5
U6/NF	24.6	2.00	27.0	25.5	25.5	25.5
L1/MP	44.2	2.68	43.0	43.0	43.0	43.0
L6/MP	32.9	2.50	34.0	32.5	32.5	32.5
Sn-G			75.0	75.0	75.0	75.0
Sn-MeS			81.0	79.5	73.5	73.5
G-Sn/Sn-MeS[b]			0.9	0.9	1.0	1.0

[a] Means and SDs of normal Japanese female adults.[41,42]
[b] MeS indicates soft tissue menton.

(0.018 × 0.025 inch) was placed on the upper and lower premolars and molars on both sides, and leveling and alignment of the teeth in these regions were performed prior to leveling and alignment in the anterior region.

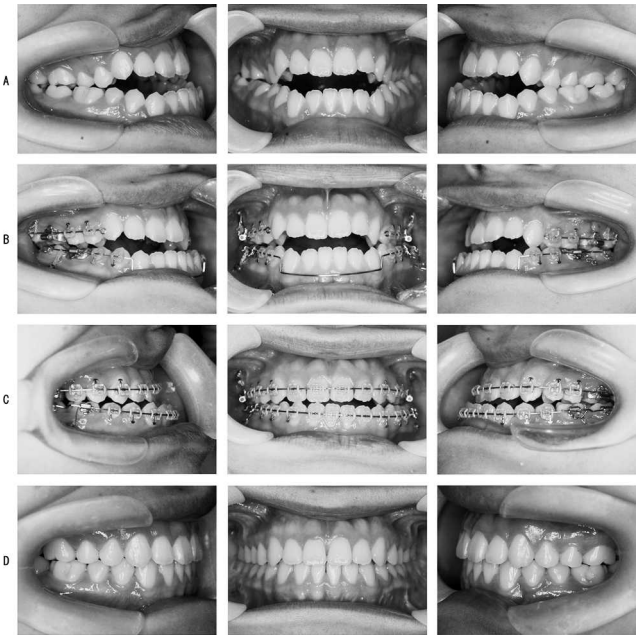

Figure 4. Intraoral photographs at pretreatment (A), intrusion of the upper and lower molars (B), immediately before surgery (C), and posttreatment (D).

After leveling and alignment of the premolars and molars was completed, the upper and lower molars of both sides were intruded by elastic chains from the titanium screws to the regions between the first and second molars of the sectional wires with an initial force of approximately 1 N per side (Figure 4B). The elastic chains were changed once a month. It is known that monitoring of the first-, second-, and third-order relationship of the intruded molars is necessary and the posterior torque control is the most important factor.[25] Therefore, to prevent buccoversion of the upper and lower molars during intrusive force application, the quad-helix appliance was used continuously in the upper arch and a lingual archwire was placed in the lower arch.[3]

After the overbite was improved following intrusion of the molars, preadjusted edgewise appliances were placed on the upper and lower anterior teeth, and leveling and alignment of the upper and lower arch were performed (Figure 4C). The total presurgical orthodontic treatment time was 21 months.

After the presurgical orthodontic treatment was completed, a mandibular setback with BSSO, superior repositioning of the chin with genioplasty, and tongue reduction procedures were all performed at the same time under general anesthesia. The tongue reduction in this case was performed according to Egyedi and Obwegeser.[33] The decrease in the size of the oral

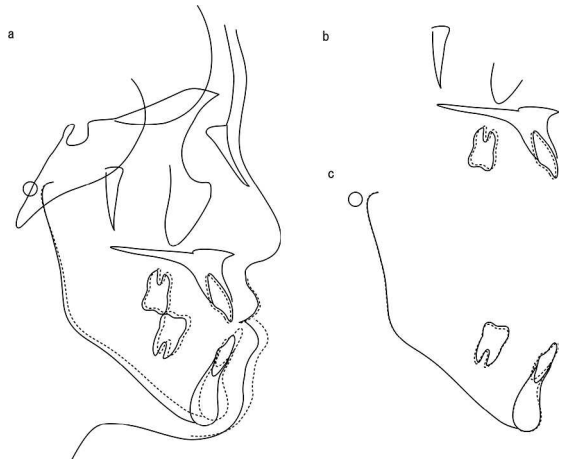

Figure 5. Superimposition of cephalometric tracings pretreatment (solid line) and immediately before surgery (dotted line). (a) A best-fit on the anterior wall of the sella turcica, the greater wings of the sphenoid, the cribriform plate, the orbital roofs, and the surface of the frontal bone; (b) a best-fit on the zygomatic process of the maxilla (key ridge) and the curvature of the palate; (c) a best-fit on the symphysis and the mandibular plane.

cavity following mandibular setback was calculated, and the tongue size was reduced accordingly.

Postsurgical orthodontic treatment was started 2 weeks after surgery and continued for 12 months to detail the occlusion. The overall active treatment time was 33 months. At the end of active treatment, the titanium screws were removed under local anesthesia. After debonding, a Begg-type retainer and a Hawley-type retainer were worn full time on the upper and lower arches, respectively (Figure 4D).

RESULTS

Cephalometric evaluation during the presurgical orthodontic treatment phase showed autorotation of the mandible in a closing direction, degeneration of the anteroposterior maxillomandibular relationship, and intrusion of the upper and lower molars; accordingly, the MP-FH angle was decreased by 3.5°, the SNB angle was increased by 1°, the ANB angle was decreased by 1°, N-Me was decreased by 3.8 mm, and U6/NF and L6/MP were each decreased by 1.5 mm (Figure 5, Table 1). In addition, the lower facial height (Sn-MeS) was decreased by 1.5 mm.

The posttreatment records showed a dramatic change in the facial profile and occlusion (Figures 6 to 8). The protruding chin and long lower facial height were reduced, resulting in a straighter profile. Acceptable overjet and overbite of anterior and posterior teeth and Angle Class I molar relations were all achieved. Cephalometric evaluation before and after treatment showed a closing rotation of the mandible and achievement of an acceptable anteroposterior maxillomandibular relationship and middle third height/lower third height (G-Sn/Sn-MeS). Accordingly, the MP-FH angle decreased by 6.5°, the SNB angle decreased by 2°, the ANB angle increased by 2°, the lower facial height (Sn-MeS) decreased by 7.5 mm, and the middle third height/lower third height (G-Sn/Sn-MeS) improved from 0.9 to 1.0, respectively (Table 1). The amount of mandibular setback was approximately 9 mm. Furthermore, the chin was moved superiorly approximately 5 mm with genioplasty. The U1/NF and L1/MP changed little (Figure 9;

Figure 6. Posttreatment facial photographs.

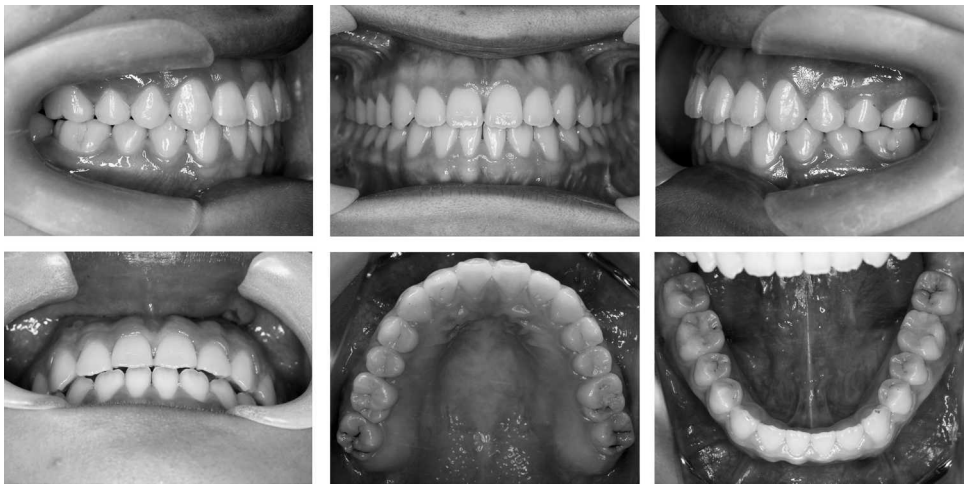

Figure 7. Posttreatment intraoral photographs.

Table 1). Panoramic radiographs after treatment showed no marked apical root resorption (Figure 10).

Cephalometric evaluation during the postsurgical orthodontic treatment showed very few changes in the skeletal measurement values (Table 1), and the mandible was stable 1 year after surgery.

DISCUSSION

In open bite treatment, molar intrusion or incisor extrusion is needed to correct the occlusal plane of the upper and lower arches[23,24,34] because a discrepancy in tooth height between the anterior and posterior teeth generally exists. The treatment of open bite by incisor extrusion has been reported to result in a gummy smile.[35] Furthermore, lack of stability of extruded anterior teeth by orthodontic treatment is a widely recognized cause of relapse.[36] In this case, a preadjusted edgewise appliance was placed only on the upper and lower premolars as well as the molars on both sides, and intrusion of the regions was performed prior to leveling and alignment in the anterior teeth region. The occlusal plane of the upper and lower arches was then corrected. As a result, the anterior teeth of both arches were extruded only minimally. Therefore, intrusion of the molars prior to leveling of the upper and lower arches may prevent a gummy smile and relapse of open bite.

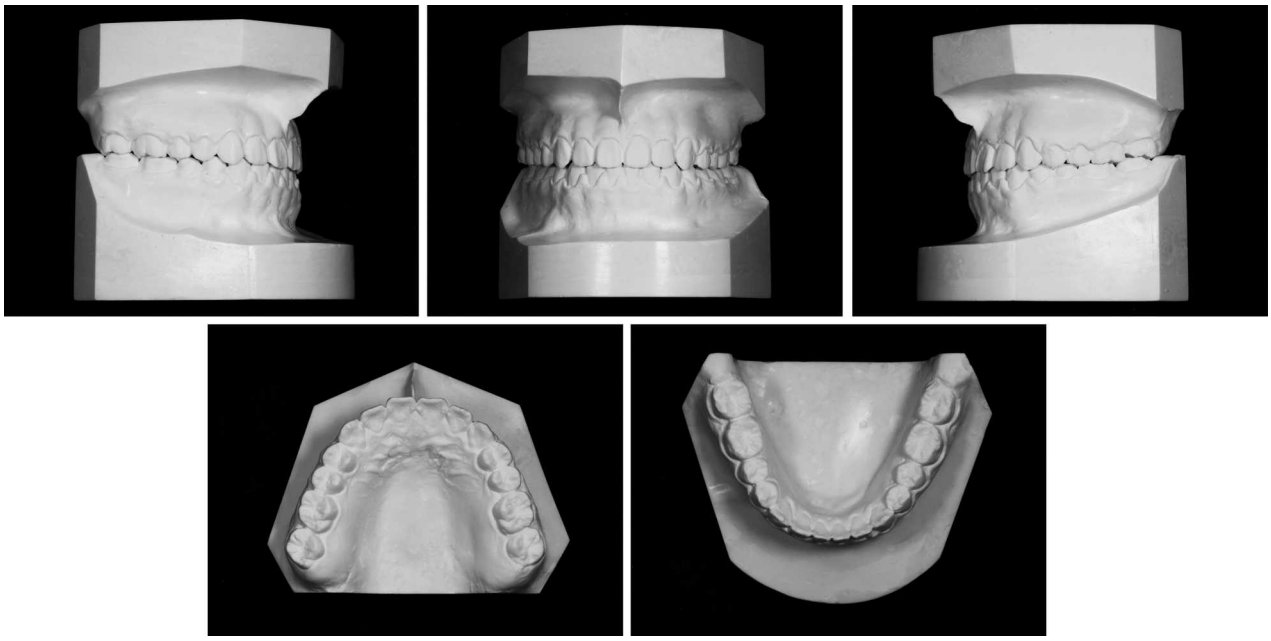

Figure 8. Posttreatment cast photographs.

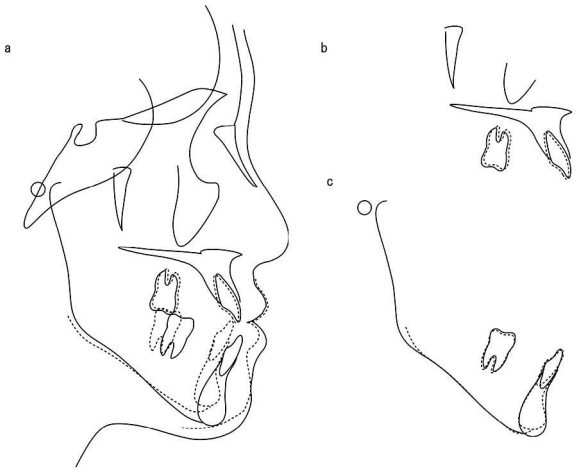

Figure 9. Superimposition of cephalometric tracings pretreatment (solid line) and posttreatment (dotted line). (a) A best-fit on the anterior wall of the sella turcica, the greater wings of the sphenoid, the cribriform plate, the orbital roofs, and the surface of the frontal bone; (b) a best-fit on the zygomatic process of the maxilla (key ridge) and the curvature of the palate; (c) a best-fit on the posterior margin of the symphysis and the mandibular plane (superimposition was performed on the mandibular middle body, because the mandibular angle and menton changed after surgery).

It has been reported that it is possible to autorotate the mandible in a closing direction, close the anterior open bite, and reduce the anterior facial height by intrusion of the molars using titanium screws for anchorage.[3,25] In this case, the mandible was autorotated in the closing direction, and the open bite was reduced by intrusion of the molars using titanium screws during the presurgical orthodontic treatment phase. The amount of mandibular rotation during mandibular setback was slight because of the autorotation of the mandible, and the mandible remained stable 1 year after surgery. It has been reported that most relapse of the mandible after BSSO can be observed within 1 year of surgery, although relapse does continue somewhat after 1 year.[37] Therefore, the combination of BSSO with intrusion of the molars using titanium screws may be an effective method for treating skeletal Class III and open bite without repositioning the maxilla by surgery such as Le Fort I osteotomy. However, long-term observation would be necessary in this case, because it has been reported that molars intruded by orthodontic treatment can relapse by approximately 30%.[35]

It is well known that tongue size and position affect skeletal and dental components.[38] Macroglossia has been suggested as a possible cause of open bite and mandibular prognathism, and reduction of tongue mass by partial glossectomy is an effective treatment for correcting open bite with macroglossia.[39] Skeletal and soft tissue orofacial components can be changed by surgical orthodontic treatment.[38] It is likely that the size of the oral cavity decreases with mandibular setback surgery and that surgery can encroach on the tongue space, even with a tongue that is of a normal size.[40] The relative increase in tongue volume in the oral cavity would cause a relapse of the mandibular position after the mandibular setback, resulting in a decrease in overjet and overbite. Therefore, tongue reduction was performed in the present patient to help ensure stability of the mandible and occlusion after treatment, and stability was confirmed 1 year after surgery. The stability of the mandible and occlusion in this case might also have been influenced by the tongue reduction. No complications such as disturbances in degustation or mobility of the tongue were observed 1 year after surgery.

Figure 10. Posttreatment panoramic radiographs.

CONCLUSION

- Surgical orthodontic treatment combined with bilateral sagittal split osteotomy and intrusion of the molars using titanium screws can reduce surgical invasion by the avoidance of maxillary surgery and can be effective for correcting the facial profile and occlusion in skeletal Class III and open bite cases.

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